JOINT NATURE CONSERVATION COMMITTEE

The Habitats Directive: selection of Special Areas of Conservation in the UK

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Preface

In 1992 the European Community adopted the Habitats Directive: *Council Directive on the Conservation of natural habitats and wild fauna and flora*. Since that time the implementation of the Directive has been a high priority for the UK statutory conservation agencies.

The Directive contains a range of measures, one of which requires each Member State to forward to the European Commission a list of sites proposed for inclusion in the European Union Natura 2000 site network. Sites adopted at Community level will be designated by Member State Governments as Special Areas of Conservation (SACs).

This publication describes the selection of sites for the UK list. Part 1 describes the criteria set out in the Directive for the selection of sites and how these have been interpreted and applied in the UK. Parts 2 and 3 provide information on the selection process and the sites for each of the habitat types and species that occur in the UK.

Some additions and changes to the national list of sites may arise as a result of further scientific work and public consultation. A number of additional sites have already been identified but are not included in this publication. Consultation on these sites will take place at the same time as any necessary SSSI/ASSI notification, and this publication will be updated in due course.

Staff in the four country agencies have worked hard to ensure that the UK adopts an effective approach to implementing the requirements of the Directive, in particular by working in partnership with the owners, managers and users of the proposed sites to ensure that the wealth of wildlife they contain is safeguarded for present and future generations. The vast majority of the organisations and individuals we work with understand and support the need to conserve our natural heritage, and they provide much of the practical management that is required to look after these sites. Effective partnerships are at the heart of conservation, and it is a tribute to all those involved that so much has already been achieved to conserve the wildlife interest of these sites.

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A large number of organisations and individuals outside the conservation agencies have provided valuable information. This information has made a significant contribution to the assessment of the nature conservation value of sites.

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Notes on nomenclature

Scientific names of higher plant species are as used in Stace (1991). English names of higher plants are from Dony *et al.* (1986). Scientific names of lower plants are as used in Hill *et al.* (1991, 1992, 1994) and Purvis *et al.* (1992). The names of National Vegetation Classification types are taken from Rodwell (1991a, b, 1992, 1995, in press). In some cases names cited by Rodwell differ from those used in Stace (1991); where such inconsistencies occur, the names used in Rodwell (1991a, b, 1992, 1995a, b, in press) have been retained. Marine species nomenclature follows Howson & Picton (1997).

The hierarchical classification of biotopes prepared in 1988 under the CORINE programme is cited in the preamble to Annex I of the Directive as the source of reference for interpretation of Annex I. However, many habitat types listed in Annex I either do not appear in the 1988 version of the CORINE biotopes classification or have different names or numbers from those used in the CORINE classification. The 1988 version of the CORINE Biotope Classification simply provides a list of habitat names and therefore provides little guidance about interpretation of Annex I. In order to assist the interpretation of Annex I, one of the major tasks undertaken by scientific specialists representing the Member States on the Habitats Committee Scientific Working Group has been the preparation of the *Interpretation manual of European Union habitats* (DGXI 1996a). A draft for priority habitat types was produced in 1994, and the final text for all habitat types was available in 1996.

During the initial period of selection of sites the *Manual* was not available. For the most part, as interpretations of the Annex I habitat types became available they were found to accord with those already being used for the selection of sites in the UK. However, in a small number of cases, some adjustments of the sites list were required, to take account of the interpretations agreed by the Scientific Working Group.

The CORINE Biotope Classification number codes used in the Directive have been inserted after Annex I habitat type names in section headings in this report. Names of Annex I habitat types are given in bold in the text where appropriate. Annex I priority habitat types and the single Annex II priority species known to occur in the UK are preceded in headings by an asterisk (*).

Numbers in brackets after site names are those shown on Map A1 in the Appendix.

Part 1: Background to site selection

1.1 Introduction

In 1992 the European Community (EC) adopted the *Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora*, known as the Habitats Directive. The main aim of the Directive is:

> ". . . to contribute towards ensuring biodiversity through the conservation of natural habitats and of wild fauna and flora in the European territory of the Member States to which the Treaty applies."

The Directive requires the establishment of a European network of important high quality conservation sites that will make a significant contribution to conserving the 169 habitat types and 623 species identified in Annexes I and II of the Directive. The listed habitat types and species are those considered to be most in need of conservation at a European level. A number of the listed habitat types and species are given priority status in the Directive (Article 1d; Article 1h). Each Member State is required to prepare and propose to the European Commission a national list of sites, which will be evaluated in order to form a European network of Sites of Community Importance (SCIs). These will eventually be designated by the Member States as Special Areas of Conservation (SACs) (Article 4.4.). These SACs, and the Special Protection Areas (SPAs) classified under the Bird's Directive (79/409/EEC), will be known as the Natura 2000 network (Article 3.1.).

Article 4.1 requires that Member States employ criteria set out in Annex III to make a selection of high quality sites for each Annex I habitat type and Annex II species. It is therefore not required that Member States select all occurrences of each habitat type and species for inclusion on the national list. For some rare habitat types and some species all the resource may be included in the site list. However, for many a proportion of the resource will not be included in the site list and wider countryside measures to accompany designation of SACs of SACs will be required to ensure the maintenance of favourable conservation status as defined in Article 1 (e) and (i).

This publication relates to the preparation of the UK national list. The aim is to provide information on the process and principles used to guide the selection of sites, and to give an account of how they were applied to each of the habitat types and species for which sites were selected.

1.2 Establishment of SACs

The process and timescale for the establishment of SACs is set out in Article 4 of the Directive:

a Member States to prepare national lists of sites of importance for Annex I habitat types and Annex II species of Community interest, based on relevant scientific information and the criteria listed in Annex III Stage 1, and in the light of the aims of the Directive, and to submit the lists to the European Commission by June 1995.

b The national lists to be considered in the light of the criteria listed in Annex III Stage 2 and within the context of biogeographical regions (Article 1(c) iii) and the EC as a whole, and Member States and the European Commission to adopt sites on Member States' national lists as SCIs, by June 1998.

c SCIs to be designated by Member States as SACs within six years of adoption by the Commission.

In the UK the Directive has been transposed into legislation by The Conservation (Natural Habitats, &c.) Regulations 1994 and The Conservation (Natural Habitats, &c.) (Northern Ireland) Regulations 1995. Advice to Government on the selection of sites has been provided by the statutory conservation agencies (the Countryside Council for Wales, English Nature and Scottish Natural Heritage, together with the Environment Heritage Service in Northern Ireland), co-ordinated through the Joint Nature Conservation Committee (JNCC).

In March 1995 the JNCC published, on behalf of the UK Government, a consultation list of 280 sites that had been recommended as possible SACs. This list included an account of the principles that had been taken into account when selecting sites. That account is further amplified in this publication.

In preparing the list for recommendation to the UK Government the statutory conservation agencies have paid careful attention to the text of the Directive and other interpretative materials produced by the European Commission in consultation with the Habitats Committee, established under Article 20 of the Directive. In the process of deciding the scope and scale of the UK site list, it has been necessary to apply scientific judgement at many stages. This has also been the case in other EC Member States. This document sets out the issues on which judgements have been required and explains the process put in place to ensure that judgements have been

taken in a structured and responsible way, and as objectively as possible, to meet the statutory requirements of the Directive.

In the UK, the site selection process is largely complete. Further scientific work is, however, needed for a small number of habitat types and species, and for some sites conservation measures need to be put in place before site information is published. All sites currently proposed for the national list by the UK Government have been included in this document, which therefore covers all sites that were part of the public consultation processes launched in March 1995 and October 1997. An indication has been provided under the relevant habitat type and species accounts where further sites are expected to be added in due course. When all the UK sites have been identified this document will be updated.

1.3 The EC process and criteria for site selection

The process that Member States and the Commission must follow in drawing up the list of Sites of Community Importance is set out in Article 4 and Annex III of the Directive. The process is broken down into two stages:

Stage 1 - assessment of the relative importance of sites containing examples of the individual Annex I habitat types and Annex II species in each Member State;
Stage 2 - assessment of the overall importance of the sites in the context of the appropriate biogeographical region and the EC as a whole.

The criteria to be employed in Stage 1 are listed in Annex III. They can be summarised as:

Habitats

a. degree of representativity;
b. area;
c. degree of conservation of habitat structure and function and restoration possibilities;
d. global assessment of the site (i.e. the overall assessment, based on a-c above).

Species

a. proportion of the total national population at the site;
b. degree of conservation and restoration possibilities of the features of the habitat that are important for the species;
c. degree of isolation of the population;
d. global assessment (i.e. overall assessment, based on a-c above).

In addition, Member States are required to classify sites on their national lists according to their relative value for each habitat type and species and to identify which of the sites in their national lists are selected for priority habitat types and species.

The criteria used in Stage 2 are intended to be used to assess the sites at the level of the six biogeographical regions and the EC as a whole. The Stage 2 criteria may be summarised as:

a. relative value of the site at national level;
b. relationship of the site to migration routes or its role as part of an ecosystem on both sides of one or more Community frontiers;
c. total area of the site;
d. number of Annex I habitat types and Annex II species present;
e. global ecological value (i.e. overall assessment, based on a-d above) of the site at the level of the Biogeographical Region and/or EC as a whole.

The Stage 1 and Stage 2 criteria must be read alongside other site selection requirements or qualifications set out in the Directive. More specific requirements for site selection include:

a. restrictions on the site selection obligations in respect of widely dispersed and aquatic species (Article 4.1);

b. the requirement to contribute towards the maintenance of *favourable conservation status*[1] (Article 2.2 and Article 3.1.);
c. the obligation on each Member State to select a series of sites that reflects the proportion of the EC resource of a given habitat or species within their national territory (Article 3.2.).

1.4 The Atlantic Biogeographical Region

The six biogeographical regions recognised by the Directive form an important part of the framework for the evaluation of sites at a European level. The UK falls entirely within the Atlantic Biogeographical Region (Map 1).

In October 1994 Directorate General XI (DGXI) of the European Commission, the UK Environment Departments and the JNCC jointly organised a meeting of EC Member States with territory in the Atlantic Biogeographical Region. This was the first of a series of meetings for each of the biogeographical regions. Its purpose was to assist Member States in the preparation of their national lists. Agreements were reached concerning the interpretation and application of the Annex III Stage 1 criteria. It was also recognised by all Member States represented at that meeting that consideration of certain of the Stage 2 criteria, particularly those related to the habitat and species diversity of the sites, was relevant to ensure a proper representation of sites and consistency across the biogeographical region.

A more detailed report of this meeting is given in Hopkins & Buck (1995). The agreed conclusions, which were subsequently endorsed by the EC Habitats Committee are set out below; the initial procedures for site selection adopted in the UK are fully consistent with these conclusions:

Provision of information

a. Acknowledging that the quality and extent of information about habitat types and species varies within the Region, Member States will provide information to the Commission in the Natura 2000 data entry form using the best scientific information available at the time according to the format agreed by the Habitats Committee.

Balancing the national lists

b. Acknowledging that outstanding single interest sites in terms of quality, extent or range make an important contribution to the Natura 2000 network, special emphasis will be given to identifying and delimiting sites containing complexes of interests on Annexes I and II as valuable ecological functional units.
c. Member States will give significant additional emphasis in number and area to sites containing priority habitat types and species.
d. In considering the degree of representativity of Annex I habitat types on individual sites, Member States will take account of the best examples in extent and quality of the main type (which is most characteristic of the Member State) and its main variants, having regard to geographical range.
e. Acknowledging that sites containing Annex I habitat types and Annex II species at the centre of their range will make an important contribution to Natura 2000, Member States will take responsibility for proposing sites containing habitats and species that are particularly rare in that Member State, with a view to preserving the range.
f. It is acknowledged that certain habitat types and species listed in Annexes I and II are relatively common and extensive in certain Member States. These Member States will have particular responsibility for proposing a proportion of the resource that is sufficient to contribute significantly to the maintenance of the habitat types and species at a favourable conservation status.
g. Where Annex II species' populations are too small to be naturally viable, or where the species occur only as vagrants or reintroductions, Member States may exclude them from consideration for site selection.
h. Artificial areas need not be excluded from site selection if they have spontaneously given rise to Annex I habitat types or host Annex II species and if it is considered that they have exceptional value.

[1]See Article 1(e) and 1(i) for definitions of favourable conservation status.

Defining boundaries

i. It is acknowledged that different Member States will have different approaches to the definition of boundaries (e.g. the inclusion of buffer zones within the site), according to the habitat type or species concerned and the legal and management measures necessary to protect and extend the landscape context.

1.5 Summary of site selection principles in the UK

It can be seen, therefore, that the broad principles for site selection extend beyond the specific criteria that are included in Annex III and occur at various points in the Directive. Decisions about the interpretation of the Annex III criteria have been agreed between the Member States and the European Commission. In preparing the UK national list, eleven main factors have been employed on the basis of the above requirements (Table 1.1). The interpretation of these main factors and the judgements made in applying them to selection of a high quality site list are described in section 1.10.

Table 1.1 Summary of selection principles in the UK

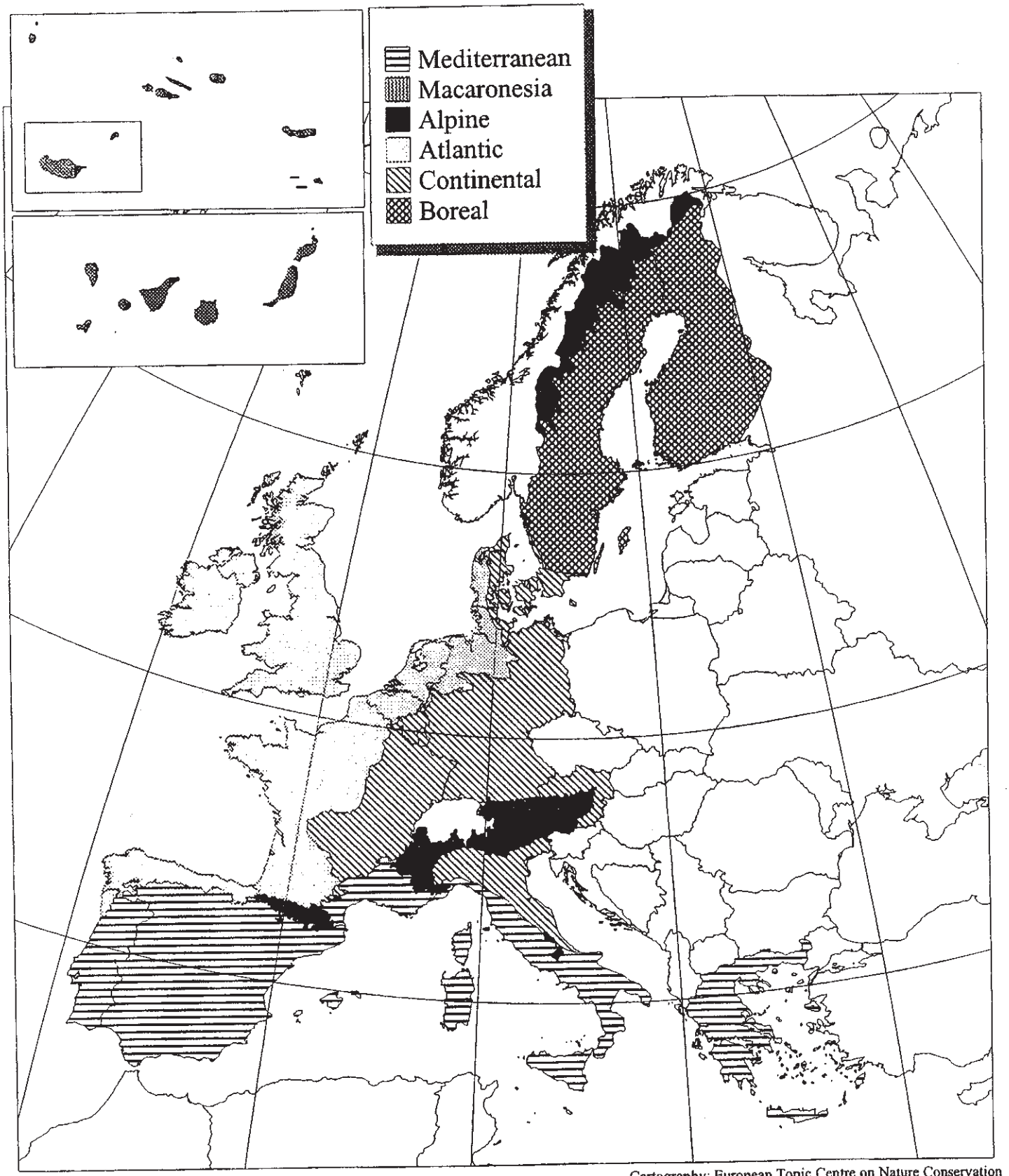
Main factors		Reference
Habitats		
i)	Representativity	Annex III Stage 1A. Conclusions of Atlantic Biogeographical Region Meeting (para. d). Article 1e.
ii)	Area of habitat	Annex III Stage 1A. Article 1e.
iii)	Conservation of structure and function	Annex III Stage 1A. Article 1e.
Species		
iv)	Proportion of UK population	Annex III Stage 1B. Article 1i.
v)	Conservation of features important for species survival	Annex III Stage 1B. Article 1i.
vi)	Isolation of species populations	Annex III Stage 1B. Conclusions of Atlantic Biogeographical Region Meeting (para. g).
General		
vii)	Priority/non priority status	Annex I Stage 1D. Conclusions of Atlantic Biogeographical Region Meeting (para. c).
Viii	Rarity	Conclusions of Atlantic Biogeographical Region Meeting (para. e).
ix)	Geographical range	Article 1e. Article 1i.
x)	Special UK responsibilities	Article 3.2. Conclusions of Atlantic Biogeographical Region (para. f).
xi)	Multiple interest	Annex II Stage 2. Conclusions of Atlantic Biogeographical Region Meeting (para. b).

The process of site selection as a whole in the UK has been one of considering, in respect of the relevant principles in Table 1.1, the relative value of the sites in relation to the whole national resource of each habitat type and species. Information on how this is applied in each case is included in the accounts that follow and has been summarised in the information required by the European Commission as a contribution to the Annex III Stage 2 assessment.

Application of the principles in Table 1.1 has led to the selection of a list of sites, all of which, subject to consultation, have been or will be submitted as eligible for identification as Sites of Community Importance. The UK is submitting to the Commission only those high quality sites that it believes are worthy to be designated as SACs.

Council Directive 92/43/EEC

Biogeographic Regions



Cartography: European Topic Centre on Nature Conservation
October 1995

1.6 Habitat types of Community Interest in the UK

Annex I of the Directive includes a list of 169 habitat types for which Member States must designate SACs.

Of these habitat types, 82 are known to occur in the UK. As discussed later, the habitat types are very variable in the range of ecological variation they encompass. Some are very narrowly defined, encompass a single vegetation type and are analogous to single associations of traditional phytosociology; others are large units defined on a physiographic basis, such as estuaries, encompassing complex mosaics of habitats and corresponding approximately to the Broad Habitats of the UK Biodiversity Action Plan (Department of the Environment 1995).

A selection of these habitat types are identified in Annex I as priority habitat types because they are judged to be in danger of disappearance and are mainly, or exclusively, found within the European Community (Article 1d). The importance of these priority habitat types is emphasised at several places in the Directive (Articles 4 and 5 and Annex III), not only in terms of the selection of sites, but also in the measures required for site protection (Article 6) and surveillance (Article 11).

Of the 82 habitat types that occur in the UK, 22 are priority habitat types for which sites have been selected (Table 1.2).

Table 1.2 Annex I priority habitat types known to occur in the UK

Lagoons
Continental salt meadows (*Puccinelliatalia distantis*)
Fixed dunes with herbaceous vegetation (grey dunes)
Decalcified fixed dunes with crowberry *Empetrum nigrum*
Eu-Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)
Dune juniper *Juniperus* spp. thickets
Mediterranean temporary ponds
Southern Atlantic wet heaths with Dorset heath *Erica ciliaris* and cross-leaved heath *E. tetralix*
Dry coastal heaths with *Erica vagans* and *Ulex maritimus*
Dry grasslands on calcareous substrates (*Festuco - Brometalia)* (*important orchid sites)
Species rich *Nardus* grassland, on siliceous substrates in mountain areas (and submountain areas of continental Europe)
Active raised bogs
Blanket bogs (* active only)
Calcareous fens with *Cladium mariscus* and *Carex davallianae*
Petrifying springs with tufa formations (*Cratoneurion)*
Alpine pioneer formations of *Caricion bicoloris - atrofuscae*
Limestone pavements
Tilio - Acerion ravine forests
Caledonian forests
Bog woodland
Residual alluvial forests
Taxus baccata woods

Seven of the 82 habitat types that are known to occur in the UK are at present considered to be represented by poor examples or by examples that are not considered to fit the interpretation of the Annex I habitat type, and so do not merit the identification of a site in the national list (Table 1.3).

Table 1.3 Annex I habitat types known to occur in the UK in some form but for which no SACs have been proposed

Habitat types	Reason sites not selected
Marine 'columns' in shallow water made by leaking gases	Poor quality examples of this habitat by European standards
Dunes with sea-buckthorn *Hippophae rhamnoides*	An invasive species, non-native over most of the UK, and which is actively controlled
Wooded dunes of the Atlantic coast	Poor quality examples of this habitat when judged by European standards
Alpine rivers and the herbaceous vegetation along their banks	Poor quality examples of this habitat when judged by European standards
Pioneer vegetation of rock surfaces	Poor quality examples of this habitat when judged by European standards
Caves not open to the public	Poor quality examples of this habitat when judged by European standards
Forests of holly *Ilex aquifolium*	Examples not considered to fit Annex 1 habitat type

1.7 Species of Community Interest in the UK

The strategy for conservation of species set out in the Directive is more complex than that for habitat types and includes measures related to site designation for species listed on Annex II, the strict protection of all populations of species listed in Annex IV, and the managed exploitation of species in Annex V. A number of species occur on more than one Annex. This report is concerned only with the process of site selection and so considers only those Annex II species for which site designations are proposed in the UK. Annex II lists 623 species, of which 51 have been recorded in the UK in recent times.

A number of species listed in Annex II are considered to be particularly rare or endangered and are classified as priority species. Only one of these, the liverwort western rustwort *Marsupella profunda*, occurs in the UK. It is currently known from only two localities, both of which are in England.

Two plant species, lady's-slipper orchid *Cypripedium calceolus* and Killarney fern *Trichomanes speciosum*, are rare plants considered to be in danger from collecting and other disturbance if details of their location are released. In the case of the lady's-slipper orchid, one site has been selected but the site details have not been provided in this report. In the case of the Killarney fern, no account is provided of site selection as the sites for the sporophyte generation (the reproductive phase) are unknown. However, it is understood that the species may be present on several sites selected for other features.

Of the 51 species that have been recorded in the UK in the last century, eleven have not had specific sites proposed (Table 1.4).

Table 1.4 Annex II species recorded in the UK for which no SACs have been proposed

Mammals	***Reason sites not selected***
Mouse eared bat *Myotis myotis*	Believed extinct
Harbour porpoise *Phocoena phocoena*	Insufficient data to evaluate sites
Reptiles	
Loggerhead turtle *Caretta caretta*	Vagrant
European pond terrapin *Emys orbicularis*	Recently established alien
Fish	
Sturgeon *Acipenser sturio*	Vagrant
Houting *Coregonus oxyrhincus*	Believed extinct
Bitterling *Rhodeus sericeus*	Introduced alien
Invertebrates	
Orange spotted emerald dragonfly *Oxygastra curtisii*	Extinct
Beetle *Cerambyx cerdo*	Extinct
Large copper butterfly *Lycaena dispar*	Extinct but re-established
Plants	
Armeria pseudarmeria	Established alien

Article 4(1) states that, for aquatic species that range over wide areas, sites will be proposed only where there is a clearly identifiable area providing the physical and biological factors essential for their life and reproduction. In the case of harbour porpoise *Phocoena phocoena,* available evidence is that the species is widespread in territorial waters of the UK and the rest of northern Europe and relatively evenly distributed. Current scientific knowledge indicates that we cannot identify specific sites for the species within the terms of Article 4(1).

1.8 Considerations in the UK approach to site selection

The Habitats Directive requires Member States to use the principles and criteria set out in the Directive to propose a national list of sites that is an appropriate proportion of the total resource of the habitat types listed in Annex I and of habitats of the species listed in Annex II. The UK has had long experience of this kind of site selection process. The first major exercise to select a national site series was carried out by the Society for the Promotion of Nature Reserves, which in 1915 produced a provisional list of 273 areas in Britain worthy of protection as nature reserves - one of the first ever attempts to produce a series of areas to be protected by conservation measures. This work helped to prepare the ground for the first official national strategy for nature conservation, which was set out in 1947 (Command 7122 and Command 7235) and led to the selection of a national series of sites designated as Sites of Special Scientific Interest (SSSIs).

The expanding information on and growing experience in nature conservation led to the publication in 1977 of *A nature conservation review* (Ratcliffe 1977), a major selection process to produce a revised list of biological sites considered to be of national importance for nature conservation. A major contribution of this work was to set out a series of clear, largely qualitative site selection criteria to guide and structure judgements about the nature conservation value of sites. The rationale and criteria used for site selection in the Review have been widely accepted and used in the UK, and the systems for conservation evaluation in many parts of the world draw upon them (Nature Conservancy Council 1989; Joint Nature Conservation Committee 1992, 1994). The criteria in Annex III of the Directive show clear similarities to those in the Review, and the UK clearly has a great deal of practical experience in the use of such criteria for site evaluation and selection.

Despite the UK's long track record and experience in identifying areas of particular importance for wildlife conservation, identifying a national list of Sites of Community Importance in terms of Article 4 and Annex III posed a number of practical difficulties.

a. It is not possible simply to assume that all the UK's SSSIs and ASSIs should be put forward as candidate Sites of Community Importance. The Annex I list of habitat types and the Annex II list of species are special subsets of the habitats and species occurring in the EC, and they stem from application of the Article1

definitions. Many SSSIs/ASSIs either have no, or no significant, occurrence of this subset of habitat types and species and so cannot be regarded as of Community importance within the meaning of the Directive. Even where sites do have habitats types and species listed in the Directive they may not qualify for selection when assessed against the criteria set out in Annex III of the Directive and the other principles established. The UK has thus based site assessment on the criteria and principles set out in the Directive and has not simply made a selection based on existing protected areas. This has resulted in the identification of a number of sites that are not yet notified as SSSI/ASSIs, and this process will need to be undertaken at the same time as publication of SAC proposals.

b. The Annex III criteria are similar to UK domestic site-selection guidelines in that they are the principles by which to judge the relative importance of sites. The problems of applying such principles in practice are therefore familiar. Scaling or quantifying the assessments would necessarily be arbitrary for many of the criteria. Even if it were possible to produce objective numerical values for each attribute (and this has certainly not been achieved by the scientific community for the Stage 1 criteria A(a) "degree of representativity . . .", A(c) "degree of conservation of the structure and functions . . .", and B(c) "degree of isolation of the population ..."), there would be a need to transform the various ratings into a common range of values, a process which would inevitably introduce an element of subjective weighting. There is currently no widely agreed way of determining such weighting and of then integrating the data into a single overall index (Margules 1986). Further, in any attempt to produce a single indicator value from assessments of a number of criteria there is the problem that intercorrelations are likely to introduce bias (Usher 1980). For example, in the Annex III criteria, there will always be a degree of positive correlation between the area of any site and the number of Annex I habitat types and Annex II species present on the site. As yet there is no broad consensus on how these problems should be resolved.

Thus, quantitative rule-based systems have so far not been widely adopted for the purpose of selecting statutory sites, either in the UK or elsewhere. The conservation agencies, faced with having to complete a major site-selection exercise within a limited timescale, using available data, felt that the risks of using any new, untried, quantitative rule-based approach outweighed any potential benefits. Instead the proven approach, which recognises that site selection is essentially a matter of judgement and relies on a group of experts, each of whom understands the aims and guiding principles of the exercise to make informed judgements to select an agreed list of sites, was utilised.

c. Annex I of the Directive utilises a classification of habitat types that is unfamiliar in the UK and in most other Member States. This was compounded by the fact that the *Interpretation manual of European Union habitats* (DGXI 1996a) was not available in a final published form until April 1996. For site selection, therefore, it was necessary to interpret much of the habitat information available in the UK in terms of the Annex I habitat list before the manual was published. This is a complex task for those habitat types, such as ***Tilio-Acerion* ravine forests**, that do not correspond clearly to types in classifications that have been used in habitat surveys in the UK, such as the National Vegetation Classification.

d. As in other Member States, the distribution and abundance within the UK of certain of the Annex I habitat types and Annex II species are imperfectly known. The timetable set out in the Directive precluded the commissioning of significant amounts of additional survey work to complement existing knowledge. However, for certain habitat types and species, critical appraisal led to the conclusion that current knowledge was inadequate to evaluate sites, and site selection was then necessarily delayed to await the results of additional information collection and analysis. This process is still on-going for a small number of cases.

The distribution and relative abundance of many habitat types and species are even less well understood within the Community as a whole. In the UK a best assessment has been made of the contribution that will be necessary to fulfil the Article 3.2 requirement for each Member State to "contribute to the creation of Natura 2000 in proportion with the representation within its territory of the natural habitat types and species in Annexes I and II".

1.9 Process adopted for site selection in the UK

In developing the process for selecting sites the conservation agencies initial planning considerations were:

a. the timetable, principles and criteria for site selection set out in the Directive should be followed, along with any interpretation developed by the EC Habitats Committee;
b. selection should be based upon current knowledge of the Annex I habitat types and Annex II species, as the timetable did not allow for large amounts of extra survey. Only where current knowledge is inadequate should selection be delayed to await the results of additional survey;
c. there should be a consistent approach to selection taking account of the relative occurrence and variety of habitat types and species; and
d. social and economic factors should not be taken into account.

In order to ensure an effective UK approach to the selection of SACs an interagency team of senior staff was established. This team was chaired by the Chief Officer of the Joint Nature Conservation Committee and co-ordinated the interaction of the various specialists, provided quality assurance and managed various working groups involved in the process.

As a first stage of site selection seven specialist working groups were established to provide advice relating to woodlands, coastlands, marine habitats, freshwater habitats, lowland habitats, upland/peatland habitats and species. These groups were commissioned to produce initial ideas on high quality sites for each of the Annex I habitat types and Annex II species by application of the criteria listed at Annex III Stage 1 of the Directive. Later on in the process the choice was informed by relevant Annex III Stage 2 criteria, and by the other requirements or qualifications upon site selection set out in the Articles of the Directive.

The process of site selection involved repeated internal peer review of the developing ideas and advice on high quality sites. Changes were made to the proposals for sites to take account of the comments from internal peer review, new knowledge as it came to light or was produced from new surveys, and the comments and suggestions that arose from public consultation. A range of professional groups and statutory committees have scrutinised and critically reviewed the lists of sites in various iterations, as follows:

a specialist working groups (covering woodlands, coastal, marine, freshwater, other lowland habitats, upland/peatlands and species) drew up the initial list of sites for evaluation and quality assured subsequent changes to the list recommended by other groups;
b local staff of the country agencies were required to ensure that sites selected were the ones in their area of geographical responsibility that best satisfy the selection criteria, particularly in terms of representation and the conservation of structure and function;
c the management boards or project boards of the individual agencies have taken an overview of the representation of sites in their country to ensure an evenness of response and proper representation of habitats and species;
d the governing bodies of the Agencies have approved the proposals within their particular geographical areas of responsibility;
e the Joint Nature Conservation Committee has formally approved the proposals prior to providing formal advice to Government;
f Government Departments have scrutinised the selection process and the resulting list to satisfy themselves that Agencies have acted in accordance with the requirements of the Directive.

Public consultation has played an important part in ensuring the appropriateness of the site list as a UK contribution to the Natura 2000 network. Several changes to the site list have arisen from new scientific information and clarification of interpretations arising from the first public consultation round. Further changes may arise from the second and any further public consultation.

1.10 UK interpretation of site selection principles

1.10.1 Selection principles for Annex 1 habitat types

1.10.1.1 Representativity

Representativity is the degree to which a given habitat corresponds to a described type, including not only the most typical form of the habitat, but also its main variations. The *Interpretation manual of European Union*

habitats (DGXI 1996a) is the reference source for defining the habitat types. A first requirement in the evaluation of any habitat example for inclusion on the national list has therefore been to ensure that it conforms to the general habitat type description in the *Manual*.

It is recognised in the introduction to the *Manual* that judgement plays a part in determining the degree to which a given habitat example fits the general description. This is because that description reflects the full variation of the habitat type in Europe and at a given site it is unlikely that the full range of variation will be encountered. The *Manual* is necessarily general in character and cannot fully accommodate all the variation of the given habitat types in all countries in which they occur. Habitat selection in the UK has sought to cover the range of variation a habitat type encompasses, including its most typical form and the main variations.

In most cases, the decision concerning whether a given habitat example refers to a described Annex I type has been straightforward. However, unlike most species, habitat types show a continuum of variation, and in the field there are frequently uninterrupted zonations between types. For example, transitions between **North Atlantic wet heaths with *Erica tetralix*** and **Dry heaths (all subtypes)** frequently occur on lowland heaths and moorlands, with the former gradually changing to the latter as soils become drier. Such transitions may be important in their own right and may contribute towards the diversity of some sites. Some habitat examples may therefore be intermediate in character between two or more Annex I types. An extreme example of this problem for site selection is illustrated by the selection of rias. These are flooded river valleys typical of south Wales and south-west England and which also occur in France, Spain and Portugal. For the most part, such flooded valleys have limited freshwater influence and are classified as **Large shallow inlets and bays**. However, in a few cases substantial rivers enter into rias and give, in the upper part of these inlets, brackish conditions more typical of **Estuaries.** For this reason, for example, parts of the ria systems at Milford Haven and Plymouth Sound have been listed as **Estuaries**.

The range of variation exhibited by terrestrial habitats has been described in terms of the National Vegetation Classification (NVC) (Rodwell 1991a, 1991b, 1993, 1995, in press), where possible. In the case of a small number of habitats, there is simple correspondence between a single NVC community and an Annex 1 type, for example **Mountain hay meadows (British types with *Geranium sylvaticum*)**, which corresponds to MG3 *Anthoxanthum odoratum - Geranium sylvaticum* grassland of the NVC.

In other cases, an Annex I habitat type corresponds to a series of NVC types; for example, **Dry heath (all subtypes)** corresponds to twelve different NVC types. For habitat types such as these, which show a wide range of variation, the NVC classification of the type has influenced site selection by providing the framework within which the diversity of the habitat type can be categorised and sites chosen to reflect this diversity.

In other instances, the NVC is less valuable as a source of reference about the character or variability of a given habitat. For example, the NVC classification did not include Northern Ireland, and, whilst there is general correspondence of vegetation types between Northern Ireland and England, Scotland and Wales, some vegetation types are probably restricted to Northern Ireland. In other cases the variability of the type is not fully described in the NVC or has been completely omitted, for example **Depressions on peat substrates (*Rhynchosporion*)**, various types of vegetation associated with **Perennial vegetation of stony banks** (see Sneddon and Randall 1993) and the complex vegetation assemblages associated with types of soft rock cliff within **Vegetated sea cliffs of the Atlantic and Baltic coasts.** In the case of certain coastal habitats, such as sand dunes, representative communities can be variable depending on the initial colonising species.

Marine habitats are often characterised by physical features or by sedentary animals such as molluscs and barnacles, rather than by their flora. These are not covered by the NVC, which is a terrestrial vegetation classification. Coincident with the selection of sites under the Habitats Directive, work was in hand within the JNCC to develop a UK habitat classification for marine habitats, and this ongoing work has helped inform the process of selection.

Certain habitat types, such as **Estuaries** and **Large shallow inlets and bays**, are broad physiographic units, within which other Annex I habitat types, such as **Mudflats and sandflats not covered by seawater at low tide**, may occur. In these cases, the larger physiographic habitat type and those included within it have been evaluated independently, as part of the national series for each type.

1.10.1.2 Area of habitat type

For the most part, the sites selected contain the largest examples in the UK of the habitat types for which they have been selected. Particular attention has been paid to the selection of sites that host more than 10% of the habitat resource in the UK: for example, Salisbury Plain contains more than 10% of the UK resource of **Dry calcareous grassland (*Festuco - Brometalia)*** and Dungeness supports approximately 50% of the **Perennial vegetation of shingle banks** in the UK.

In general, this selection has been reinforced by other criteria: for example, structure and function are most often best conserved in sites that are extensive. There are, however, circumstances where relatively small sites are selected. The most obvious cases are situations where only small sites for a given habitat survive: for example, the last known surviving area of **Continental salt meadow** is only *c.* 0.1 ha in extent.

In other cases, relatively small sites are selected to encompass the range of ecological variation or to take account of the geographical range of a habitat. For example, the **semi-natural dry grassland and scrubland facies on calcareous substrates (*Festuco - Brometalia)*** which occurs on magnesian limestone in north-east England is recognised in the NVC as a distinct type, MG8 *Sesleria albicans - Scabiosa columbaria* grasslands. This distinct type has an ecological character intermediate between southern limestone grasslands and the limestone grasslands typical of northern England. It was always very localised and is now severely reduced. Thrislington, County Durham, was selected as representative of this type, although it covers only 23 ha, contrasting with other sites in the calcareous grassland site series, which includes Salisbury Plain, Wiltshire, which at 21,114 ha is thought to be the largest calcareous grassland in Europe.

1.10.1.3 Conservation of structure and function

The vegetation of most terrestrial sites in the UK's proposed list is either the result of or has been appreciably affected by past and present management practices. Habitat structure and function involve a number of inter-related components. Structure can relate to a variety of biotic and abiotic features, including species composition, the physical architecture of the vegetation, the ground morphology, the successional status of the vegetation, or species assemblages of plants, animals or both. Function relates to the way in which the biotic and abiotic features interact over time. Functions may include energy flows, biogeochemical cycles, hydrology and many other processes.

The value of structure as a criterion for comparing the quality of sites is very variable. Some types have very limited variation in structure. In the example of **Lowland hay meadows (*Alopecurus pratensis - Sanguisorba officinalis*)** the vegetation is characterised by a narrow range of plant forms that provide a vegetation canopy whose structure varies little between sites. Damaging activities, such as fertiliser application (which changes the botanical composition and reduces the biological diversity of such grassland), may cause only very modest changes to physical structure.

In other cases, structural features play a critical part in discrimination between sites. In the case of **Limestone pavement** the chosen sites are those that are of the highest quality in terms of well-developed 'clint' and 'grike' rock structure, reflected in the pattern of vegetation. Similarly **Active raised bogs** in which the central peat dome and surrounding lagg fen are most complete have been seen as of high value.

Many habitat types occur not as isolated examples surrounded by intensive land use but as parts of mosaics of habitat, notably on the coast and in the uplands. In these situations the juxtaposition of communities and the transitions between them have been seen as an important element of habitat structure.

The evaluation of function is in many cases more difficult than that of structure, because of the complexity of functions and the limitations of our information and understanding of these functions. In some cases certain features are known to be of overriding importance for the maintenance of function. For example, in the freshwater habitat types listed in Annex I, an increase in nutrient status of the water will cause adverse change. However, in many cases the maintenance of habitat function is dependent upon a wide range of biotic and abiotic processes. It would be difficult to define and evaluate these individually, and in general the lack of significant deterioration of the habitat, as evidenced by, for example, the presence of typical native species, has been seen as evidence that habitat function is being preserved. In some cases these influences have been operating for a very long time. Current structure and function may be related to management, and such practices must be continued if the interest of the site is to be maintained.

Annex III also refers to possibilities for restoration of habitat structure and function. Where a sufficient number of examples of habitat types in good condition can be identified, it is considered unnecessary to select sites that are damaged or in relatively poor condition. However, a number of sites may require adjustments to management or a modification in human impacts. In these cases, the likelihood of successfully restoring structure and function has been a helpful consideration. Where the habitat type is rare in all or part of its range, options for site selection are more limited and sites needing more significant restoration management may be selected. This is true with a proportion of the listed sites in the lowlands supporting **Alkaline fens**, for example, where traditional management has been abandoned.

1.10.2 Selection principles for Annex II species

1.10.2.1 Proportion of UK population

For the most part the sites chosen for individual species are those where the evidence indicates thatthe largest populations occur. Where they are known, particular attention was paid to ensure that all sites hosting more than 10% of the UK population of a given Annex II species were selected. In many cases these judgements have to be based not on precise counts of individuals but on indirect evidence of abundance. For example, the number of colonies has been taken into account in the case of marsh fritillary butterfly *Eurodryas aurinia*. This species has naturally highly variable populations, so the numbers of individuals in a given year are not necessarily an indication of the value of the site in the longer term. In other cases, extent within the site has been relevant and is typically used as a measure of abundance for perennial plants that spread by vegetative reproduction, such as creeping marshwort *Apium repens*.

For widely distributed species, for example certain common seal *Phoca vitulina* sites, or where a distinct form occurs, such as the populations of marsh fritillary butterfly *E. aurinia* in Scotland, sites with a relatively small proportion of the UK population may also have been selected to ensure conservation of range. Where such species occur at low population densities, as does the otter *Lutra lutra*, or are relatively abundant within a more restricted range, for example stag beetle *Lucanus cervus*, the differentiation of sites on the basis of population size has not been possible, and the sites were selected using other criteria, particularly geographical range.

1.10.2.2 Conservation of features important for species survival

The value of this factor in the comparison of sites is variable. For some species, such as early gentian *Gentianella anglica*, a small number of features are required at the site to ensure survival: essentially, short open turf and low nutrient status calcareous soils. For other species, as for example the otter *Lutra lutra*, a complex range of site features may be required, including all-year-round availability of food, suitable areas providing cover for young otters and good water quality. The features will vary from site to site, particularly depending on whether it is freshwater or coastal. For some species, the features required for survival are not fully known. In these cases the presence of a persistent population that is known to be stable has been seen as *prima facie* evidence that the features of the site are particularly favourable.

1.10.2.3 Isolation of species populations

This factor has been found to be relevant to only a small number of species populations in the UK. As agreed by the EC Habitats Committee (DGXI 1996b), isolation has been viewed positively only where there is a large isolated population or other indications that the species is likely to be persistent and has distinctive physiological or ecological features, for example the distinctive form of marsh fritillary butterfly *E. aurinia* in Scotland.

The white-clawed crayfish *Austropotamobius pallipes* is a special case for which this factor has been of primary significance in site selection. Crayfish plague has been introduced into the UK and is spreading through the country, wiping out the native crayfish populations. Therefore, selected sites are those having a significant population that has been recorded over a number of years; but, most importantly, they are isolated from areas of crayfish plague infection and, where possible, are cut off from other populations. The degree of isolation is variable and the possibility of crayfish plague spreading to the selected sites cannot be ruled out entirely.

1.10.3 General principles

1.10.3.1 Priority/non-priority status

The Directive requires Member States to give special attention to sites containing priority habitat types and species. Although there is no requirement to select every example of the priority habitat types and species, site selection has been significantly weighted in favour of priority habitat types in terms of both number of sites and area covered. Of the 22 priority habitat types in the UK, some, such as **Blanket bog (active only),** are very extensive, while others, such as **Continental salt meadows**, cover a small surface area at only one site. Site selection takes account of this wide variability in abundance of priority habitat types.

There is only one priority species known from the UK, the liverwort *Marsupella profunda,* and the two known sites for this species are selected.

1.10.3.2 Rarity

The habitat types listed at Annex I vary greatly in their abundance in the UK, ranging from **Continental salt meadow,** with only some 0.1 ha, to **Blanket bog,** which covers more than 1.5 million ha. Many of the habitat types are very local and only a small proportion of them are known or thought to cover more than 50,000 ha in the UK.

For the purposes of implementing the Directive the following habitat types are considered to be rare in the UK because they cover less than 1,000 ha or because there is a significant representation of the habitat type at three or fewer sites:

Annual vegetation of drift lines
Spartina swards (*Spartinion*)[2]
Continental salt meadows
Mediterranean salt meadows (*Juncetalia maritimi*)
Mediterranean and thermo-Atlantic halophilous scrubs (*Arthronemectelia fruticosae*)
Embryonic shifting dunes
Dune with *Salix arenaria*
Dune juniper thicket (*Juniperus* spp.)
Open grassland with *Corynephorus* and *Agrostis* of continental dunes
Oligotrophic waters containing few minerals of Atlantic sandy plains with amphibious vegetation: *Lobelia, Littorella* and *Isoetes*
Mediterranean temporary ponds
Southern Atlantic wet heath with *Erica ciliaris* and *Erica tetralix*
Dry coastal heaths with *Erica vagans* and *Ulex maritimus*
Sub Arctic willow scrub
Stable *Buxus sempervirens* formations of calcareous rock slopes *(Berberidion* p.)
Alpine calcareous grasslands
Eutrophic tall herbs
Mountain hay meadows
Depressions on peat substrates (*Rhynchosporion*)
Alpine pioneer formations of *Caricion bicoloris - atrofuscae*
Stellario - Carpinetum oak hornbeam forests

Selection has aimed to ensure that the majority of the area covered by these habitat types has been included in the sites selected. It should be noted that rare habitat typess vary in their patterns of distribution. Some, such as **Dune juniper thickets (*Juniperus* spp.)**, are very localised and found at only a small number of sites. In these cases all of the resource is included within the site series. However, some of the rare habitats, for example **Eutrophic tall herbs**, are widely distributed, with a relatively small amount of the resource found at a larger number of sites. In these cases, although a large proportion of the resource is included in the site series, some small fragmentary examples with poor representation of the main features of the type have not been selected.

[2] In the UK this type relates only to stands dominated by *Spartina alterniflora* and *S. maritima* (DGXI 1996).

In the case of rare species, those that occur in fifteen or fewer 10 km squares of the national grid (Red Data Book species), a high proportion of the resource, are included within the site series. These are:

Limoniscus violaceus
Vertigo angustior
Vertigo genesii
Vertigo geyeri
Liparis loeslii
Rumex rupestris
Apium repens
Buxbaumia viridis
*Marsupella profunda (*priority species in the Directive)

1.10.3.3 Geographical range

In the case of both habitat types and species, favourable conservation status is dependent upon the maintenance of the geographical range of the habitat type or species, amongst other things. The site series for each habitat type and species has been chosen to reflect its distribution in the UK. Habitat types and species vary considerably in their patterns of distribution. Some, such as **Dry heaths (all subtypes),** are found in all parts of the UK and the site series reflects this. Others, such as **Dry coastal heaths with *Erica vagans* and *Ulex maritimus,*** are very localised. However, there are also habitat types and species with very disjunct distributions, in that they occur in two or more parts of the UK that are widely separated. For example, **Dystrophic lakes** are found in blanket bogs and on lowland heaths, and the sites chosen reflect this disjunct distribution.

Frequently, where a very high proportion of the resource for a relatively widespread species or habitat type occurs in a given part of the UK, a high proportion of sites are chosen for these centres of distribution.

1.10.3.4 Special UK responsibilities

The UK has special responsibility in the EC for certain habitat types and species because of the large proportion of the European resource we hold. Endemic or near endemic habitat types, such as **Caledonian forests** and **Old oak woods with *Ilex* and *Blechnum* in the British Isles,** and species such as early gentian *Gentianella anglica*, are obvious examples. There are others, such as the habitat types **Northern Atlantic wet heaths with *Erica tetralix*** and **Blanket bog** and the species grey seal *Halichoerus grypus*, where the UK resource is relatively large compared with that of other Member States. For these, and other habitat types and species where the UK hosts a disproportionately large part of the resource, the number and area of UK sites selected is considerably higher than for other habitat types and species, making a significant UK contribution to the maintenance of favourable conservation status in the EC. For some habitat types and species there is insufficient information upon which to make judgements about the proportion held by the UK. In these cases some adjustments to the list could be appropriate if the Community level assessment demonstrates the importance of the UK resource to be higher, or lower, than is currently known.

The proportion of the UK resource selected is, however, not a simple reflection of the proportion of the EC habitat type or species resource in the UK. The sites selected are themselves all of high quality when judged against other criteria. An objective of the selection process has been to ensure that selection is consistently based upon all the relevant factors for of each habitat type and species. For example, **Caledonian forest** is a priority habitat and covers a small geographical area, and all the EC resource occurs in the UK, but it exhibits a relatively narrow range of variation. Taking this into account, over 80% of the resource is proposed for selection; only a few small sites that were evaluated unfavourably against the Annex III Stage 1 criteria have been excluded. **Estuaries**, in contrast, are a non-priority habitat, cover a large geographical area and exhibit a wide range of variation, and a high proportion of the EC resource occurs in the UK. The proportion of the UK estuary resource proposed for inclusion on the national list is, therefore, less than for **Caledonian forest** but nevertheless ensures adequate representation of the range of variation.

1.10.3.5 Multiple interest

Sites with multiple interests are of high intrinsic value. The Directive recognises this in its emphasis on the maintenance of biodiversity. Whilst the UK list contains many high-quality single-interest sites, special emphasis has been given to the identification and delimitation of sites containing a multiplicity of high quality interests forming an ecologically functional unit. Examples of such sites include The New Forest, Moor House - Upper Teesdale, the Cairngorms and Eryri/Snowdonia. Some multiple and single interest sites also contain habitat types and species which, although listed in the Directive, are of lower quality, when viewed in a European context using the Directive's criteria, than examples selected elsewhere in the UK. Where this is the case, they are not included as features for which the sites were selected.

Multiple interest sites are, for the most part, also the largest sites and account for a high proportion of the total area of the site series. Sites selected for three or more habitat types or species account for approximately 25% of the site series by number, but cover approximately 50% of the area of the site network. These multiple interest sites are usually found on the coast and in the uplands, where semi- natural vegetation is most extensive. Tables 1.5-1.8 show a range of Annex I habitat types found on a sample of sites. In these four tables the sites have been divided subjectively into four main site types - sand dunes, other coastal and marine sites, upland sites and lowland sites. The sites listed are all those in which three or more features of high value have been identified using the principles described. It can be seen, from the list of sand dunes, other coastal sites and upland sites, that combinations of habitat types occur frequently on the sites.

In the list of lowland sites a very different range of habitat types occurs at each site, indicating that, in general, large, multiple-interest sites are of high intrinsic value. Possibly the most outstanding examples of this are The New Forest, The Lizard and The Broads. Few sites in Europe have an ecological character similar to these areas.

A similar analysis can be carried out on a range of Annex I habitat types and Annex II species occurring in rivers (Table 1.9).

A selection process that only included multiple interest sites would have provided an inadequate representation of habitat types and species in the UK. A number of habitat types and species, most typically those of lowland situations, are seldom found as part of habitat mosaics, as they occur most often in intensively managed countryside, where wildlife sites are highly fragmented. They include rare habitat types, such as **Continental salt meadows**, as well as more widespread habitat types and species, such as **Active raised bog** and the great-crested newt *Triturus cristatus*.

1.11 Identifying boundaries

Sites on land (including freshwater sites) are designated as SSSI or ASSI and, where appropriate, the same boundary has been used to simplify administrative arrangements and to assist in identification of the boundary on the ground. As a general principle, site boundaries have been drawn closely around the qualifying habitat types or the habitats of species for which the sites have been selected, taking into account the need to ensure that the site operates as a functional whole for the conservation of the habitat type(s) or species and to maintain sensible management units.

Buffer zones have generally not been included as part of the sites. Measures are provided in the UK Regulations to control, through the planning system, adverse impacts on a listed feature arising outside the site. Some sites straddle the land/sea divide or are entirely marine. In these situations the seaward boundaries of the site have been drawn as straight lines, to ensure ease of identification on charts and at sea.

Some sites are in fact clusters of smaller sites that are geographically separate. This has generally been appropriate when qualifying interests are ecologically interdependent or were geographically contiguous before being divided by human activity, as, for example, has happened in a number of cases with heathland and woodland. In some cases, such as the North Pennine Dales Meadows, a number of small individual SSSIs in the same geographical area have been clustered into one site. Such clusters may contain a range of habitat types; however, the argument for clustering of sites is strongest where the fragments support the same habitat types or species. Since the area of the cluster is larger than an individual fragment, it will support more species characteristic of the habitat type, simply because of the species-area relationship. This is well established for a variety of habitats (see for example Dawson 1994). In addition, a cluster is likely to span a wider range of conditions for a single habitat type than a single fragment. This will increase the total species richness and to

some degree buffer the habitat resource against the uncertain effects of climate and other changes. Where the sites in the cluster are close together and species have relatively mobile patterns of distribution over time, there will be a higher probability of maintaining species diversity, as opportunities for successful dispersal and establishment will be more frequent.

Table 1.5 Sand dune sites: range of Annex I habitat types at a selection of multiple interest sites

Site	Decalcified fixed dunes with *Empetrum nigrum*	Dunes with *Salix arenaria*	Embryonic shifting dunes	Eu-Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)	Fixed dunes with herbaceous vegetation (grey dunes)	Humid dune slacks	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	Other habitat types for which site selected	Annex II species for which site selected
Barry Links	X		X	X		X	X	0	0
Braunton Burrows		X			X	X	X	0	1
Burry Inlet: Dunes/Cilfach Burry: Twyni		X	X		X		X	0	2
Dornoch Firth and Morrich More	X		X	X		X	X	4	0
Drigg Coast		X		X				1	0
Glannau Môn: Twyni/Anglesey Coast: Dunes		X	X		X	X	X	0	2
Invernaver	X	X		X	X			3	0
Kenfig/Cynffig		X			X	X		0	2
Magilligan		X			X	X		0	0
Morfa Harlech and Morfa Dyffryn		X	X			X	X	0	0
North Northumberland Dunes		X	X		X	X		0	1
Penhale Dunes		X			X			0	2
Sands of Forvie	X		X			X	X		0
Sandwich Bay		X	X		X		X	0	0
Sefton Coast		X	X		X	X		0	0
South Uist Machair								4	1
Studland Dunes			X	X			X	0	0
Torrs Warren - Luce Sands	X		X	X			X	0	0
Winterton - Horsey Dunes			X	X		X		0	0

Table 1.6 Other coastal and marine sites: range of Annex I habitat types at a selection of multiple interest sites

Site	Lagoons	Reefs	Atlantic salt meadows *(Glauco-Puccinellietalia)*	Estuaries	Large shallow inlets and bays	Mediterranean and thermo-Atlantic halophilous scrubs (*Arthrocnemetalia fruticosae*)	Mudflats and sandflats not covered by seawater at low tide	Perennial vegetation of stony banks	*Salicornia* and other annuals colonising mud and sand	Sandbanks which are slightly covered by sea water all the time	Submerged -partly submerged sea caves	Other habitat types for which site selected	Annex II species for which site selected
Berwickshire and North Northumberland Coast		X					X				X	0	1
Burry Inlet: Saltmarsh and Estuary/Cilfach Burry: Cors heli ac Aber			X	X					X			1	0
Chesil and the Fleet	X					X		X				1	0
Dungeness								X				1	1
Essex Estuaries			X	X		X	X		X			1	0
Fal and Helford			X		X		X			X		0	1
Flamborough Head		X									X	1	0
Isles of Scilly Complex							X			X		0	1
Morecambe Bay			X		X		X	X	X			0	0
North Norfolk Coast and Gibraltar Point Dunes	X					X		X				4	0
Orfordness-Shingle Street	X							X				1	0
Pembrokeshire Islands		X		X	X								1
Plymouth Sound and Estuaries				X	X					X		0	1
Severn Estuary			X	X			X			X		0	0
Solent Maritime			X	X								1	0
Solway Firth			X	X			X		X	X		0	0
St Albans Head to Durlston Head												2	1
St Kilda		X									X	1	0
The Wash and North Norfolk Coast			X		X	X	X		X	X		1	1

Table 1.7 Upland sites: range of Annex I habitat types at a selection of multiple interest sites

Site	Alpine and sub-alpine heaths	Alpine cal-careous grass-lands	Alpine pioneer formations of *Caricion bicoloris-atrofuscae*	Chasmo-phytic veg'n on rocky slopes - calcareous sub-types	Chasmo-phytic veg'n on rocky slopes - silicicolous sub-types	Eutric scree	Eutro-phic tall herbs	Lime-stone pave-ments	Petrifying springs with tufa formations (*Crato-neurion*)	Siliceous alpine and boreal grass	Siliceous scree	Species-rich *Nardus* grassland, on siliceous substrates in mountain areas	Sub-Arctic willow scrub	Other habitat types for which site selected	Annex II species for which site selected
Asby Complex								X	X					2	2
Beinn Dearg	X	X	X		X		X			X				0	0
Ben Alder and Aonach Beg		X	X										X	0	0
Ben Heasgarnich		X	X	X			X					X	X	0	0
Ben Lawers		X	X	X			X						X	0	0
Ben Lui		X	X				X						X	0	0
Ben Nevis		X			X						X			0	0
Caenlochan			X	X		X	X						X	1	0
Cairngorms	X		X		X				X	X	X	X		6	0
Craven Limestone Complex								X	X					4	2
Drumochter Hills	X									X			X	0	0
Durness		X						X						2	0
Eryri/Snowdonia				X	X		X			X	X			1	1
Foinaven	X				X		X							0	0
Glen Coe					X		X				X	X		0	0
Helvellyn and Fairfield					X	X	X				X			0	0
Hoy	X								X					1	0
Inchnadamph		X		X		X		X	X				X	0	0
Ingleborough Complex				X				X						1	0
Loch Maree Complex	X				X						X			3	0
Meall na Samhna		X										X	X	0	0
Merrick Kells										X				2	0
Moor House - Upper Teesdale	X		X	X		X			X	X	X			6	2
Rannoch Moor														3	0
Rum						X						X		2	0
Strath		X		X				X	X					0	0
Strathglass Complex	X									X			X	1	0
Trotternish Ridge				X		X						X		0	0

Table 1.8 Lowland sites: range of Annex I habitat types at a selection of multiple interest sites

Site	Alkaline fens	Calcareous fens with *Cladium mariscus* and *Carex davalliana*	Dry heaths (all subtypes)	Depressions on peat substrates (*Rhyncho-sporion*)	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* formations	Mediterr-anean temporary ponds	Natural eutrophic lakes with *Magno-potamion or Hydro-charition*-type vegetation	Northern Atlantic wet heaths with *Erica tetralix*	Residual alluvial forests *(Alnion glutinoso-incanae)*	Semi-natural dry grasslands and scrubland facies: on calcareous substrates (*Festuco-Brometalia*)	Other habitat types for which site selected	Annex II species for which site selected
Breckland			X				X			X	1	0
Corsydd Môn/Anglesey Fens	X	X			X						0	1
Dorset Heaths			X					X			0	1
Dorset Heaths (Purbeck and Wareham) and Studland Dunes			X	X				X			1	1
Gower Commons/Tiroedd Comin Gwyr								X			0	2
Morecambe Bay Pavements					X					X	4	1
Norfolk Valley Fens	X										0	2
Roudsea Wood and Mosses											3	0
Salisbury Plain										X	1	1
The Broads	X	X					X		X		1	2
The Lizard					X	X		X			2	1
The New Forest			X	X		X		X	X		4	2
Thursley, Ash, Pirbright and Chobham			X	X				X			0	0
Tulach Hill and Glen Fender Meadows	X										0	2
Waveney and Little Ouse Valley Fens		X									1	2
Wye Valley Woodlands											3	0

Table 1.9 River sites with more than one Annex II species and/or Annex I habitat type

Site	**Floating vegetation of *Ranunculus***	**Otter *Lutra lutra***	**River lamprey *Lampetra fluviatilis***	**Brook lamprey *Lampetra planeri***	**Sea lamprey *Petromyzon marinus***	**Atlantic Salmon *Salmo salar***	**Allis shad *Alosa alosa***	**Twaite shad *Alosa fallax***	**Bullhead *Cottus gobio***	**White-clawed crayfish *Austro-potamo-bius pallipes***	***Vertigo moulinsi-ana***	***Coenagrion mercuriale***	**Other habitat types for which the site selected**
River Avon	X			X	X	X			X		X		
River Derwent and Bassenthwaite Lake			X	X	X	X							X
River Eden	X		X	X	X	X			X	X			
River Itchen	X											X	
River Usk/ Afon Wysg			X	X			X	X	X				
River Wye/ Afon Gwy	X	X	X	X	X	X	X	X	X	X			

Part 2: Annex I habitat type accounts

Section 2.1: Coastal and halophytic habitats

2.1.1 Sandbanks which are slightly covered by sea water all the time (11.25)

2.1.1.1 Background to selection

This habitat type occurs widely on the north-east Atlantic coast of Europe and is extensive in the UK. Sites have been selected to represent the main geographical and ecological range of variation of the habitat type and are amongst the most extensive in the UK.

The habitat type consists of soft sediment types that are permanently covered by shallow sea water, typically at depths of less than 20 m below chart datum. Sites have been selected to cover the geographical and ecological range of variation of the following categories:

(i) gravelly and clean sands
(ii) muddy sands
(iii) eelgrass *Zostera marina* beds, and
(iv) maerl beds.

The latter two categories are distinctive communities associated with shallow sublittoral sandy sediments and are of particular value because of the diversity of species they may support.

The diversity and types of community associated with this habitat type are determined by sediment type and a variety of other physical factors. These include geographical location, the relative exposure of the coast (from wave-exposed open coasts to tide-swept coasts or sheltered inlets and estuaries) and differences in the depth, turbidity and salinity of the surrounding water. The site series includes a range of physiographic types to encompass the variation within the four main sub-types of this habitat type.

Shallow sandy sediments are typically colonised by a burrowing fauna of worms, crustaceans, bivalve molluscs and echinoderms. Mobile fauna at the surface of the sandbank may include shrimps, prosobranch molluscs, crabs and fish. Sandeels, an important food for birds, live in sandy sediments. Where coarse stable material such as shells or maerl is present, epifaunal attached species may include foliose algae, hydroids, bryozoans and ascidians. Mixtures of sand and associated hard substrate can lead to the presence of very rich communities. Shallow sandy sediments may be important nursery areas for fish and feeding grounds for seabirds (especially puffins *Fratercula arctica*, guillemots *Uria aalge* or razorbills *Alca torda*) and seaduck (for instance common scoter *Melanitta nigra*).

2.1.1.2 Site list

Fal and Helford (158)

This is a sheltered site on the south-west coast of England, with a low tidal range and a wide range of substrata resulting in biologically one of the richest examples of sandbanks in the UK. Sublittoral sandbanks are present throughout much of the ria system and Falmouth Bay. There are particularly rich sublittoral sand invertebrate communities with eelgrass *Zostera marina* beds near the mouth of both the Fal and Helford and in some channels of the rias, such as the Percuil River and Passage Cove. Of particular importance are the maerl (*Phymatolithon calcareum* and *Lithothamnium corallioides*) beds that occur in the lower Fal. These are the largest beds in south-west Britain and harbour a rich variety of both epifaunal and infaunal species, including some rarely encountered species such as Couch's goby *Gobius couchi*. The Helford is one of very few locations where the mussel *Atrina fragilis* survives in Britain.

Isles of Scilly Complex (179)

The Isles of Scilly archipelago, off the south-west tip of England, encompasses extensive sublittoral sandy sediments, which, between the islands, are contiguous with the intertidal sandflats. They are important in the UK for the extent and diversity of their associated communities. In particular, their isolation and the presence of oceanic water contribute to the special nature of the site, which is characterised by shallow sandy sediments with low silt content and by the constant salinity. There are rich communities present on the tide-swept sandbanks in the narrow channels between the islands and in the deeper, more stable, wave-sheltered sediments. The fauna of

these sediments includes tanaid crustaceans, a diversity of polychaete worms and various echinoderms. The shallow sublittoral sediments are colonised by the most extensive and best developed eelgrass *Zostera marina* beds in southern Britain. These beds have a rich associated flora and fauna of algae, hydroids, sea anemones, molluscs and fish. Fauna with warm-water affinities include the trumpet anemone *Anthopleura ballii*.

Plymouth Sound and Estuaries (157)

This site, on the south-west coast of England, has been selected for its extensive areas of sandbanks, which consist of a range of sandy sediments within the inlet and on the open coast. These sediments include tide-swept sandy banks in estuarine habitats, sandy muds north of the Breakwater, muddy sands in Jennycliff Bay, fine sands with eelgrass *Zostera marina* and a rich associated flora and fauna in the Yealm entrance, as well as tide-swept sandy sediments with associated hard substrata colonised by distinctive communities of algae and invertebrates.

Severn Estuary/Môr Hafren (138)

The Severn Estuary, between south Wales and England, has been selected on account of the presence of extensive areas of highly mobile sandy sediments in highly turbid waters. These conditions result from the influence of the highest tidal range and some of the strongest currents in Europe. The fresh water inputs result in reduced or lower salinity. The presence of extensive areas of sand in sheltered low salinity conditions distinguishes the site from others in the same biogeographical area. The few biotopes represent those of clean sand with a restricted fauna characteristic of this extreme environment. These include communities dominated by bivalve molluscs, such as a *Spisula* community in large sandbanks and mobile sands and a *Tellina* community in more hard-packed sands, which occur particularly in the central part of the outer estuary. More stable benthic communities also occur, largely in Bridgwater Bay, and include polychaete-dominated mixed sediments.

Solway Firth (136)

This site is representative of this habitat type on the coast of north-west England/south-west Scotland. The sandbanks are mainly gravelly and clean sands, owing in part to the very dynamic nature of the estuary. The inner estuary contains constantly changing channels, and a predominance of sand is characteristic of such high energy systems. There is a transition to less extreme conditions in the outer estuary. The dominant species of the infaunal communities comprise different annelid worms, crustaceans, molluscs and echinoderms, depending on the nature of the substrate. For example, the bivalve molluscs *Fabulina fabula* and *Spisula subtruncata* occur at the edge of sandbanks in fine and medium sand respectively. These communities are richer in the less extreme conditions of the outer estuary.

Sound of Arisaig (Loch Ailort to Loch Ceann Traigh) (262)

The Sound of Arisaig is representative of the habitat type on the west coast of Scotland. It is sheltered, with low turbidity, and has an unusually high diversity of sublittoral sediment habitats within a relatively small area. These range from very soft mud and muddy sands in Loch Ailort and the deeper parts of its entrance to coarse, clean shell sand in the more exposed parts of the site. This site is particularly significant in that it supports some of the most extensive beds of maerl in the UK. These maerl beds have very rich associated communities that include several rare and scarce species, such as the alga *Gloiosiphonia capillaris* and the hydroid *Halecium plumosum*. Eelgrass *Zostera marina* is found on shallow sand in outer Loch Ailort. In the more sheltered conditions in inner Loch Ailort muddy sand occurs, supporting large populations of the echiuran worm *Amalosoma eddystonense*, a nationally scarce species. The Sound of Arisaig supports species of both predominantly southern origin, such as the sipunculan worm *Sipunculus nudus*, and predominantly northern distributions, such as the starfish *Luidia sarsi*. The site is an important part of the transition from southern to northern communities that occurs along the coast of the UK.

The Wash and North Norfolk Coast (233)

On this site sandy sediments occupy most of the subtidal area, resulting in one of the largest expanses of this habitat type in the UK. It provides a representative example of this habitat type on the more sheltered east coast of England. The subtidal sandbanks vary in composition and include coarse sand through to mixed sediment at the mouth of the embayment. Subtidal communities present include large areas of dense brittle star *Ophiothrix fragilis* beds. Species include polychaetes such as the sand mason *Lanice conchilega* and the bivalve tellin *Angulus tenuis*. Benthic communities on sandflats in the deeper, central part of the Wash are particularly

diverse. The sublittoral sandbanks provide important nursery grounds for young commercial fish species, including plaice *Pleuronectes platessa*, cod *Gadus morhua* and sole *Solea solea*.

2.1.2 Estuaries (13.2)

2.1.2.1 Background to selection

Estuaries are complex ecosystems interlinking the terrestrial and aquatic environments and are composed of an interdependent mosaic of subtidal, intertidal and surrounding terrestrial habitats. Many of these habitats, such as intertidal mudflats and sandflats, saltmarshes, sand dunes and reefs, are identified as habitat types in their own right in Annex I of the Directive.

The UK has a particularly large number of estuaries. Indeed, more than a quarter of the area of north-western European estuaries occurs in the UK. The wide range of estuary types occurring in the UK is also unusual in a European context. Site selection has taken account of the UK's EC responsibility for the protection of estuaries. Sites have been selected to represent the geographical range of estuaries present in the UK and to encompass examples of the four geomorphological types, the range of substratum types and associated fauna. Selection has generally favoured larger sites, as they display a wider variety of estuarine habitats, but smaller sites that have specific features of interest, such as undisturbed marine/terrestrial transitions, or are representative of their physiographic types have also been selected.

Estuaries can be defined as the downstream part of a river valley, subject to the tide and extending from the limit of brackish water. There is a gradient of salinity from fresh water in the river to increasingly marine conditions towards the open sea. Inputs of sediment from the river, shelter from wave action and, often, low current flows lead to the presence of extensive sediment flats. Similar large geomorphological systems where seawater is not significantly diluted by fresh water are considered as **Large shallow inlets and bays.**

The structure of estuaries is largely determined by geological and physiographic factors. There are four main geomorphological types, defined by these physiographic features:

Coastal plain estuaries: these estuaries have formed where pre-existing valleys were flooded at the end of the last glaciation. They are usually less than 30 m deep, with a large width-to-depth ratio. This is the main type of estuary, by area, in the UK.

Bar-built estuaries: these characteristically have a sediment bar across their mouths and are partially drowned river valleys that have subsequently been inundated. Bar-built estuaries tend to be small but are widespread around the UK coast.

Complex estuaries: these river estuaries have been formed by a variety of physical influences, which include glaciation, river erosion, sea-level change and geological constraints from hard rock outcrops. There are few examples of this type of estuary in the UK.

Ria estuaries: ria estuaries are drowned river valleys, characteristically found in south-west Britain. The estuarine part of these systems is usually restricted to the upper reaches. The outer parts of these systems are little diluted by fresh water and are defined as **Large shallow inlets and bays**.

The intertidal and subtidal sediments of estuaries support biological communities that vary according to geographic location, the type of sediment, tidal currents and salinity gradients within the estuary. The parts of estuaries furthest away from the open sea are usually characterised by soft sediments and the water is more strongly influenced by fresh water. Here the sediment-living animal communities are typically dominated by oligochaete worms, with few other invertebrates. Where rock occurs, there are restricted communities characteristic of brackish flowing water, consisting of green unicellular algae, sparse fucoid algae and species of barnacle and hydroid. The silt content of the sediment decreases nearer to the mouth of the estuary, and the water gradually becomes more saline. Here the animal communities of the sediments are dominated by species such as ragworms, bivalves and sandhopper-like crustaceans. In the outer estuary, closer to the open sea, the substrate is often composed of fine sediment and supports communities of more marine bivalves, polychaete worms and amphipod crustaceans. Where rock occurs, a restricted range of species more characteristic of the open sea is found.

2.1.2.2 Site list

The list of sites for this habitat type is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

Burry Inlet: Saltmarsh and Estuary/Cilfach Burry: Cors heli ac Aber (293)

This site provides an example of a large estuarine site on the south coast of Wales and encompasses the estuaries of the River Loughor, Tâf and Tywi (coastal plain estuaries) and the Gwendraeth (a bar-built estuary). These four adjoining estuaries form a single functional unit around the Burry Inlet, with important interchanges of sediment and biota. The estuaries of this site support a range of subtidal and intertidal sediments that grade from sand at the mouth to mudflats in the upper estuary. The fauna of the sediments varies, but includes communities with polychaete and oligochaete worms and areas with extensive cockle beds and other bivalve molluscs. This site has a range of undisturbed transitions to coastal habitats.

Dornoch Firth and Morrich More (265)

This site is the most northerly large, complex estuary in Scotland. The estuary is fed by the Kyle of Sutherland and is virtually unaffected by industrial development. There is a complete transition from riverine to fully marine conditions and associated communities. Inland, and in sheltered bays, sediments are generally muddy. Gravely patches occur in the central section of the Firth. Wide sandy beaches dominate the large bays at the mouth of the Firth, and areas of saltmarsh occur around the shores. Sublittoral sediments are predominantly medium sands with a low organic content. Several of the associated coastal habitats have been proposed as Annex I interests in their own right.

Drigg Coast (139)

This site is an example of a small, bar-built estuary on the north-west coast of England. It is fed by three rivers - the Irt, Mite and Esk - which discharge through a mouth that has been narrowed by large sand and shingle spits. The sediments within the estuary are largely muddy within the Rivers Irt and Mite, while those of the Esk are more sandy, particularly towards the mouth. There is a substantial freshwater influence in the upper reaches of all three rivers, with good development of associated animal communities. Within the site are some of the least disturbed transitions to terrestrial habitats of any estuary found in the UK.

Essex Estuaries (178)

This is a large estuarine site in the south-east of England and is a typical, undeveloped, coastal plain estuarine system with associated open coast mudflats and sandbanks. The site comprises the major estuaries of the Colne, Blackwater, Crouch and Roach rivers and is important as an extensive area of contiguous estuarine habitat. Essex Estuaries contains a very wide range of characteristic marine and estuarine sediment communities and some diverse and unusual marine communities in the lower reaches, including rich sponge communities on mixed, tide-exposed substrata. Sublittoral areas have a very rich invertebrate fauna, including the reef-building worm *Sabellaria spinulosa*, the brittlestars *Ophiothrix fragilis*, crustacea and ascidians. The site also has large areas of saltmarsh and other important coastal habitats.

Pembrokeshire Islands/Ynysoedd Sir Benfro (160)

This site includes the Daugleddau estuary, a ria estuary in south-west Wales, formed in the upper reaches of one of the best examples of a ria in the UK. The wide range of environmental conditions, particularly seabed substrata, tidal streams and salinity gradients, support a wide diversity of both communities and numbers of species. The species richness of sediment communities throughout Milford Haven and the Daugleddau is high. Current-swept sponge communities on shell/cobble substrates and bedrock in the upper reaches of the Daugleddau are exceptional in their diversity. The site also includes smaller estuaries entering the Daugleddau and Millford Haven and wide intertidal mudflats with rich and productive invertebrate annelid and mollusc communities, occurring in 'pills' (creeks).

Pen Llín a'r Sarnau/Lleyn Peninsula and the Sarnau (161)

This site has representative examples of bar-built estuaries in north-west Wales and includes the Glaslyn/Dwyryd, the Mawddach and the Dyfi Estuaries. There is a continuous gradient between the clean sands near the entrance to the sea and the mud or muddy sands in the sheltered extremes of the estuaries. The intertidal sand flats support communities of burrowing invertebrates and dense populations of polychaete worms, crustaceans, bivalve molluscs and gastropod molluscs. Saltmarsh fringing the shores of the estuaries and the saltmarsh creeks and pools are important habitat features for juvenile fish.

Plymouth Sound and Estuaries (157)

This site is representative of the ria type of estuary in the south-west of England. The Rivers Tamar and Lynher are linked at their mouths. The upper parts of the Tamar and Lynher include a very well developed estuarine gradient. As a consequence, they exhibit one of the finest examples of changing estuarine communities with changing salinity regime in the UK. Rocky reefs in low salinity estuarine conditions far inland on the Tamar are very unusual and support species such as the hydroid *Cordylophora caspia*. The Tamar is one of few estuaries where zonation of rocky habitats (intertidal and subtidal) can be observed along an estuarine gradient.

Severn Estuary/Môr Hafren (138)

The Severn Estuary is the largest example of a coastal plain estuary in the UK and one of the largest estuaries in Europe. It has an exceptional tidal range and turbid water conditions. Five large rivers discharge into it, the Wye, Usk, Severn, Avon and Parrett, and smaller rivers include the Rhymney, Yeo and Axe. Together these produce a marked east-west salinity gradient. The strong tidal currents create a highly dynamic environment and the resultant scouring of the seabed and high turbidity give rise to low diversity communities. Some of them are uncommon in Britain. The estuary comprises many different habitats, including saltmarsh, intertidal and subtidal mud and sand, rock outcrops, boulder and shingle shores. There is a variety of subtidal and intertidal benthic biotopes, epibenthic fauna and fish species and the site contains the only known extensive subtidal *Sabellaria alveolata* reefs in the UK; these have relatively rich associated communities. The fish fauna of the Severn Estuary is one of the most diverse in the UK and the estuary is one of the most important British estuaries for several rare species, including twaite shad *Alosa fallax* and allis shad *Alosa alosa*. An area of narrow-leaved eelgrass *Zostera angustifolia* and dwarf eelgrass *Zostera noltii* occurs on the Welsh side of the estuary.

Solent Maritime (206)

The site encompasses a major estuarine system on the south coast of England with four coastal plain estuaries (Yar, Medina, Kings Quay Shore, Hamble) and four bar-built estuaries (Newtown Harbour, Beaulieu, Langstone Harbour, Chichester Harbour). The site is the only one in the series to contain more than one physiographic type of estuary (it contains two) and is the only cluster site. The Solent and its inlets are unique in Britain and Europe for their hydrographic regime of four tides each day and the complexity of the marine and estuarine habitats present within the area. Sediment habitats within the estuaries include extensive estuarine flats, often with intertidal areas supporting eelgrass *Zostera* spp. and green algae, sand and shingle spits and natural shoreline transitions. The mudflats range from low and variable salinity in the upper reaches of the estuaries to very sheltered almost fully marine muds in Chichester and Langstone Harbours. Unusual features include the presence of very rare sponges in the Yar estuary and a sandy 'reef' of the polychaete *Sabellaria spinulosa* on the steep eastern side of the entrance to Chichester Harbour.

Solway Firth (136)

The Solway is a large, complex estuary on the west coast of Britain. It is one of the least industrialised and most natural large estuaries in Europe. Tidal currents in the estuary are moderately strong and levels of wave energy can be high. There is considerable seasonal fluctuation in water temperature, owing to the shallow nature of the estuary. The sediment habitats present, mainly dynamic sandflats and subtidal sediment banks, are separated by six main river channels, which are continually changing their patterns of erosion and accretion. The sublittoral sediment communities are typically sparse in the inner estuary, owing to the mobility of the sediment coupled with low and variable salinity. Communities become richer towards the outer estuary, owing to less extreme environmental conditions and more varied substrata. The dominant species of bivalve molluscs, polychaete worms, crustaceans and echinoderms vary, depending on location within the estuary.

2.1.3 Mudflats and sandflats not covered by seawater at low tide (14)

2.1.3.1 Background to selection

This is a widespread habitat type on the North Sea coasts of Atlantic Europe and occurs widely throughout the UK. Sites have been selected to encompass the range of geographical and ecological variation of this habitat type in the UK. Sites with large areas of intertidal flats as well as a range of shelter, mobility and diversity of subtypes were favoured.

Intertidal mudflat and sandflats are submerged at high tide and exposed at low tide. They form a major component of estuaries and embayments in the UK but also occur along the open coast. The physical structure of the intertidal flats can range from the mobile, coarse-sand beaches of wave-exposed coasts to the stable, fine-sediment mudflats of estuaries and embayments. This habitat type can be divided into three broad categories: clean sands, muddy sands and muds, although in practice there is a continuous gradient between them. Within this range the plant and animal communities present vary according to the type of sediment, its stability and the salinity of the water.

Muddy sands: these occur in a particular combination of conditions. Shelter from wave action is sufficient to allow the deposition of fine sediments, but some water movement or the lack of supply of silt leads to a more sandy substratum. Such conditions may occur at the mouths of estuaries or behind barrier islands, where sediment conditions are more stable. A wide range of organisms, such as lugworms *Arenicola marina* and bivalve molluscs, can colonise these sediments. Substantial beds of mussels *Mytilus edulis* may develop on the lower shore. Beds of intertidal dwarf eelgrass *Zostera noltii* or narrow-leaved eelgrass *Zostera angustifolia* and eelgrass *Zostera marina* may also occur on the lower shore. In estuaries, reduced salinity may cause a variation in these communities.

Mudflats: these form in the most sheltered areas of the coast, usually where large quantities of silt derived from rivers are deposited in estuaries. The sediment is stable and communities are dominated by polychaete worms and bivalve molluscs. Such soft mudflats typically support very high densities of the snail *Hydrobia ulvae*. The high biomass of intertidal species in such sediments provides important feeding areas for waders and wildfowl.

Clean sands: these communities occur at mid- to low-tide levels on clean, sandy beaches on the open coast and in bays around the UK where wave action or strong tidal streams prevent the deposition of finer silt. Clean sands also occur where the supply of silt in suspension is low. In such conditions there is a high proportion of the heavier grains of sediment. Owing to mobility of sediment and consequent abrasion, species that inhabit clean sands tend to be mobile and robust and include amphipod crustaceans, such as sandhoppers *Bathyporeia* spp., some polychaete worms and bivalve molluscs.

Sites have been selected to reflect the geographical and ecological range of variation of this habitat type. The complex nature of the habitat type means that many sites selected will contain a mixture of the types recognised above.

2.1.3.2 Site list

Berwickshire and North Northumberland Coast (230)

This is an extensive and diverse stretch of coastline in north-east England and south-east Scotland. There is variation in the distribution of features of interest along the coast. Stretches of the coast in England support a very extensive range of littoral mud and sandflats, ranging from wave-exposed beaches to sheltered muddy flats with rich infaunal communities. These have been selected as a biologically diverse and extensive example of clean sand flats on the east coast. Those in the Lindisfarne and Budle Bay area and on the adjacent open coast flats north of Holy Island are the most extensive in north-east England, with the largest intertidal beds of narrow-leaved eelgrass *Zostera angustifolia* and dwarf eelgrass *Zostera noltii* on the east coast of England, a diverse infauna and some large beds of mussels *Mytilus edulis*. Some of the bays along the open coast have mobile sediments, with populations of sandeels *Ammodytes* sp., small crustaceans and polychaete worms. More

sheltered sediments have very stable lower shore communities of burrowing heart urchins *Echinocardium cordatum* and bivalve molluscs.

Essex Estuaries (178)

Essex Estuaries represents the range of variation of this habitat type found in south-east England and includes the extensive intertidal flats of the Colne, Blackwater, Roach and Crouch estuaries, Dengie Flats and Maplin Sands. The area includes a wide range of sediment flat communities, from estuarine muds, sands and muddy sands to fully saline, sandy mudflats with extensive growths of eelgrass *Zostera* spp. on the open coast. The open coast areas of Maplin Sands and Dengie Flats have very extensive mudflats and an unusually undisturbed nature. Maplin Sands is particularly important for its large, nationally-important beds of dwarf eelgrass *Zostera noltii* and associated animal communities.

Fal and Helford (158)

This area supports examples of sheltered intertidal sandflats and mudflats representative of the south-west of England and is particularly recognised for the importance of the species living in the sediments. Most of the shores of the Fal and Helford rias, and their upper reaches, are fringed by sandflats and mudflats. Owing to its sheltered nature, the sediments are stable as well as being diverse, and include muds, muddy sand and clean sand. These support particularly rich and nationally important sediment communities in the Fal/Ruan estuary, Percuil River and in Passage Cove, including beds of dwarf eelgrass *Zostera noltii* and diverse invertebrate communities.

Isles of Scilly Complex (179)

The Isles of Scilly archipelago supports extensive areas of undisturbed intertidal sandflats in the extreme south-west of the UK. The islands are particularly important for the exceptionally rich communities occurring in coarse sediments, including clean sand, a substrate that is usually poor in species. Although sheltered, the sediments include little mud because the surrounding seas have a low suspended sediment concentration, resulting from the islands' isolation and the presence of oceanic water. The sandflats exposed at low tide between the northern islands are of national marine nature conservation importance, owing to their extent and diversity and the presence of species rarely found elsewhere in the intertidal. The lower shore sandflats are particularly notable, for they include the fringes of the most extensive and diverse beds of eelgrass *Zostera marina* known in Britain, with an unusually rich associated biota including various seaweeds and fish and rich sediment communities of anemones, polychaete worms, bivalve molluscs and burrowing echinoderms. These include many species restricted to the sublittoral elsewhere in the UK. Many southern species are present, often in large numbers, including some, such as the hermit crab *Cestopagurus timidus* and the spiny cockle *Acanthocardia aculeata*, that are recorded only rarely in the UK.

Morecambe Bay (137)

Morecambe Bay represents the largest single area of continuous intertidal mudflats and sandflats in the UK and is the best example of west coast muddy sandflats. They are strongly influenced by the erosion and deposition effects of the sea, and range from normal to reduced salinity. At low water vast areas of intertidal sandflats are exposed, with only small areas of mudflat. The intertidal flats support a range of community types, from typical mobile well-sorted fine sands of open coasts, grading through sheltered sandy sediments, into estuarine sands and finally low-salinity muds within the estuaries themselves. The infaunal communities have particularly high numbers of various polychaete worms, bivalve molluscs and amphipod crustaceans. There are eelgrass *Zostera* spp. beds in the South Walney and Piel Channel Flats.

Severn Estuary/Môr Hafren (138)

The Severn Estuary contains the fourth largest area of intertidal mudflats and sandflats in the UK and supports communities that are highly influenced by the extreme tidal range and currents found in this site. The resultant broad intertidal flats comprise unstable sands in the inner areas of the Estuary and on outer sandbanks, with muddy flats on the upper shores and further upstream, and some gravelly areas. The area is notable for its very large tidal range, strong tidal streams and extreme silt loading. The presence of sand in estuarine conditions is a notable feature. These littoral sediments have infaunal communities dominated by polychaete worms, amphipod crustaceans and gastropod molluscs, which support internationally important wintering wildfowl populations.

Narrow-leaved eelgrass *Zostera angustifolia* and dwarf eelgrass *Z. noltii* occur in a single area on the Welsh side of the estuary.

Solway Firth (136)

The site is representative of highly mobile, predominantly sandy intertidal flats on the west coast. The Solway Firth contains the third largest area of continuous littoral mudflats and sandflats in the UK. These occur within a natural estuary system substantially unaffected by human activities such as industrial development and dredging. The Solway is an unusually dynamic estuarine system, with mobile channels and banks. Fine sandy sediments occur in the inner estuary and more stable and diverse conditions in the outer reaches. Water varies from fully saline through to estuarine in character, and these gradients in physical conditions add to the ecological diversity within the site. The presence of intertidal sediment flats of fine sands, rather than muds, in conditions of estuarine salinity is a notable feature.

The Wash and North Norfolk Coast (233)

The Wash, on the east coast of England, is the second largest area of intertidal flats in the UK. The sandflats in the embayment of the Wash include extensive fine sands and drying banks of coarse sand, and this diversity of substrates, coupled with variety in degree of exposure, means that there is a high diversity relative to other east coast sites. Sandy intertidal flats predominate, with some soft mudflats, in the areas sheltered by barrier beaches and islands along the North Norfolk Coast. The biota includes large numbers of polychaetes, bivalves and crustaceans. Salinity ranges from that of the open coast in most of the area (supporting rich invertebrate communities) to estuarine close to the rivers. Smaller, sheltered and diverse areas of intertidal sediment, with a rich variety of communities including some eelgrass *Zostera* spp. beds, and large shallow pools are protected by the North Norfolk barrier islands and sand spits.

2.1.4 *Lagoons (21)

2.1.4.1 Background to selection

Lagoons are localised in the EC and have a restricted distribution on the Atlantic coast. The habitat type is complex, and a wide range of physical types and origins can be included in the broad definition. There is a wide range of geographical and ecological variation of the habitat type, and some of the types of lagoon found in the UK are rare elsewhere in Europe. This is a priority habitat type and is relatively uncommon in the UK. Therefore a high proportion of the sites identified as meeting the definition of the habitat type have been selected.

Although uncommon, lagoons may be clustered together on particular stretches of coast, where they are dependent on specific local physical processes. Such clusters have been considered particularly important for conservation of structure and function. Some of the sub-types of lagoon have a very restricted distribution in the UK, with one type being found mainly in the Outer Hebrides and a high proportion of another type occurring on the east coast of England. Site selection reflects this distribution.

Lagoons are areas of shallow, coastal salt water, wholly or partially separated from the sea by sandbanks, shingle or, less frequently, rocks. Five main sub-types of lagoon have been identified in the UK, on the basis of their physiography, as meeting the definition of the habitat type.

Isolated lagoons: these are separated completely from the sea by a barrier or rock or sediment. Seawater enters by limited ground water seepage or by over-topping of the sea barrier. Salinity is variable but often low. Isolated lagoons are often transient features with a limited life-span due to natural processes of infilling and coastal erosion. Isolated lagoons may have less water exchange than percolation lagoons and consequently a more impoverished biota.

Percolation lagoons: these are normally separated from the sea by shingle banks. Seawater enters by percolating through the shingle or occasionally by over-topping the bank (e.g. in storms). The water level shows some variation with tidal changes, and salinity may vary. Since percolation lagoons are normally formed by natural processes of sediment transport, they are transient features, which may be eroded and swept away over a period of years or decades or may become infilled by movement of the shingle bank.

Silled lagoons: water in silled lagoons is retained at all states of the tide by a barrier of rock (the 'sill'). There is usually little tidal rise-and-fall. Seawater input is regular and frequent and although salinity may be seasonally variable, it is usually high, except where the level of the sill is near to high tide level. These lagoons are restricted to the north and west of Scotland and may occur as sedimentary basins or in bedrock (where they are called 'obs'). Muddy areas are dominated by filamentous green algae, amongst which may be colonies of rare charophytes, such as foxtail stonewort *Lamprothamnion papulosum*. Beds of tasselweeds *Ruppia* spp. and, in the deeper, most stable lagoons, eelgrass *Zostera marina* may be present.

Sluiced lagoons: sluiced lagoons develop where the natural movement of water between the lagoon and the sea is modified by human mechanical interference such as the construction of a culvert under a road or valved sluices. Communities present in sluiced lagoons vary according to the substrate type and salinity but may resemble those of silled lagoons.

Lagoonal inlets: sea water enters lagoonal inlets on each tide and salinity is usually high, particularly at the seaward part of the inlet. Larger examples of this sub-type may have a number of different basins, separated by sills, and demonstrate a complete gradient from full salinity through brackish to fresh water. This salinity gradient significantly increases the habitat and species diversity of the sites in which it occurs.

Only sites on natural substrates have been selected. Sites that are entirely artificial in origin, e.g. some docks, have been excluded from the definition, even though in some cases the communities present may be similar to those of more natural sites.

The water in lagoons can vary in salinity from brackish (owing to dilution of sea water by fresh water) to hypersaline (i.e. more salty than sea water as a result of evaporation). The plant and animal communities of lagoons vary according to the physical characteristics and salinity regime of the lagoon, and therefore there are significant differences between sites. Although a limited range of species may be present, compared with other marine habitats, these species are especially adapted to the varying salinity and some are unique to lagoon habitats. The vegetation may include beds of eelgrasses *Zostera* spp., tasselweeds *Ruppia* spp. and pondweeds *Potamogeton* spp. or stoneworts such as foxtail stonewort *Lamprothamnium papulosum*. In more rocky lagoons, communities of fucoid wracks *Fucus* spp., sugar kelp *Laminaria saccarina* and red and green algae are also found. The fauna is often characterised by mysid shrimps and other small crustaceans, worms which burrow into the sediment, prosobranch and gastropod molluscs and some fish species. Species that are particularly found in lagoons and consequently have restricted distributions in the UK include starlet sea anemone *Nematostella vectensis*, lagoon sandworm *Armandia cirrhosa*, lagoon sand shrimp *Gammarus insensibilis* and foxtail stonewort *Lamprothamnium papulosum.*

2.1.4.2 Site list

Benacre to Easton Bavents Lagoons (155)

Benacre to Easton Bavents Lagoons is a series of percolation lagoons on the east coast of England. The lagoons (The Denes, Benacre Broad, Covehithe Broad and Easton Broad) have formed behind shingle barriers and are a feature of a geomorphologically dynamic system. Seawater enters the lagoons by percolation through the barriers, or by overtopping them during storms and high spring tides. The lagoons show a wide range of salinities, from nearly fully saline in South Pool, The Denes, to extremely low salinity at Easton Broad. This range of salinity has resulted in a series of lagoonal vegetation types, including beds of narrow-leaved eelgrass *Zostera angustifolia* in fully saline or hyper saline conditions, beds of spiral tasselweed *Ruppia cirrhosa* in brackish water and dense beds of common reed *Phragmites australis* in freshwater. The site supports a number of specialist lagoonal species.

Chesil and the Fleet (234)

The site comprises the Fleet lagoon and Chesil Beach on the south coast of England. The Fleet is the largest example of a lagoonal habitat in England and has features of both lagoonal inlets and percolation lagoons. It is bordered by the fossil shingle barrier beach structure of Chesil Beach, through which seawater percolates into the lagoon, but most of its water exchange occurs through the narrow channel that links it to Portland Harbour. A low freshwater input produces fully saline conditions throughout most of the Fleet, with reduced salinity occurring only in the west. The lagoon is extremely sheltered from wave action and has weak tidal currents, except in the eastern narrows and entrance channel. The tidal range is much smaller and temperature range far greater than on the open coast. The lagoon supports extensive populations of two species of eelgrass *Zostera* and three species of tasselweed *Ruppia*, including the rare spiral tasselweed *R. cirrhosa*, and a diverse fauna that includes a number of nationally rare and scarce species.

Loch nam Madadh (229)

Rock-bound silled lagoons in Europe are virtually restricted to the Outer Hebrides in Scotland. Loch nam Madadh (Loch Maddy) is one of two sites in North Uist selected to reflect this distribution.

Loch nam Madadh lagoons form the most extensive and diverse saline lagoon system in the UK. The only comparable site is Obain Loch Euphoirt (Loch Eport), which has also been selected. There are fourteen lagoons in the Loch nam Madadh complex. These connect with the extensive system of freshwater lochs and lochans in the North Uist hinterland and the fjardic sea loch of Loch nam Madadh itself. There is a wide range of types, from large, complex lagoons with several sills and basins to small, shallow single lagoons. Together they encompass the full transition from fresh water to marine conditions, through a series of basins and sills, and have an exceptionally wide range of habitat types with associated characteristic communities. Most have one or more basins floored with soft, peaty mud, and there are usually boulders and cobbles around the margins. At the entrances to some of the lagoons there are rock and boulder waterfalls. Others have rock and coarse sediment rapids that flood at all states of the tide, and yet others have a percolation barrier. Within the basins of Loch an Dãin and Loch an Strumore there are beds of dwarf eelgrass *Zostera noltii,* small patches of eelgrass *Zostera marina,* large quantities of the scarce green alga *Cladophora battersii*, and the scarce foxtail stonewort *Lamprothamnion papulosum*. Other lagoons in the complex have tidal rapids with kelps *Laminaria* spp. and sea oak *Halidrys siliquosa,* which supports extensive epiphytic growths of sponges, anemones and ascidians. Others

have intertidal rapids dominated by fucoids. In these lagoons, coarse sediment has the fanworm *Sabella pavonina*. Shallow peaty mud in the basins has large numbers of the burrowing amphipod *Corophium volutator* and the lugworm *Arenicola marina*, and beds of mussels *Mytilus edulis* and the green alga *Codium* sp. are found on hard substrata near the entrance channels.

Loch of Stenness (187)

Loch of Stenness in Orkney has a single basin characteristic of lagoons in this part of Scotland, and has characteristics of both silled lagoons and lagoonal inlets. It is the second largest brackish lagoon in the UK and is of particular importance on account of its large size, stability, reduced salinity regime and northern location. There is a salinity gradient in the lagoon, and communities respresenting sheltered marine, brackish and fresh water conditions are found. The Loch of Stenness is predominantly sedimentary: the lagoon basin is floored by soft mud, while round the shoreline muddy sediments with sand and gravel grade into pebbles, cobbles and boulders. The soft sublittoral mud supports mats of filamentous green algae and large numbers of burrowing worms, and the bivalve mollusc *Mya arenaria* and the prosobranch mollusc *Hydrobia ulvae* may be dominant. Littoral boulders are dominated by filamentous green algae or fucoid algae, with *Fucus ceranoides*, characteristic of brackish conditions, abundant in places. Submerged boulders in more saline areas of the lagoon support clumps of mussels *Mytilus edulis*, the brown alga *Fucus serratus* and species of foliose red and filamentous green algae. In the inner parts of the loch, where salinity is reduced, the cobbles and gravel support stands of beaked tasselweed *Ruppia maritima*, *Fucus ceranoides* and filamentous green algae. Extensive stands of pondweed *Potamogeton* spp. are present in areas of particularly low salinity.

Loch Roag Lagoons (232)

Loch Roag Lagoons is a complex of silled lagoons illustrating the range of variation from fresh water to marine conditions on the Atlantic coast of the Hebrides. Tob Valasay has a complex salinity regime, determined by the balance between saturated salt water introduced over the sill and fresh water from run off and small inlet streams. Its basins contain a diverse range of habitats, including rocky outcrops, boulders and muddy sand, with softer mud in the eastern basin and boulders, cobbles and shell gravel in the narrows. A range of communities are present, including beds of eelgrasses *Zostera* spp. and tasselweeds *Ruppia* spp., turfs of marine algae and stands of large brown algae.

Loch Siadar is a smaller lagoon that is mainly brackish in character. It has soft, sheltered mud and sand sediments, with some boulders and cobbles on the shore and in shallow water. These substrata support a characteristic range of species. The narrows consists of a bedrock and boulder sill, supporting a more diverse community with a variety of species, including kelps *Laminaria* spp., anemones and sponges.

North Norfolk Coast and Gibraltar Point Dunes (276)

This site encompasses a number of small percolation lagoons on the east coast of England; together with Orfordness - Shingle Street and Benacre to Easton Bavents, it forms a significant part of the percolation lagoon resource concentrated in this part of the UK. The most notable of the lagoons at this site are Blakeney Spit Pools, a lagoon system of six small pools between a shingle ridge and saltmarsh. The bottom of each pool is shingle overlain by soft mud. The fauna of the lagoons includes a nationally rare species, the lagoon mysid *Paramysis nouvelli*.

Obain Loch Euphoirt (238)

Rock-bound silled lagoons in Europe are virtually restricted to the Outer Hebrides in Scotland. Obain Loch Euphoirt (Loch Eport) is one of two sites in North Uist selected to reflect this centre of distribution.

Obain Loch Euphoirt Lagoons forms one of the most extensive and diverse systems of saline lagoons in the UK. The only comparable site is Loch nam Madadh, which has also been selected. The site is a complex of four individual lagoons, which together support the complete range of physical conditions and communities characteristic of this part of Scotland. Loch Obisary is a silled lagoon and is unique amongst the brackish basins of the UK on account of its size, depth (over 40 m), permanent hydrographic stratification and the range of communities it supports. There is a zonation of species within the loch. Several algal species are restricted to within 200 m of the sea water entrance channel. Some, such as *Phyllophora pseudoceranoides*, are abundant on shallow rock close to the inlet and dominate deeper water throughout the loch. This deeper rock also supports

marine ascidians, and there are beds of the fresh water species fennel pondweed *Potamogeton pectinatus* in shallow water with a greater fresh water influence.

Oban nam Fiadh is an extensive system of sluiced lagoons consisting of a series of basins separated by channels and sills with a full transition from marine to fresh water conditions. There is a full transition from plant communities typical of fresh or brackish waters, occurring in the inner basin, through distinctive brackish communities including the nationally scarce foxtail stonewort *Lamprothamnium papulosum*, to marine communities with fucoid algae at the entrance to Loch Euphoirt. Beds of eelgrasses *Zostera* spp. and tasselweeds *Ruppia* spp. occur, supporting the opisthobranch mollusc *Akera bullata*.

The smaller Oban Sponish is a silled lagoon separated from Loch Euphoirt by a boulder sill. There are two basins. Of particular note in the inner basin is a brackish/marine community of a dense bed of eelgrass *Zostera marina* and tasselweeds *Ruppia* spp. supporting the opisthobranch mollusc *Akera bullata*. The outer basin supports communities more typical of those found in very sheltered marine conditions.

The fourth lagoon in this complex is the small brackish silled lagoon west of Loch Euphoirt. It has a mud floor that supports a dense bed of tasselweeds *Ruppia* spp. The rocky intertidal zone and the sill support characteristic marine fucoid algae.

Orfordness - Shingle Street (193)

This site encompasses a series of percolation lagoons on the east coast of England, and, together with Benacre to Easton Bavents and North Norfolk Coast and Gibraltar Point Dunes, forms a significant part of the percolation lagoon resource concentrated in this part of the UK. The lagoons at this site have developed in the shingle bank adjacent to the shore at the mouth of the Ore estuary. The salinity of lagoons is maintained by percolation through the shingle, although at high tides sea water can overtop the shingle bank. The fauna of these lagoons includes typical lagoon species, such as the cockle *Cerastoderma glaucum,* the ostracod *Cypredeis torosa* and the gastropods *Littorina saxatilis tenebrosa* and *Hydrobia ventrosa*. The nationally rare starlet sea anemone *Nematostella vectensis* is also found at the site.

Solent and Isle of Wight Lagoons (231)

This site encompasses a series of lagoons, including percolation, isolated and sluiced lagoons on the south coast of England. The site includes a number of lagoons in the marshes in the Keyhaven - Pennington area, at Farlington Marshes in Chichester Harbour, behind the seawall at Bembridge Harbour and at Gilkicker, near Gosport. The lagoons show a range of salinities and substrata, ranging from soft mud to muddy sand with a high proportion of shingle, which support a diverse fauna including large populations of three notable species: the nationally rare foxtail stonewort *Lamprothamnium papulosum*, the nationally scarce lagoon sand shrimp *Gammarus insensibilis* and the nationally scarce starlet sea anemone *Nematostella vectensis*. The lagoons in Keyhaven - Pennington Marshes are part of a network of ditches and ponds within the saltmarsh behind a sea wall. Farlington Marshes is an isolated lagoon in marsh pasture that, although separated from the sea by a sea wall, receives sea water during spring tides. The lagoon holds a well developed low-medium salinity insect-dominated fauna. Gilkicker Lagoon is a sluiced lagoon with marked seasonal salinity fluctuation which supports a high species diversity. The lagoons at Bembridge Harbour have formed in a depression behind the sea wall and sea water enters by percolation. Species diversity in these lagoons is high and the fauna includes very high densities of *Nematostella vectensis*.

The Vadills (227)

The Vadills, at the head of Brindister Voe in Shetland, is an outstanding example of a complex lagoon system. It is a complex of eight shallow basins and has examples of both lagoonal inlets and silled lagoons. This is an extremely sheltered, undisturbed and natural environment. There is a gradation of habitats within the system, from brackish to fully marine conditions, from still to fast-flowing water and from soft, flocculent, peaty mud through coarse sediments including the maerl *Lithothamnion corallioides* to bedrock and boulders. There is a correspondingly wide range of communities, with a high diversity of species. Such diversity is unusual given the complex's northern location and relatively small size. The site supports several unusual species and communities. These include the holothurians *Leptopentacta elongata* and *Leptosynapta inhaerens*, present in dense populations, areas of the free-living fucoid alga *Ascophyllum nodosum* ecad *mackaii*, for which this is the only known location in Shetland, and the brittle star *Ophiura affinis*, which is unusual in such shallow water. There are small areas of extremely sheltered littoral sediment, which support filamentous green and brown algae

and several beds of beaked tasselweed *Ruppia maritima*. Marlee Loch supports a bed of eelgrass *Zostera marina*. Shallow rock supports sugar kelp *Laminaria saccharina,* whilst *Laminaria hyperborea* and sea oak *Halidrys siliquosa* occur in the channels, where tidal streams are faster.

2.1.5 Large shallow inlets and bays (12)

2.1.5.1 Background to selection

Large shallow inlets and bays are complex systems interlinking the terrestrial and aquatic environments and composed of an interdependent mosaic of subtidal, intertidal and surrounding terrestrial habitats. Several of these habitat types are proposed as Annex I interests in their own right.

This is a very variable habitat type. The different sub-types may vary in their distribution and extent. While some are widespread in Europe, others are found mainly in the UK. The habitat type is widespread in the UK, but some sub-types may be localised in their distribution.

Sites have been chosen to represent the range of physiographic types, the geographical range and the ecological variation of this habitat type. Selection favoured larger sites, which tend to encompass the greatest variety of habitats.

Large shallow inlets and bays are large indentations of the coast, generally more sheltered from wave action than the open coast. They are relatively shallow, usually averaging less than 30 m in depth. In the UK, three main physiographic types can be identified that meet the EC definition:

Embayment: a type of marine inlet typically where the line of the coast follows a concave sweep between rocky headlands, sometimes with only a narrow entrance to the embayment.

Fjard: a series of shallow basins connected to the sea via shallow and often intertidal sills. Fjards are found in areas of low-lying ground which have been subject to glacial roughening. They have a highly irregular outline, no main channel and lack the high relief and U-shaped cross-section of fjiordic inlets.

Ria: a drowned river valley in an area of high relief; most have resulted from the post-glacial rise in relative sea-level. This sub-type is known in Scotland as a Voe.

'Shallow' has been defined by the depth limit of the photic zone in open coastal waters adjoining the inlet or bay. In the UK this has been interpreted as a depth of 30 m below chart datum or shallower across at least 75% of the site. Deep fjordic sealochs are not included because they do not conform to the definition of the habitat type. The physiographical character of **Large shallow inlets and bays** is similar to that of the Annex I **Estuaries** habitat type, but the influence of fresh water is reduced.

There are only a few large embayments around the coast of the UK. Rias occur only in southern Wales and south-west England, while voes (which are similar in character to rias) occur only in Shetland and fjards in western Scotland and Northern Ireland. Rias are particularly well represented in the UK compared with other parts of northern Europe, whilst fjardic habitats are rarely found elsewhere in the EC.

Large shallow inlets and bays vary widely in habitat and species diversity according to their geographic location, size, shape, form and geology, depending on whether they occur on hard (rocky) or soft (sedimentary) coasts. The degree of exposure is a critical factor in determining habitat and species diversity. This affects communities on the shore and in the sublittoral zone. The range of plants and animals associated with this habitat type is therefore very wide. Communities may be dominated by *Fucus* species, particularly in more sheltered locations. Extensive beds of mussels *Mytilus edulis* may be present on mixed substrate. Sediment shores may vary widely, depending on the degree of exposure. Very exposed conditions may result in shingle beaches, while less exposed shores may consist of clean sand. In sheltered conditions shores may consist of fine sand and mud. Very exposed sediment shores are unable to support animal populations. On less exposed shores, communities of crustaceans and polychaetes develop, while shores of fine sand and mud are characterised by polychaete and bivalve communities and beds of eelgrasses *Zostera* spp. In the sheltered conditions of Scottish fjards, loose-lying mats of green algae and the unattached form *mackaii* of the wrack *Ascophyllum nodosum* may occur.

In the sublittoral zone, more exposed rocky coasts support forests of the kelp *Laminaria hyperborea*, with forests of sugar kelp *Laminaria saccharina* occurring in more sheltered conditions. Communities of ephemeral algae and maerl (including *Phymatolithon calcareum* and *Lithothamnion corallioides*) may be present on exposed or

current-swept coasts, whilst sheltered shallow sediments may be covered by communities of filamentous red and brown algae, by loose-lying mats of algae or by beds of eelgrass *Zostera marina*.

Animal-dominated rocky communities in the sublittoral zone also vary according to local conditions of wave exposure and tidal streams. In more wave-exposed coasts, soft corals, anemones, sponges, seafans, feather stars and hydroids may be dominant, whilst more sheltered coasts support different species of sponges, hydroids, brachiopods and solitary ascidians. A particular feature of rias is the presence of sublittoral rock in conditions of strong tidal flow but negligible or no wave action. Particular growth forms of sponges and ascidians as well as specific biotopes occur in these unusual conditions. In tide-swept areas communities of hydroids and bryozoan turf or beds of brittle stars may be dominant. Beds of horse mussel *Modiolus modiolus* characterise some seabeds. Animal-dominated sediment communities range from gravels and coarse sands dominated by burrowing sea cucumbers, large bivalve molluscs and heart urchins, through finer sediments supporting communities of polychaetes and small bivalves, to fine muds with beds of seapens, large burrowing crustaceans and bottom-dwelling fish.

2.1.5.2 Site list

The list of sites for this habitat type is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

Fal and Helford (158)

This site is an example of a ria system in south-west England and supports a wide range of communities representative of marine inlets and shallow bays. The rias of the Fal and Helford have only a low freshwater input and as a result the area contains a range of fully marine habitats from extremely sheltered in the inlets to the wave-exposed, tide-swept open coast. There is a particularly diverse algal flora and a number of warm-water species are present. The area supports extensive and rich sediment communities, which include the largest and most south-westerly maerl bed in the UK.

Loch nam Madadh (229)

Loch nam Madadh (Loch Maddy) is selected as representative of the fjardic sea lochs on the coast of north-west Scotland. This site is exceptionally complex. It is predominantly shallow, with deeper water only in its entrance, and wave exposure grades from moderately exposed to extremely sheltered in the inner basins. There are numerous rocks and islands and at least 22 shallow sills and associated basins. The fjardic marine communities on this site are more diverse than on any other known site in the EC. There is a particularly wide variety of shallow tide-swept reef and sediment habitats and communities. Some of the holothurian species found in abundance on soft mud in the inner basins, such as the sea cucumber *Labidoplax media*, are considered rare elsewhere. There are dense beds of knotted wrack *Ascophyllum nodosum (*ecad *mackaii)* and a variety of kelp forest types that illustrate the wave exposure gradient in the loch. There are transitions to a complex system of lagoons, which have been proposed as an Annex I interest in their own right.

Morecambe Bay (137)

Morecambe Bay is the second largest embayment in the UK, after the Wash. It is a large, predominantly sandy bay on the west coast of England. The area encompasses a very shallow bay bordered on the south by the channel of the Lune Estuary and on the north by the Walney Channel. At low water vast areas of intertidal sandflats are exposed, with small areas of mudflat, particularly in the upper reaches of the associated estuaries. The sediments of the bay are mobile and support a range of community types, from those typical of open coasts (mobile, well-sorted fine sands), grading through sheltered sandy sediments to low-salinity sands and muds in the upper reaches. Apart from the areas of intertidal flats and subtidal sandbanks, Morecambe Bay supports exceptionally large beds of mussels *Mytilus edulis* on exposed 'scars' of boulder and cobble, and small areas of reef with fucoid algal communities. Of particular note is the rich community of sponges and other associated fauna on tide-swept pebbles and cobbles at the southern end of Walney Channel.

Pembrokeshire Islands/Ynysoedd Sir Benfro (160)

This area in south-west Wales includes Milford Haven, one of the best examples of a ria in the UK, and the wide, shallow, predominantly sandy embayment of St Brides Bay. The wide range of environmental conditions,

particularly seabed substrates, tidal streams and salinity gradients, supports high community and species diversity. Species richness of sediment communities throughout Milford Haven is particularly high, with intertidal sandy/muddy areas supporting extensive beds of narrow-leaved eelgrass *Zostera angustifolia*. The seabed in the open coast embayments is predominantly sandy sediment in the more shallow and high energy locations. It is muddier and mixed with stones and shells in low energy areas. High salinity water and rocky substrata penetrate far upstream, and communities characteristic of fully saline conditions occur. A wide range of subtidal and intertidal rocky habitats are present, from rocky reefs and boulders to rich underboulders, crevices, overhangs and pools.

Plymouth Sound and Estuaries (157)

Plymouth Sound and Estuaries on the south-west coast of England includes the rias of the rivers Tavy, Tamar, Lynher and the Yealm. The first three of these join at the wide, rocky inlet of Plymouth Sound and the Yealm enters the adjacent Wembury Bay. The Yealm has good examples of habitats and communities characteristic of sheltered marine inlets with little fresh water input, including a range of sponge- and worm-dominated communities on lower shore mixed sediments. The Plymouth Sound complex has a high diversity of habitats and communities characteristic of different salinities, in contrast to the Fal and Helford. Some of these support extremely rich marine flora and fauna, which include abundant southern Mediterranean-Atlantic species rarely found in Britain, such as the carpet coral *Hoplangia durotrix*. Particularly notable habitats include (i) the littoral and sublittoral limestone reefs extensively bored by bivalves and harbouring a rich fauna, (ii) offshore sublittoral tide-swept reefs, (iii) tide scoured limestone channels with animal communities rarely encountered in other marine inlets and (iv) subtidal sediments with rich and often diverse invertebrate communities.

Strangford Lough (222)

Strangford Lough on the east coast of Northern Ireland is an outstanding example of a large, enclosed fjardic sea lough. Sea water enters the Lough through a narrow entrance, expanding into a broad, mostly shallow basin that has a central deep channel (30-60 m deep), which carries rapid currents and causes great turbulence in some parts, particularly the Narrows. With a wide range of tidal stream strengths and depths, there is a remarkable marine fauna within Strangford Lough and it is one of the most diverse sea loughs in the UK. The communities present range from the very rich high-energy communities near the mouth, which depend on rapid tidal currents, to communities in extreme shelter where fine muds support burrowing brittlestars, the Dublin Bay prawn *Nephrops norvegicus* and a rich community associated with horse mussels *Modiolus modiolus.*

The Wash and North Norfolk Coast (233)

The Wash is the largest embayment in the UK and this site provides a representation of the habitat type on the east coast of England. It is connected via sediment transfer systems to the North Norfolk Coast. Together the Wash and North Norfolk Coast form one of the most important marine areas in the UK and European North Sea coast and include extensive areas of varying, but particularly sandy, sediments subject to a range of conditions. Communities in the intertidal include those characterised by large numbers of polychaetes, bivalve and crustaceans. Subtidal communities cover a diverse range from the shallow to the deeper parts of the embayments and include dense brittlestar beds and areas of an abundant reef-building worm ('ross worm') *Sabellaria spinulosa*. The embayment supports a variety of mobile species, including a range of fish species and common seals *Phoca vitulina*.

2.1.6 Reefs (11.24)

2.1.6.1 Background to selection

Reefs are widespread in northern and southern Europe and occur widely around the UK coast. They are very variable in form and in the communities that they support. Sites have been chosen to represent the main geographical and ecological range in the UK of this extremely variable habitat type. Selection has favoured extensive examples with diverse community structure. The selection process has taken account of the UK's special EC responsibility for reef types in conditions of extreme wave and tidal stream exposure. A large proportion of the chalk reefs of Europe occur in the UK and selection of this type of reef was emphasised in recognition of the UK's special responsibility.

Reefs are rocky marine habitats or biological concretions that rise from the sea bed. They are generally subtidal but may extend as an unbroken transition to the intertidal zone, where they are exposed to the air at low tide. Two main types of reef can be recognised, those where structure is created by the animals themselves (biogenic reefs) and those where animal and plant communities grow on raised or protruding rock. Only a few invertebrate species are able to develop biogenic reefs, which are therefore restricted in distribution and extent.

There is a far greater range and extent of rocky reefs than biogenic concretions in the UK. Rocky reef types are extremely variable, both in structure and in the communities they support. A wide range of topological reef forms meet the EC definition of this habitat type. These range from vertical rock walls to horizontal ledges, broken rock and boulder fields. The common feature between these different forms is the type of animal and plant community that grows on the rock. The species assemblage is characterised by attached algae and invertebrates, usually associated with a range of mobile animals, including invertebrates and fish. The specific communities that occur vary according to a number of factors. For example, rock type is important, with particularly distinct communities associated with chalk and limestone rock. These have a restricted distribution in accordance with the distribution of the rock type on which they grow. There may be further variety associated with topographical features such as vertical rock walls, gully and canyon systems, outcrops from sediment and rock pools on the shore. The greatest variety of communities is typically found where coastal topography is highly varied, with a wide range of exposures to wave action and tidal streams.

Exposure to wave action has a major effect on community structure, with extremely exposed habitats dominated by a robust turf of sponges, anemones and foliose red seaweed, while reefs in the most sheltered sea lochs and rias support delicate or silt-tolerant filamentous algae, fan worms, ascidians and brachiopods. The presence of enhanced tidal streams often significantly increases species diversity, although some communities require very still conditions. The strength of tidal streams varies considerably, from negligible currents in many sea loch basins to very strong tidal currents of 8-10 knots (4 to 5 m/s) or more through tidal rapids or in sounds. In strong currents there are communities of barnacles, the soft coral *Alcyonium digitatum*, massive sponges and hydroids.

In addition, in the UK there is a marked biogeographical trend in species composition related to temperature, with warm, temperate species such as the sea fan *Eunicella verrucosa* and the corals *Leptopsammia pruvoti* and *Balanophyllia regia* occurring in the south, and cold-water species such as the anemone *Bolocera tuediae* and the red seaweed *Ptilota plumosa* in the north. A major factor affecting reef communities is the turbidity of the water. In turbid waters, light penetration is low and algae can occur only in shallow depths or in the intertidal zone. However, in such conditions animals have a plentiful supply of suspended food and filter-feeding species may be abundant. Salinity is also important. Although most reefs are fully marine, rocky habitats in certain marine inlets are subject to variable or permanently reduced salinities and have their own distinctive communities.

Where reefs extend from the seabed into the intertidal zone, a strong vertical zonation of communities is apparent. Lichens occur at the top of the shore, with communities characterised by barnacles, mussels or species of fucoid (wrack) seaweeds in the intertidal zone.

2.1.6.2 Site list

The list of sites for this habitat type is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

Berwickshire and North Northumberland Coast (230)

This site is an extensive and diverse stretch of coastline in north-east England and south-east Scotland. There is variation in the distribution of features of interest along the coast. Moderately wave-exposed reef habitats occur throughout the site. The subtidal rocky reefs and their rich marine communities, together with the wide variety of associated littoral reefs, are the most diverse known on the North Sea coast. Their remarkably varied nature is due to the wide range of physical conditions in the area, from wave-exposed locations on the open coast, through more sheltered reefs within bays, to those exposed to strong tidal currents in sounds and off headlands. There is also a diverse range of rock types, including soft limestones and hard volcanic rock. The Farne Islands are of special importance as they are the only rocky islands with extensive reefs in the enclosed North Sea. A large number of the species present are characteristic of cold water and several reach their southern or eastern limit of distribution within the area.

Flamborough Head (140)

Flamborough Head has been selected for the presence of species associated with the chalk and for the site's location at the southern limit of distribution of several northern species. It lies close to the biogeographic boundary between two North Sea water bodies and encompasses a large area of hard and soft chalk on the east coast of England. The site covers around 14% of UK and 9% of European coastal chalk exposure, represents the most northern outcrop of chalk in the UK, and includes bedrock and boulder reefs which extend further into deeper water than at other subtidal chalk sites in the UK, giving one of the most extensive areas of sublittoral chalk in Europe.

The reefs and cliffs on the north side of the headland are very hard, resulting in, for example, the presence of many overhangs and vertical faces, a feature uncommon in sublittoral chalk. The clarity of the relatively unpolluted seawater and the hard nature of the chalk have enabled kelp *Laminaria hyperborea* forests to become established in the shallow sublittoral. The reefs to the north support a different range of species from those on the slightly softer and more sheltered south side of the headland. The site supports an unusual range of marine species and includes rich animal communities and some species that are at the southern limit of their North Sea distribution, e.g. the northern seaweed *Ptilota plumosa*. For these reasons, the sublittoral and littoral reef habitats at Flamborough are considered to be the most diverse in the UK.

Lochs Duich, Long and Alsh Reefs (235)

This site has been selected as an extensive area of extremely sheltered reefs within a system of fjordic sea lochs in the north-west of Scotland. There is considerable diversity within the site, with areas of sheltered sublittoral rock supporting unusual assemblages of encrusting sponges and solitary sea squirts, and, on shallower reefs, tide-swept kelp forests influenced by brackish water. Loch Duich is particularly notable for its well developed communities of brachiopods and sea anemones on sheltered bedrock. Characteristic species include the sea anemone *Protanthea simplex*, the fan worm *Sabella pavonina*, the brachiopods *Neocrania anomala* and *Terebratulina retusa*, amongst other characteristic species. The reefs in Kyle Rhea and Kyle Akin are subject to some of the strongest tidal streams in the British Isles and the bedrock in Kyle Rhea supports rich communities typically dominated by the hydroids *Tubularia indivisa* and *Sertularia argentea*, the barnacle *Balanus crenatus*, anemones, sponges and ascidians. Tide-swept reefs also support unusually dense beds of the brittlestar *Ophiopholis aculeata*, an extremely rare feature in the UK.

The sheltered reefs in Loch Long, the second most brackish of the large Scottish sea lochs, are unusual in that they are subject to variable salinities and support communities characterised by encrusting sponges and large numbers of ascidians, such as *Ascidia virginea*, *Boltenia echinata* and *Pyura squamulosa*.

Lundy (159)

This site is a granite and slate reef system and is selected for its outstanding representation of reef habitats in south-west England. Lundy is exposed to a wide range of physical conditions as a result of differing degrees of wave action and tidal stream strength on sheltered and exposed coasts and headlands. This range of physical conditions, combined with the site's topographical variation, has resulted in the presence of a unusually diverse complex of marine habitats and associated communities within a small area.

The reefs of Lundy extend well over 1 km offshore and drop steeply into deep water in some areas. The variety of habitats and associated species on the reefs is outstanding and includes, for example, a large number of

seaweeds and a large number of rare or unusual species, including Mediterranean-Atlantic species representing biogeographically distinct communities at, or very close to, their northern limit of distribution. In particular, fragile long-lived species such as the soft coral *Parerythropodium coralloides*, sea fan *Eunicella verrucosa* and a variety of erect branching sponges are found in deep, sheltered conditions, particularly on the east coast of the island. All five British species of cup coral are found here, including the scarlet and gold star-coral *Balanophyllia regia*, the brown cup coral *Caryophyllia inornata*, the carpet coral *Hoplangia durotrix* and the sunset cup coral *Leptopsammia pruvoti*.

Papa Stour (228)

This site in Shetland has been selected as an example of very exposed reefs on hard rocks in the extreme north of Scotland. The rocky coastline of Papa Stour is among the most exposed in the UK, and the island and the adjacent mainland are fringed entirely by sublittoral bedrock and boulder reefs reaching depths of more than 30 m. The underwater terrain is rugged, with rock walls, slopes, gullies, ledges, ridges and boulder slopes, which support a diverse range of plant and animal communities. The extensive kelp forests on these reefs have a rich associated algal community at shallow depths because wave action prevents grazing by urchins. Kelp extends to depths of up to 28 m in the clear waters surrounding the island. Communities on circalittoral rock are characteristic of northern parts of the UK, with dominant species including the soft coral *Alcyonium digitatum*, the feather star *Antedon bifida*, encrusting coralline algae and the serpulid worm *Pomatoceros triqueter*. Wave-exposed gullies have rich, surge-tolerant communities, with turfs of the jewel anemone *Corynactis viridis*, ascidians and bryozoans. In the strong tidal streams of the Sound of Papa, boulder reefs and bedrock ridges are dominated by scour-tolerant organisms such as the hydroid *Abietinaria abietina* and the brittlestar *Ophiocomina nigra*.

Pembrokeshire Islands/Ynysoedd Sir Benfro (160)

Reefs in this south-west Wales site are largely composed of igneous rock but include areas of more friable Old Red Sandstone and some limestone. Extensive areas of sublittoral rocky reef stretch offshore from the west Pembrokeshire coast and between the Pembrokeshire islands and many small rocky islets. Reefs also extend through Milford Haven and into the variable salinity conditions of the Daugleddau estuary. Reefs within the site are subject to an exceptional variation in strength of tidal streams and wave exposure. The highly variable rocky seabed topography, together with the indented coastline and extreme tidal range, cause strong tidal streams, particularly around headlands, through sounds or in tidal inlets. The shallower and south-western-facing rocky reefs are exposed to severe wave action, while many others are extremely wave-sheltered. Many of the reefs extend onto the shore and provide examples of both the most exposed and the most sheltered intertidal rock communities in southern Britain. Reef habitat diversity is increased by caves, tunnels and surge gullies in both sublittoral and intertidal areas.

The wide variation in exposure to water movement, the range of rock type, slope, aspect and topography and high water quality, together with local exposure to abrasion from adjacent sediments and reduced salinity in the Daugleddau, are reflected in the wide diversity and species abundance of biological communities. Offshore are particularly extensive areas of tide-swept kelp and species-rich red algal populations and, across the large areas of deeper rock reef, a wide range and abundance of invertebrate animal communities, with hydroid, bryozoan, soft coral and anemone species More sheltered reefs, including those in lowered salinity and higher turbidity, typically support diverse and species-rich sponge- and tunicate-dominated communities.

Pen Llín a'r Sarnau/Lleyn Peninsula and the Sarnau (161)

This site on the coast of north-west Wales encompasses a varied range of reef habitats, including an unusual series of submerged and intertidal glacial moraines. The areas of bedrock, boulders, cobbles, sandy rock, surge gullies and the tideswept area of Bardsey Sound support a diverse array of plant and animal communities. There are distinctive communities on bedrock and boulders, ranging from sites exposed to very strong wave action and/or tidal streams to sites sheltered from strong water movement. For example, reefs on the north coast of the Lleyn are dominated, in different locations, by either the mussels *Musculus discors* and *Mytilus edulis*, or tunicates, or the tube worm *Sabellaria spinulosa*. Ross coral *Pentapora foliacea* has been recorded from these reefs and elsewhere around Bardsey and south west Lleyn. Several Mediterranean-Atlantic species have been recorded from south-east Bardsey.

The Sarnau (Sarn Badrig, Sarn-y-Bwlch and Cynfelyn Patches) are very unusual shallow subtidal reefs, which extend many kilometres into Cardigan Bay from the coast. The Sarnau are glacial moraines (resulting from the

last glaciation) and are composed entirely of boulders, cobbles and pebbles mixed with various grades of sediments. Fast tidal currents and strong wave action have a profound influence on the marine communities present, and the reefs are characterised by a large number of species resistant to scour and sand cover. Algal communities are dominant over much of the reefs, with growths of foliose red and brown algae forming very dense beds in many places, in the absence of shading from kelp. The brown algae *Chorda filum* and *Laminaria saccharina* and red algae flourish on or near the reef crest, while the number of algae species on pebbles increases with depth. In certain areas there are extensive forests of sea oak *Halidrys siliquosa*. Rich animal populations are found in the deeper parts of the reefs, including crustaceans, cnidarians, sponges, hydroids and encrusting bryozoans.

South Wight Maritime (284)

The southern shore of the Isle of Wight, off the coast of southern England, includes a number of subtidal reefs that extend into the intertidal zone. This site was selected on account of its variety of reef types and associated communities, including chalk, limestone and sandstone reefs. To the west and south-west some of the most important subtidal British chalk reefs occur, representing over 5% of Europe's coastal chalk exposures, including the extensive tide-exposed reef off the Needles and examples at Culver Cliff and Freshwater Bay. These support a diverse range of species in both the subtidal and intertidal. Other reef habitats within the site include areas of large boulders off the coast around Ventnor. There is a large reef of harder limestone off Bembridge and Whitecliff Bay, where the horizontal and vertical faces and crevices provide a range of habitats. The bedrock is extensively bored by bivalves. Their presence, together with the holes they create, give shelter to other species, which adds further to habitat diversity. Intertidal pools support a diverse marine life, including a number of rare or unusual seaweeds such as the shepherd's purse seaweed *Gracilaria bursa-pastoris*. A number of other species reach their eastern limit of distribution along the English Channel at the Isle of Wight.

St Kilda (180)

The St Kilda archipelago is selected to represent extremely wave-exposed reefs off the coast of north-west Scotland. The islands are formed of hard, igneous rock, which forms steep and vertical reefs around the entire island group. Littoral reef communities extend several metres above mean high water because of wave exposure, and populations of the uncommon exposed-shore fucoid *Fucus disticus* are present. Rock faces may extend sublittorally to reach depths of 50 m and support communities characteristic of very exposed conditions on rock walls, overhangs and ledges, in surge gullies and amongst boulders. The clarity of the Atlantic sea water is high, and dense kelp forests may occur as deep as 35 m. The sublittoral fringe communities which, elsewhere, are found only at the low-water mark, may here reach depths of 12 m. Circalittoral rock is dominated by diverse communities of anemones, sponges and soft corals, with different species of sponge, hydroid and bryozoan occurring in surge gullies and caves.

Thanet Coast (156)

The Thanet Coast has been selected on account of the unusual communities that are found on this, the longest continuous stretch of coastal chalk in the UK. It represents approximately 20% of the UK resource of this type and 12% of the EC resource. This site contains an example of reefs on soft chalk, along the shore on the extreme south-east of England. Thanet has sublittoral chalk platforms that extend into the littoral and form chalk cliffs. The sublittoral chalk reefs within the site are comparatively impoverished, owing to the harsh environmental conditions in the extreme southern area of the North Sea, but they are an unusual feature because of the scarcity of hard substrata in the area. Infralittoral kelp forests are characteristically absent, owing to the high turbidity of the water. The subtidal chalk platforms extend offshore in a series of steps dissected by gullies. Species present include an unusually rich intertidal algal flora essentially of chalk-boring algal communities, which may extend above the high water mark into the splash zone in wave-exposed areas. Thanet remains the sole known location for some algal species.

2.1.7 Annual vegetation of drift lines (17.2)

2.1.7.1 Background to selection

Approximately a third of the coastline of the UK is fringed by a shingle or sand/shingle beach, but much of this is devoid of vegetation. Many of the fringing beaches with driftline vegetation are small, and annual vegetation may exist in one location in one year but not another. Therefore, although widely spread in terms of total area, sites where the habitat type is persistent are rare. Many sites are naturally species-poor, and the range of ecological variation is very limited.

The sites selected have been chosen to reflect the more constant occurrence of the vegetation in association with larger, more stable areas of stony banks. These sites represent the majority of the more persistent examples of this habitat type in the UK. The sites selected all exhibit good conservation of structure and function (i.e. they are relatively unmodified and are less prone to human disturbance) and represent variations of the habitat type in terms of substrate type.

This habitat type occurs on deposits of shingle lying at or above mean high water spring tides. Varying amounts of sand are interspersed in the shingle matrix and the type described here generally lies at the lower end of the size range of shingle (2-200 mm diameter). These deposits occur as fringing beaches that are subject to periodic displacement or overtopping by high tides and storms. The vegetation is therefore ephemeral and composed of annual or short-lived perennial species and is very distinctive. A number of recognisable NVC communities occur, but the vegetation is not always easy to classify because it is highly variable between sites and from year to year at the same site. Driftlines on essentially sandy beaches are assessed within the sequence of sand dune communities or machair, and are not included here.

Mobility is an over-riding consideration, and colonising species are able to withstand periodic disturbance, which may involve the total removal of the surface. Species are also tolerant of saltwater inundation, as the beaches are often over-topped by the tide or subject to spray from waves breaking over the beach. Level, gently sloping, high-level mobile beaches, with little or no human disturbance, support the best examples of this vegetation.

2.1.7.2 Site list

Chesil and the Fleet (234)

This site has a large, relatively undisturbed beach and has been selected as one of two representatives of this habitat type on the south coast of England. The inner shore of the beach supports extensive driftline vegetation dominated by sea beet *Beta vulgaris* subsp. *maritima* and orache *Atriplex* spp. This community exists in a dynamic equilibrium with the perennial shrubby sea-blite *Suaeda vera* community typical of **Mediterranean and thermo-Atlantic halophilous scrubs (*Arthrocnemetalia fructicosae*)**, for which this site has also been selected.

Dungeness (150)

The Dungeness foreland has a very extensive and well developed shoreline, although with sparse vegetation and in places some human disturbance. It has been selected as one of two representatives of this habitat type on the south coast of England. The strandline community on this site comprises Babington's orache *Atriplex glabriuscula*, which occurs mostly on the accreting eastern shoreline, although it is also present on the eroding southern shoreline.

Minsmere to Walberswick Heaths and Marshes (73)

This site has been selected as one of two representatives of the habitat type on the east coast of England. It occurs on a well-developed beach strandline of mixed sand and shingle and is the best and most extensive example of this restricted geographical type. Species include those typical of sandy shores, such as sea sandwort *Honckenya peploides* and shingle plants such as the sea beet *Beta vulgaris* subsp. *maritima.*

Orfordness - Shingle Street (193)

Orfordness is an extensive shingle spit some 15 km in length and is one of two sites selected to represent the habitat type on the east coast of England. In contrast with the other site, driftline vegetation occurs on the sheltered, western side of the spit, at the transition from shingle to saltmarsh. The driftline community is widespread on the site and comprises sea beet *Beta vulgaris* subsp. *maritima* and orache *Atriplex* spp. in a strip 2-5 m wide.

2.1.8 Perennial vegetation of stony banks (17.3)

2.1.8.1 Background to selection

Vegetated stony banks are scarce. There are only a few large sites in Europe, and the UK hosts a significant part of the European resource of this habitat. Although there are only some 4,000 ha of stable or semi-stable vegetated shingle around the whole of the coast of the UK, the habitat is widely distributed and also exhibits a wide range of variation. The largest and most significant shingle structures are found in north-east Scotland and in south and south-east England. The selection of sites reflects the UK's special responsibility for conservation of this habitat type and aims to cover the geographical range and variation of the habitat type. All the largest examples with good conservation of structure and function have been selected, together with additional smaller sites to complete the coverage of range. These sites represent a substantial proportion of the European resource.

Perennial vegetation of stony banks (shingle structures) develops when a sequence of foreshore beaches are deposited at the limit of high tide. More permanent ridges are formed as storm waves throw pebbles high up on the beach, from where the backwash cannot remove them. Several beaches may be piled against each other and extensive structures can form. The ecological variation in this habitat type depends on stability, the amount of fine material accumulating between pebbles, climatic conditions, width of the foreshore and past management of the site.

Narrow, less stable structures (spits and bars or the fringing beach associated with older, fossil beaches) are more exposed to waves or salt spray. Where wave energy causes movement of the shingle, the plant communities have affinities with the annual vegetation of driftlines. The presence of the yellow horned-poppy *Glaucium flavum* and the rare sea-kale *Crambe maritima* and sea pea *Lathyrus japonicus,* all species that can tolerate periodic movement, is significant. In more stable areas above this zone, where sea spray is blown over the shingle, plant communities with a high frequency of salt-tolerant species such as thrift *Armeria maritima* and sea campion *Silene uniflora* occur. These may exist in a matrix with abundant lichens.

On the largest and most stable structures the sequence of vegetation includes scrub, notably broom *Cytisus scoparius* and blackthorn *Prunus spinosa*. Heath vegetation with heather *Calluna vulgaris* and/or crowberry *Empetrum nigrum* occurs on the more stable shingle structures, particularly in the north. This sequence of plant communities is also influenced by natural cycles of degeneration and regeneration of the shrub vegetation that occurs on some of the oldest ridges. Site selection has favoured these more complete vegetation sequences.

2.1.8.2 Site list

Chesil and the Fleet (234)

The 28 km shingle bar of Chesil Bank, with the contiguous Portland Harbour shore, is an extensive representative of this habitat type on the south coast of England, and most of it is relatively undisturbed by human activities. Much of the shingle bar is subject to wash-over and percolation in storm conditions and is therefore sparsely vegetated. It supports the most extensive occurrences of the rare sea-kale *Crambe maritima* and sea pea *Lathyrus japonicus* in the UK, together with other grassland and lichen-rich shingle plant communities typical of more stable conditions, especially towards the eastern end of the site.

Culbin Bar (266)

Historically, this site in north-east Scotland formed part of the same shingle aggregation as Lower River Spey/Spey Bay to the east. Although sea-level rise has separated the sites, they are still linked, being maintained by the same coastal processes. Culbin Bar and the Lower River Spey/Spey Bay are, individually, the two largest shingle sites in Scotland and together form a shingle complex unique in Scotland. They represent this habitat type in the northern part of its range in UK. Culbin Bar is 7 km long. It has a series of shingle ridges running parallel to the coast that support the best and richest examples of northern heath on shingle. Dominant species are heather *Calluna vulgaris*, crowberry *Empetrum nigrum* and juniper *Juniperus communis*. The natural westward movement of the bar deposits new ridges for colonisation. Being virtually unaffected by damaging human activities, Culbin Bar is an example of a system with natural structure and function.

Dungeness (150)

Dungeness is the UK's largest shingle structure and represents the habitat type on the south-east coast of England. The total area of exposed shingle covers some 1,600 ha, though the extent of the buried shingle ridges is much greater. Despite considerable disturbance and destruction of the surface shingle, the site retains very large areas of intact parallel ridges with characteristic zonation of vegetation. It still has the most diverse and most extensive examples of stable vegetated shingle in Europe, including the best representation of scrub on shingle, notably prostrate forms of broom *Cytisus scoparius* and blackthorn *Prunus spinosa*. A feature of the site, thought to be unique in the UK, is the small depressions formed within the shingle structure, which support fen and open-water communities.

Lower River Spey/Spey Bay (291)

Historically, this site in north-east Scotland formed part of the same shingle aggregation as Culbin Bar to the west. Although sea-level rise has separated the sites, they are still linked, being maintained by the same coastal processes. Lower River Spey/Spey Bay and Culbin Bar are, individually, the two largest shingle sites in Scotland and together form a shingle complex unique in Scotland. They represent this habitat type in the northern part of its range in the UK. Lower River Spey/Spey Bay contains significant areas of both bare and naturally vegetated parallel shingle ridges, although these occur within a matrix of planted trees. The most significant feature of the site is the complex of wet and dry vegetation types, depending on the physical relief of the shingle ridges and hollows. Species-rich dry heath occurs on the ridges, while in the wetter hollows there is species-rich wet heath and transitions to a vegetation type comparable to that of dune slacks. Transitions to scrub also occur.

Morecambe Bay (137)

This site represents the habitat type in the north-west of England. Walney Island on the shores of Morecambe Bay is a barrier island fringed by shingle with a partial sand covering. Two areas of exposed vegetated shingle occur at the extremes of the barrier. The southern area has been highly modified by eutrophication from a large gull colony, resulting in communities that are unusually species-rich for pioneer shingle vegetation. Perennial rye-grass *Lolium perenne*, common chickweed *Stellaria media* and biting stonecrop *Sedum acre* are constant elements, with dove's-foot crane's-bill *Geranium molle* an unusual and important feature.

North Norfolk Coast and Gibraltar Point Dunes (276)

This habitat type occurs at Blakeney Point on the North Norfolk Coast, a shingle spit on the east coast of England with a series of recurves partly covered by sand dunes. This extensive site has a typical sequence of shingle vegetation, which includes open communities of pioneer species on the exposed ridge and more continuous grassland communities on the more sheltered shingle recurves. It also includes some of the best examples of transitions between shingle and saltmarsh, with characteristic but rare species more typical of the Mediterranean. These include one of the best examples of the transition from sand and shingle to the community dominated by shrubby sea-blite *Suaeda vera*. Blakeney Point is part of a multiple interest site. The shingle structure forms a highly significant component of the geomorphological structure of the North Norfolk Coast and helps to maintain a series of interrelated habitats.

Orfordness - Shingle Street (193)

Orfordness is an extensive shingle structure on the east coast of England and consists of a foreland, a 15 km long spit and a series of recurves running from north to south on the Suffolk coast. This spit has been selected as it supports some of the largest and most natural sequences in the UK of shingle vegetation affected by salt spray. The southern end of the spit has a particularly fine series of undisturbed ridges, with zonation of communities determined by the ridge pattern. Pioneer communities with sea pea *Lathyrus japonicus* and false oat-grass *Arrhenatherum elatius* grassland occur. Locally these are nutrient-enriched by the presence of a gull colony; elsewhere they support rich lichen communities. The northern part of Orfordness has suffered considerable damage from defence-related activities but it is planned to restore the shingle surface vegetation.

2.1.9 Vegetated sea cliffs of the Atlantic and Baltic coasts (18.21)

2.1.9.1 Background to selection

The UK supports a significant proportion of EC sea cliff vegetation. In particular, the coast of England holds a major proportion of the European coastal chalk exposures (113 km, compared with 85 km in France and shorter lengths in the Baltic), and this is reflected in site selection. The sites chosen are all extensive and have an exceptionally well-developed zonation of vegetation. They reflect the very wide ecological variation of the habitat type. The series includes rock types that range from soft shales, mudstones, limestones and chalk through to acid igneous formations. In addition, both sheltered east-facing sites and exposed west-facing sites are included. There is considerable geographical variation. Southern types are rich in Atlantic-Mediterranean species, while northern sites support boreal species such as the endemic Scottish primrose *Primula scotica*.

Vegetated sea cliffs occur discontinuously along the west-facing coasts of Europe. On more sheltered coasts they are more local and show less expression of maritime features. Exposure to the sea is a key determinant of the type of vegetation. In the UK this exposure is greatest on the south-west and northern coasts. The long fetch associated with these coasts generates high waves and swell and the prevailing winds help deliver salt spray to the cliff face and cliff tops. The most exposed areas support maritime vegetation dominated by a range of salt-tolerant plants.

Cliff structure and geomorphological processes are major influences on cliff vegetation. 'Hard' cliffs with vertical or very steep faces are characteristic of hard igneous and sedimentary rocks and also of chalk, which, although a soft rock, nevertheless forms vertical cliffs. 'Soft' cliffs have a sloping or slumped profile, often with a distinct 'undercliff'; they occur on a range of soft rocks, or on hard rocks interspersed with softer deposits. The more mobile soft cliffs occur where there are unstable soft deposits such as mudstones or glacial drift deposits. They may be subject to mudslides or landslips, which create complexes of pioneer and more mature vegetation of conservation importance.

The profile and stability of the cliff face is one of the major determinants of cliff vegetation. Even near-vertical cliffs support specialist crevice communities, with rock samphire *Crithmum maritimum*, while ledges occupied by breeding seabirds may develop specialist nitrophilous communities. On less extreme slopes, species tolerant of exposure to wind and salt spray and of thin soils can find a foothold. The most characteristic maritime cliff communities occur in such situations. On relatively stable soft cliffs a wide range of progressively less specialised communities can occur, including grassland, heath, scrub and even woodland. The more mobile soft cliffs show a complex sequence of successional communities related to degrees of instability and the age of the slope. The vegetation of these sites forms a mosaic of pioneer, ruderal, grassland, scrub and woodland communities. Streams and flushes provide a fresh water wetland element, and seepage lines may be rich in orchids.

The second major influence on maritime cliff vegetation is the nature of the underlying rock or drift deposit, notably whether it is basic or acidic. In the most exposed situations this effect is masked by the saline influence of sea spray, but more sheltered cliffs support communities closely related to those found on similar substrates inland, with only a minor maritime element in the flora. Thus, chalk and limestone cliffs support calcareous grassland communities, while acidic hard rocks support heath communities. Base-rich hard rocks, such as the limestones of the south coast or the basic igneous rocks of the Lizard, support particularly rich assemblages of rare plants and plant communities.

The maritime influence on cliff communities is shown in both vertical and lateral zonation. The effects of sea spray are greatest close to the water and least at the cliff top, especially where a sloping profile sets this back from the shoreline. Superimposed on this pattern is the effect of local topography. The most maritime sites are those facing the prevailing winds or the longest 'fetch' of open sea, notably headlands projecting from the coastline and gullies or blowholes which funnel salt water up the cliff. On the sheltered side of headlands and in bays the maritime influence is progressively diminished and is replaced by a mild, humid climate in which plant species normally restricted to woodland are found in open situations. The site series includes the full range of variation arising from the variability of cliff structure, geology and levels of maritime exposure.

In the UK, the exposed western and northern coasts have extensive cliffs composed of hard, mostly acidic, rocks. The sheltered south coast of England supports hard cliffs of chalk, limestones and sandstone and, more locally,

mobile cliffs subject to landslips. The east coast has fewer cliffs, often formed in glacial drift deposits. The sites selected cover this geographical pattern of variation.

2.1.9.2 Site list

The list of sites for this habitat type is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

Flamborough Head (140)

This site is chosen as an east coast representative of hard chalk cliffs, which more frequently occur on the south coast of England. The vegetation of east coast cliff sites is typically less influenced by salt deposition and there are few such areas with predominantly limestone vegetation. Flamborough Head is an exception and is therefore important for the conservation of calcareous cliff vegetation. Maritime vegetation is local and occurs where topography increases salt spray deposition. Elsewhere the chalk substrate supports calcareous grassland communities. Towards the eastern end of the site the chalk is masked by drift deposits, which support mesotrophic and acidic grassland communities.

Glannau Ynys Gybi/Holy Island Coast (147)

This site off the north-west coast of Wales has hard rock acidic cliffs and supports important examples of coastal cliff heathland vegetation. In addition to maritime heath with several rare species such as the spotted rock-rose *Tuberaria guttata*, there are extensive maritime cliff-crevice and grassland communities. The maritime influence is not as extreme as in north Scotland, and this site represents an important part of the range of variation on the mid-west coast of the UK.

Isle of Portland to Studland Cliffs (283)
Sidmouth to West Bay (286)
St Albans Head to Durlston Head (285)

These sites comprise a large complex which provides representation of both hard calcareous and soft cliffs on the south coast of England.

Sidmouth to West Bay is separated from the other two sites by Chesil and the Fleet, which does not have a cliffed coastline. Sidmouth to West Bay is an example of a highly unstable soft cliff coastline subject to mudslides and landslips. The principal rock types are soft mudstones, clays and silty limestones, with a small chalk outlier in the west. The central part comprises the extensive Axmouth to Lyme Regis landslip, where chalk overlies the unstable rocks mentioned, resulting in slips ranging from frequent minor events to occasional mass movement events when entire blocks of the chalk scarp move seawards. The eastern part has no chalk capping and is subject to frequent mudslides in the waterlogged soft limestones and clays. Vegetation is very varied and includes pioneer communities on recent slips, calcareous grassland and scrub on detached chalk blocks and extensive natural woodland dominated by ash *Fraxinus excelsior* or sycamore *Acer pseudoplatanus.*

Isle of Portland to Studland Cliffs and St Albans Head to Durlston Head form a single unit of cliffed coastline some 40 km in length, together with the detached peninsula of Portland. The cliffs are formed of hard limestones, with chalk at the eastern end, interspersed with slumped sections of soft cliff of sand and clays. The cliffs support species-rich calcareous grassland with species that are rare in the UK, such as wild cabbage *Brassica oleracea* var. *oleracea*, early spider-orchid *Ophrys sphegodes* and Nottingham catchfly *Silene nutans*. The Portland peninsula, extending 8 km south of the mainland, demonstrates very clearly the contrast between the exposed western and southern coasts, with sheer rock faces and sparse maritime vegetation, and the sheltered eastern side, with sloping cliffs supporting scrub communities, where wood spurge *Euphorbia amygdaloides* grows in grassland.

Limestone Seacliffs of S.W. Wales/Clogwyni Calchfaen De-Orllewin Cymru (197)

These extensive cliffs of south-west Wales provide representation of hard calcareous cliffs in the south-west of the UK. The nature of the rock and the warm south-facing slopes have resulted in the occurrence of a sequence of important species-rich plant communities. At the base of the cliff, on rock platforms, characteristic maritime communities with thrift *Armeria maritima*, rock samphire *Crithmum maritimum* and buck's-horn plantain

Plantago coronopus occur. These grade into calcareous grasslands and heathlands, which support a rich assortment of rare species. These include the yellow whitlowgrass *Draba aizoides*, a Mediterranean species restricted in the UK to south Wales, where it grows with more characteristic coastal species such as spring squill *Scilla verna*. Other rarities include small restharrow *Ononis reclinata*, early gentian *Gentianella anglica*, goldilocks aster *Aster linosyris* and an endemic sea-lavender *Limonium parvum*. Important lichen communities occur, with good populations of *Fulgensia fulgens.*

South Wight Maritime (284)

This site provides representation of contrasting Cretaceous calcareous hard cliffs, semi-stable soft cliffs and mobile soft cliffs on the south coast of England. The western and eastern extremities of the site consist of high chalk cliffs with species-rich calcareous grassland vegetation, the former exposed and the latter comparatively sheltered. The most exposed chalk cliff tops support important assemblages of nationally rare lichens, including *Fulgensia fulgens*. The longest section is composed of slumping acidic sandstones and neutral clays with an exposed south-westerly aspect. The vegetation communities are a mixture of acidic and mesotrophic grasslands with some scrub and a greater element of maritime species, such as thrift *Armeria maritima,* than is usual on soft cliffs. This section supports the Glanville fritillary butterfly *Melitaea cinxia* at its only English location. St. Catherine's Point demonstrates a particularly well developed undercliff, where the inner cliff supports rare plant species such as field cow-wheat *Melampyrum arvense*. A small, detached section of the site on clays has a range of successional stages, including woodland, influenced by landslips. These cliffs are minimally affected by sea defence works, which elsewhere disrupt ecological processes linked to coastal erosion, and together they form one of the longest lengths of naturally-developing soft cliffs on the UK coastline.

St David's/Ty Ddewi (146)

This south Wales site is selected as a representative of hard acidic cliffs on the west coast of the UK. It is chosen as providing the most extensive examples of the typical west coast transition on acidic rocks from maritime crevice vegetation through maritime grassland into maritime heathland with heather *Calluna vulgaris* and western gorse *Ulex gallii.* Out of reach of both salt spray and grazing animals, heavily wind-pruned wild privet *Ligustrum vulgare* and blackthorn *Prunus spinosa* scrub have developed. This site is also important for a number of rare and local species, such as hairy greenweed *Genista pilosa* and an endemic sea-lavender *Limonium paradescum*. There are good populations of the lichen *Teloschistes flavians.*

St Kilda (180)

St Kilda, an island group off the west coast of Scotland, has been selected to represent hard acidic cliff habitat with extreme levels of maritime exposure. The sea cliffs of the St Kilda archipelago are the highest in the UK, reaching 426 m. Virtually the whole of each island is influenced by salt spray and the plant communities are dominated by maritime vegetation typical of Scotland. Roseroot *Sedum rosea* and Scots lovage *Ligusticum scoticum* are present on many of the vertical salt spray-drenched cliffs, with sea campion *Silene uniflora* and thrift *Armeria maritima* present in abundance. Diversity is increased by the presence of arctic-alpine plants, such as purple saxifrage *Saxifraga oppositifolia* and moss campion *Silene acaulis*. High humidity is reflected in widespread distribution of plants such as the liverwort *Frullania teneriffae.* St Kilda has some of the most extensive and best examples of this extreme form of Atlantic maritime vegetation anywhere in Europe.

Stromness Heaths and Coast (169)

This cliff site on the north Atlantic coast of Orkney is selected as an example of extremely exposed cliffs in the north of Scotland. The combination of high, hard acidic rock cliffs and exposure to wind and salt spray results in one of the largest examples of maritime cliff in Scotland, associated with well developed cliff top transitions. Grazed cliff top maritime grassland supports red fescue *Festuca rubra*, thrift *Armeria maritima*, spring squill *Scilla verna* and sea plantain *Plantago maritima*. Further inland there are transitions to maritime heath rich in species. Rarities such as Scottish primrose *Primula scotica* occur, with an unusual maritime form of crowberry *Empetrum nigrum*-rich heath present on deep, free-draining mineral soils and cross-leaved heath *Erica tetralix* on wetter soils.

The Lizard (70)

The Lizard, at the extreme south-west tip of England, has been selected for its unusual representation of base-rich igneous and acid metamorphic cliffs. The combination of its complex geology and a southern location has

resulted in the diverse nature of the plants and plant communities found here, many of which are particularly species-rich and some of which are rare in the UK. The site includes a typical sequence of cliff vegetation, with a variety of truly maritime plants, which grades into grazed and ungrazed communities on exposed cliffs with dense red fescue *Festuca rubra* and wild asparagus *Asparagus officinalis* subsp. *prostratus*. There are also transitions to heathland, normally dominated by heather *Calluna vulgaris* and bell heather *Erica cinerea*, though in addition the Lizard has extensive heath rich in the rare Cornish heath *Erica vagans*. The Lizard is one of the richest botanical areas in the UK and is of considerable value at the EC level, owing to its unusual ecology and outlying representatives of rare species.

Tintagel - Marsland - Clovelly Coast (148)

This site represents an extensive length of largely hard coastal cliff in south-west England, with a range of maritime influences and vegetation developed on hard neutral to acidic sedimentary rocks. It demonstrates a range of vertical or near-vertical cliffs with intervening slumped sections. The greater part of this very long site, totalling approximately 60 km, is west-facing, fully exposed to Atlantic storms and therefore strongly maritime in character. The section east of Hartland Point faces north and north-east and is relatively sheltered. Inland of the crevice and grassland communities, maritime heath and short coastal grassland with wild thyme *Thymus polytrichus* and spring squill *Scilla verna* are particularly significant, and locally these show transitions to scrub and woodland in the adjacent valleys. This includes an unusual wind-pruned cliff woodland, The Dizzard, with an exceptionally rich lichen flora.

2.1.10 *Salicornia* and other annuals colonising mud and sand (15.11)

2.1.10.1 Background to selection

This vegetation occurs in a large number of saltmarshes in the UK. There are over 2,300 ha of this vegetation in the UK, and it is widespread in the saltmarshes of England and Wales. However the area of the habitat type is restricted in Scotland and Northern Ireland because of a lack of new sediment for saltmarsh development. Sites have been chosen to cover the geographical range of the habitat type. Generally, the largest areas of the habitat type have been selected, and since it occurs as an integral part of a sequence of habitats, from sand/mudflats to more stable saltmarsh vegetation, preference has been given to sites where it forms part of well-developed successional sequences.

This pioneer saltmarsh vegetation colonises intertidal mud and sandflats in areas protected from strong wave action and is an important precursor to the development of more stable vegetation. It develops at the lower reaches of saltmarshes where the vegetation is frequently flooded by the tide, and can also colonise open creek sides, depressions or pans within saltmarsh, as well as disturbed areas of upper saltmarshes. There is little variation in this habitat type. The vegetation comprises a very small number of species and is dominated by open stands of glasswort *Salicornia* spp. (SM8) or annual sea-blite *Suaeda maritima* (NVC SM9). The density of these plants can vary and may be lower on sites with sandier substrates. Other species that may be found within this vegetation include common saltmarsh-grass *Puccinellia maritima*, common cord-grass *Spartina anglica* and sea aster *Aster tripolium.* Only common saltmarsh-grass is found in any quantity as far north as Scotland. A further form of this vegetation consists of ephemeral vegetation colonising open pans in upper saltmarshes. Characteristic plants of this vegetation type are sea pearlwort *Sagina maritima* and knotted pearlwort *S. nodosa* (SM27).

2.1.10.2 Site list

Burry Inlet: Saltmarsh and Estuary/Cilfach Burry: Cors heli ac Aber (293)

This site in south Wales is selected as representative of the habitat type in the south-west of the UK. It forms an integral part of the estuarine system, supporting extensive pioneer communities and contributing to a complete sequence of saltmarsh vegetation, including transitions to upper saltmeadow and to important sand dune habitats.

Dornoch Firth and Morrich More (265)

This is the most extensive area of pioneer glasswort *Salicornia* spp. marsh in Scotland. It has been selected as the most northerly site in the series and represents the habitat type in the northern part of its range in the UK. It forms part of a complete transition from pioneer to upper saltmeadow and important sand dune habitats.

Essex Estuaries (178)

Salicornia in the Essex estuaries on the east coast of England forms an integral part of the transition from the extensive and varied intertidal mud and sandflats through to upper saltmeadows. Although the saltmarshes in this area are generally eroding, secondary pioneer communities appear as a precursor to erosion on the seaward edge of degraded mid-marsh communities. The area of pioneer marsh includes gradation into extensive cord-grass *Spartina* spp. swards.

Glannau M^n: Cors heli/Anglesey Coast: Saltmarsh (295)

This is part of a complex of saltmarsh and dune habitats lying either side of the dune systems at Newborough Warren, north Wales. It is therefore important in terms of the structural integrity of the site, which has been selected for a range of sand dune habitat types.

Morecambe Bay (137)

Two types of pioneer saltmarsh are represented on this site on the west coast of England. *Salicornia* marsh occurs intermittently along the coastline of the bay, forming a transition from the extensive intertidal sand and mudflats to the distinctive saltmeadows at this site. The sea pearlwort *Sagina maritima* community occurs in open pans on the upper marsh.

Solway Firth (136)

The pioneer saltmarsh on this site is part of a complete sequence of saltmarsh types, from pioneer communities through extensive mid-to high saltmarsh and transitions to tidal grazing marsh. It has been selected to represent the habitat type in north-west England and south-west Scotland. The pioneer marshes in this site develop in response to changing river channels and erosion of existing marsh and form part of a dynamic suite of maritime habitat types for which the site has been separately selected.

The Wash and North Norfolk Coast (233)

The largest single area of this vegetation in the UK occurs at this site on the east coast of England, which is one of the few areas in the UK where saltmarshes are generally accreting. The proportion of the total saltmarsh vegetation represented by this type is high because of the extensive enclosure of marsh in this site. The vegetation is also unusual in that it forms a pioneer community with common cord-grass *Spartina anglica* in which it is an equal component. The inter-relationship with other habitats is significant, forming a transition to important dune, saltmeadow and halophytic scrub communities.

2.1.11 *Spartina* swards (*Spartinion*) (15.12)

2.1.11.1 Background to selection

Only areas of small cord-grass *Spartina maritima* and smooth cord-grass *S. alterniflora* are considered for site selection (DGXI 1996a). The distribution of the species is limited by climatic factors and neither of these two species occurs outside south-east England. There are only two sites in the UK where either species occurs in any quantity, and both sites have been selected.

Cord-grass *Spartina* spp. colonises a wide range of substrates, from very soft muds to shingle, in areas sheltered from strong wave action. It occurs on the seaward fringes of saltmarshes and creeksides and may colonise old pans in the upper saltmarsh. There are four species of cord-grass in the UK: small cord-grass *Spartina maritima*, smooth cord-grass *S. alterniflora*, Townsend's cord-grass *S.* x *townsendii* and common cord-grass *S. anglica*. Small cord-grass is the only native species. Smooth cord-grass is a naturalised alien that was accidentally introduced to the UK in the 1820s via ships' ballast from the eastern USA, where it is a major component of saltmarshes. The introduction of smooth cord-grass and its subsequent crossing with small cord-grass resulted in both the sterile hybrid Townsend's cord-grass and later a fertile hybrid, common cord-grass.

Common cord-grass has been extensively planted as an aid to stabilisation of coastlines and a stimulus to enclosure and land-claim. It also readily colonises open mudflats and consequently has spread rapidly around the coast. Monoculture swards of either common or Townsend's cord-grass are of little intrinsic value to wildlife, and in many areas common cord-grass is considered a threat to the feeding grounds used by large populations of waders and wildfowl. As a result attempts have been made to control common cord-grass at several sites over many years, and it is generally considered to be a negative conservation feature of the sites where it occurs.

2.1.11.2 Site list

Essex Estuaries (178)

This site contains the most extensive stand of small cord-grass *Spartina maritima* remaining in the UK.

Solent Maritime (206)

This is the only site for smooth cord-grass *Spartina alterniflora* in the UK and is one of only two sites where significant amounts of small cord-grass *S. maritima* are found. It is also one of the few remaining sites for Townsend's cord-grass *S.* x *townsendii* and holds extensive areas of common cord-grass *Spartina anglica*, all four species thus occurring here in close proximity. It has additional historical interest as the site where smooth cord-grass was first recorded in the UK (1829) and where Townsend's cord-grass and, later, common cord-grass first occurred.

2.1.12 Atlantic salt meadows (*Glauco-Puccinellietalia*) (15.13)

2.1.12.1 Background to selection

Atlantic salt meadows (*Glauco-Puccinellietalia*) occur on North Sea, English Channel and Atlantic shores. There are more than 29,000 ha of the habitat type in the UK, mostly in the large, sheltered estuaries of the south-east, south-west and north-west of England and in south Wales. These large sites provide the best examples of zonation. Smaller areas of saltmarsh with more limited zonation are found in Scotland. Sites have been selected to cover the geographical range and ecological variation of this habitat type in the UK. The sites chosen are for the most part the largest examples of this habitat type, which support a well developed zonation of plant communities. There are transitions to other high quality habitat assemblages at many of the sites that have been selected.

Historically, large areas of saltmarsh, especially the upper zones, have been lost by enclosure, usually involving the erection of a sea bank to exclude sea water. Sites with complete sequences of vegetation and transitions to other habitats, such as sand dunes, represent the range of variation of the habitat type. This has been an important consideration in the site selection process.

Atlantic salt meadows develop when halophytic vegetation colonises soft intertidal sediments of mud and sand in areas protected from strong wave action. This vegetation forms the middle and upper reaches of saltmarshes, where tidal inundation still occurs but with decreasing frequency and duration. A wide range of community types is represented and the saltmarshes can cover large areas, especially where there has been little or no enclosure on the landward side. The vegetation varies with climate and the frequency and duration of tidal inundation. Grazing by domestic stock is particularly significant in determining the structure and species composition of the habitat type and in determining its relative value for plants, for invertebrates and for wintering or breeding waterfowl. The upper saltmarsh is regarded as particularly important and there is considerable variation in different parts of the UK. The upper saltmarsh has transitions to a number of habitats, including sand dune, coastal shingle, freshwater marshes and woodland. This part of the saltmarsh succession has been particularly vulnerable to destruction by enclosure, and remaining areas are particularly valuable.

At the lower reaches of the saltmarsh the vegetation is often species-poor and may form an open sward of common saltmarsh-grass *Puccinellia maritima*. Further up the marsh, the vegetation becomes herb-dominated and red fescue *Festuca rubra* becomes more important. The upper saltmarsh shows considerable variation, particularly where there are transitions to other habitats. Communities present may include tussocks of sea rush *Juncus maritimus* dominating a herb-rich vegetation, saltpans supporting patches of species-poor vegetation dominated by saltmarsh flat-sedge *Blysmus rufus* (in the north) or slender spike-rush *Eleocharis uniglumis*.

There are marked regional variations in the **Atlantic salt meadow** communities of the UK. In east and south-east England low to mid-marsh communities predominate, owing to extensive reclamation of the upper marsh. In contrast, the salt meadows of north-west England and south-west Scotland are dominated by extensive areas of grazed upper marsh communities characterised by common saltmarsh-grass and saltmarsh rush *Juncus gerardii*. In the upper marsh, swamp communities are particularly common in south-west England, with sea rush communities in Wales and transitional common reed *Phragmites australis* communities common in south-east Scotland. Some characteristic plant species of southern saltmarshes, such as sea-purslane *Atriplex portulacoides*, are absent from Scotland. These regional variations are reflected in the selection of sites.

2.1.12.2 Site list

Burry Inlet: Saltmarsh and Estuary/Cilfach Burry: Cors heli ac Aber (293)

This extensive site in south Wales has a complete sequence of saltmarsh vegetation, from pioneer vegetation through to upper saltmarsh transitions. The grazed saltmarshes include upper margins with sea rush *Juncus maritimus* and marsh-mallow *Althaea officinalis*, which are a particularly distinctive ecological feature of this site. The area is also important for transitions from saltmarsh to sand dune and other habitats.

Dornoch Firth and Morrich More (265)

This site is the most northerly site selected for this habitat type and represents Atlantic salt meadows in the northern part of their UK range. The site supports a wide variety of community types, with the characteristic

zonation from pioneer to upper marsh vegetation. At Morrich More the saltmarshes lie adjacent to shingle/sand dune and there are important transitions between these habitats.

Essex Estuaries (178)

Although the saltmarshes in this area are generally eroding, extensive salt meadows exist and provide representation of this habitat type in south-east England, with floristic features typical of this part of the UK. Golden samphire *Inula crithmoides* is a characteristic species of these marshes, occurring both on the lower marsh and on the driftline. It represents a community of south-east England also found to the south on the continent.

Fal and Helford (158)

This site is chosen to provide an example of saltmarsh vegetation in a ria (drowned river valley). Examples of saltmarsh vegetation in rias are restricted to south-west England and west Wales. There is a narrow saltmarsh zonation typical of rias, from pioneer to upper marsh, and transitions to woodland where the fringing trees overhang the tidal river, an unusual juxtaposition of vegetation in the UK.

Morecambe Bay (137)

This site is chosen as being characteristic of saltmarshes in north-west England, demonstrating large areas of closely grazed upper marsh. The mid-upper marsh vegetation is strongly dominated by the saltmarsh-grass/fescue *Puccinellia/Festuca* communities, of which over 1,000 ha occur here, and by smaller areas of saltmarsh rush *Juncus gerardii* community. The sea rush *Juncus maritimus* community is also more strongly represented here than elsewhere in England. The plant species include both southern elements, such as lesser centaury *Centaurium pulchellum*, and northern elements, such as saltmarsh flat-sedge *Blysmus rufus* and few-flowered spike-rush *Eleocharis quinqueflora*.

Severn Estuary/M^r Hafren (138)

This site holds the largest aggregation of the habitat type in the south and south-west of the UK. The extreme tidal range has resulted in saltmarshes that are both accreting and eroding (though erosion predominates). There is a wide salinity gradient, which has led to a range of transitional habitats including transitions to freshwater inundated grasslands and freshwater marshes, with communities varying according to the frequency of tidal inundation. The grazed saltmarsh is dominated by common saltmarsh-grass *Puccinellia maritima* and red fescue *Festuca rubra*. The presence of the reflexed saltmarsh-grass *Puccinellia distans* community in the upper estuary is an important feature of the site. The presence of terraces superimposed on the original post-glacial surface, representing three saltmarsh formation events occurring over the past 300 years, is an additional feature of interest.

Solent Maritime (206)

This is the second largest aggregation of salt meadows in south and south-west England. It is a composite site composed of a large number of separate areas of saltmarsh. In contrast to the Severn Estuary, the salt meadows at this site are notable as being representative of the ungrazed type and support a different range of communities dominated by sea-purslane *Atriplex portulacoides*, common sea-lavender *Limonium vulgare* and thrift *Armeria maritima.* As a whole the site is less truncated by man-made features than other parts of the south coast and shows rare and unusual transitions to freshwater reedswamp and alluvial woodland as well as coastal grassland. Typical **Atlantic salt meadow** is still widespread in this site, despite a long history of colonisation by cord-grass *Spartina* spp.

Solway Firth (136)

This site extends between north-west England and south-west Scotland. It has been little affected by enclosures, with the result that it demonstrates unusually large areas of upper marsh and transitions to freshwater grassland communities. There is a greater proportion of sand in the substrate than is found in more southern saltmarshes. The mid-upper marsh is heavily dominated by the saltmarsh rush *Juncus gerardii* community with smaller areas of the saltmarsh-grass/fescue *Puccinellia/Festuca* communities. The site has been selected because of its large size and uninterrupted transitions. Some of the species present, for example sea-purslane *Atriplex portulacoides*,

common sea-lavender *Limonium vulgare* and lax-flowered sea-lavender *L. humile*, are at their northern limit in the UK.

The Wash and North Norfolk Coast (233)

This site on the east coast of England is selected both for the extensive ungrazed saltmarshes of the North Norfolk Coast and for the contrasting, traditionally grazed saltmarshes around the Wash. The Wash saltmarshes represent the largest single area of the habitat type in the UK. The **Atlantic salt meadows** form part of a sequence of vegetation types that are unparalleled among coastal sites in the UK for their diversity and are amongst the most important in Europe. Saltmarsh swards dominated by sea-lavenders *Limonium* spp. are particularly well represented on this site. In addition to typical lower and middle saltmarsh communities, in North Norfolk there are transitions from upper marsh to freshwater reedswamp, sand dunes, shingle beaches and mud/sandflats.

2.1.13 *Continental salt meadows (*Puccinellietalia distantis*)** (15.14)

2.1.13.1 Background to selection

This is a rare habitat type in the EC, having declined dramatically in the past 50 years in all areas where it occurs. The destruction of much of the natural habitat can be traced back to early salt production activities. In the UK there is now only one known site remaining and this has been selected.

The definition of this habitat type agreed by the EC Habitats Committee interprets the term 'continental' not as the name of a biogeographic region, but to mean 'non coastal'. In addition, it was determined that this habitat type should normally refer to natural or near-natural inland saltmarsh rather than anthropogenic stands found, for example, in former salt-working sites. In the UK this corresponds to inland stands of the NVC communities SM16 *Festuca rubra* saltmarsh and SM23 *Spergularia marina-Puccinellia distans* saltmarsh.

2.1.13.2 Site list

Pasturefields Salt Marsh (66)

This site in the West Midlands, England, is the only known remaining example in the UK of a natural salt spring with saltmarsh vegetation. The vegetation consists of red fescue *Festuca rubra,* with common saltmarsh-grass *Puccinellia maritima,* lesser sea-spurrey *Spergularia marina,* saltmarsh rush *Juncus gerardii* and sea arrowgrass *Triglochin maritimum* in the most saline situations.

2.1.14 Mediterranean salt meadows (*Juncetalia maritimi*) (15.15)

2.1.14.1 Background to selection

Examples of this habitat type are very restricted in the UK, and only two sites are known to support relatively large examples of the Mediterranean salt meadow type within sites representing good conservation of structure and function, i.e. they are part of a relatively complete sequence of coastal vegetation communities. Both these sites have been selected.

Sea rush *Juncus maritimus* occurs widely on saltmarshes in the UK. It may be the dominant species over large areas of saltmarsh, although there is considerable floristic variation in different regions. The saltmarsh community that has affinities with Mediterranean saltmarshes has a very marked south and western distribution in the UK, notably in Wales. It develops in the higher reaches of the saltmarsh and sometimes in association with transitions to sand dunes or other terrestrial vegetation, and is therefore highly vulnerable to damage or destruction by the building of sea walls.

This vegetation is characterised by sea rush, which forms a prominent community at the upper levels of many grazed marshes in the west of the UK. The associated flora includes species such as sea arrowgrass *Triglochin maritimum*, common sea-lavender *Limonium vulgare* and sea aster *Aster tripolium*. In the wetter west, there is often a mesotrophic grassland component to the vegetation, with species such as autumn hawkbit *Leontodon autumnalis* and parsley water-dropwort *Oenanthe lachenalii* particularly distinctive during the flowering season.

2.1.14.2 Site list

Burry Inlet: Saltmarsh and Estuary/Cilfach Burry: Cors heli ac Aber (293)

Mediterranean salt meadows are well represented in this large west coast site in south Wales. Good examples of this vegetation occur throughout the site and there is a large and complete sequence of communities present.

The Wash and North Norfolk Coast (233)

The saltmarshes associated with the barrier islands of north Norfolk, England, include a range of habitat types, which support transitions from upper salt meadows with sea rush *Juncus maritimus* to terrestrial habitats, occurring in association with a complete range of saltmarsh and other habitats. The vegetation includes sea arrowgrass *Triglochin maritimum*, common sea-lavender *Limonium vulgare* and sea aster *Aster tripolium* and has affinities with the Mediterranean habitat type.

2.1.15 Mediterranean and thermo-Atlantic halophilous scrubs (*Arthrocnemetalia fructicosae*) (15.16)

2.1.15.1 Background to selection

In the EC this habitat is restricted to France, Greece, Italy, Portugal, Spain and the UK. In the UK it is restricted to the south and east coasts of England. Only three localities are known to support extensive examples of this habitat type, and these have been selected.

This scrubby, halophilous (i.e. salt-tolerant) vegetation develops in the uppermost levels of saltmarshes, often where there is a transition from saltmarsh to dunes, or in some cases where dunes overlie shingle. The form that most closely resembles the scrub vegetation of the Mediterranean is restricted to the south and south-east of England and is formed predominantly of bushes of shrubby sea-blite *Suaeda vera* and sea-purslane *Atriplex portulacoides*. This most frequently occurs at the upper limit of tidal inundation and is found in association with transitions to sand dunes or shingle structures. In a few sites on the south and east coasts of England a similar community develops, but with dense stands of perennial glasswort *Sarcocornia perennis* with small numbers of herbaceous species. Another local variant has reduced evidence of the characteristic shrubs and a greater abundance of herbaceous species, such as sea-lavenders *Limonium* spp. and sea-heath *Frankenia laevis,* in a matrix with more common saltmarsh species, such as annual sea-blite *Suaeda maritima* or thrift *Armeria maritima*.

2.1.15.2 Site list

Chesil and the Fleet (234)

This site on the south coast of England contains a major concentration of this scrub type in the UK. A band of shrubby sea-blite *Suaeda vera* and sea-purslane *Atriplex portulacoides* lines much of the 13 km length of the seaward margin of the Fleet. The community forms a clear zone between the Fleet and the shingle vegetation of the Chesil Bank. It appears to exist in a dynamic equilibrium with sea beet *Beta vulgaris* subsp. *maritima* dominated driftline vegetation (**Annual vegetation of drift lines**), for which the site has been separately selected. This replaces the scrub in areas subject to disturbance, and is in turn displaced by the scrub after disturbance ceases.

Essex Estuaries (178)

In this complex of estuarine marshes on the east coast of England the occurrence of this habitat type is currently artificially restricted by sea walls. It now occurs principally as a strandline community or at the foot of sea walls. Recent managed retreat schemes offer the prospect of future expansion of the habitat type. The local variant of this vegetation, which features sea-lavenders *Limonium* spp. and sea-heath *Frankenia laevis,* occurs at one location, Colne Point.

North Norfolk Coast and Gibraltar Point Dunes (276)
The Wash and North Norfolk Coast (233)

These two sites on the east coast of England comprise the only area in the UK where all the more typically Mediterranean species that characterise this habitat type occur together. The vegetation is dominated by a shrubby cover up to 40 cm high of scattered bushes of shrubby sea-blite *Suaeda vera* and sea-purslane *Atriplex portulacoides,* with a patchy cover of herbaceous plants and bryophytes. This scrub vegetation often forms an important feature of the upper saltmarshes, and extensive examples occur where the driftline slopes gradually and provides a transition to dune, shingle or reclaimed sections of the coast. At a number of locations on this coast perennial glasswort *Sarcocornia perennis* forms an open mosaic with other species at the lower limit of the sea-purslane community.

Section 2.2: Coastal sand dunes and continental dunes

2.2.1 Embryonic shifting dunes (16.211)

2.2.1.1 Background to selection

Sites have been selected to take account of the fact that this is a rare habitat type in the UK, covering less than 1,000 ha. Although very localised, the habitat type has a broad geographical range, and this is reflected in the site series. By comparison with many other habitats, ecological variation is limited, but the variation that does occur is covered by the site series. The habitat type is associated with developing (prograding) dunes, which are generally the largest and most structurally and functionally intact dunes in the UK. The distribution of such dunes is not even, and more than one example for the habitat type has been selected in some parts of the UK to reflect this uneven distribution.

Embryonic shifting dune vegetation exists in a highly dynamic state and is dependent on the continued operation of physical processes at the dune/beach interface. It is the first type of vegetation to colonise areas of incipient dune formation at the top of a beach. On a prograding dune system this vegetation may be the precursor to the main dune building vegetation dominated by marram *Ammophila arenaria*. In most cases embryonic shifting dunes are transient and will either be displaced by marram-dominated vegetation as the dunes develop (**Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes**)) or will be washed away by storms. The continued supply of new sand into the dune system is therefore vital to the continued existence of this community. The habitat type is of exceptional importance as an indicator of the general structural and functional 'health' of a dune system. Creation of new dune habitat and indeed the long-term survival of the dune system at which it occurs is often dependent upon the survival of this habitat type.

This habitat type is inherently species-poor and has a limited range of floristic variation. Marram is a common constituent. The predominant plants are strandline species such as sea rocket *Cakile maritima* and the two salt-tolerant, sand-binding grasses: lyme-grass *Leymus arenarius* and sand couch *Elytrigia juncea*. These grasses generally occur slightly higher up the beach profile than the true strandline species. There is some geographical variation, even within this very simple vegetation type. While both dune-binding grasses have a wide geographical range, lyme-grass is more abundant in the north and east of Britain and sand couch is more abundant in the south and west. The sites selected encompass this range of variation. This habitat rarely occurs in isolation, because it initiates dune succession, and it is invariably one of several Annex I habitat types to be found on a dune system.

By their very nature **Embryonic shifting dunes** are restricted in the area they can occupy. They are made even scarcer by the fact that only a relatively small number of dunes are actively prograding, the condition under which this habitat type develops best. Embryonic dunes are also particularly vulnerable to trampling by beach users and to mechanical cleaning of beaches, and this may well be a significant factor in limiting the extent of the habitat type. Owing to the small total area of the habitat type, a high proportion of the UK resource is included within the site series.

2.2.1.2 Site list

Barry Links (145)

At this site (one of three representative sites on the east coast of Scotland), there is an identifiable zone of **Embryonic shifting dunes** with lyme-grass *Leymus arenarius,* most frequently found on accreting sand spits. Of additional interest is the regular occurrence of an identifiable zone of sand couch *Elytrigia juncea* foredune, which may extend in summer as a narrow band in front of the main foredune ridge. There are well developed gradations to **Shifting dunes along the shoreline with *Ammophila arenaria***.

Burry Inlet: Dunes/Cilfach Burry: Twyni (292)

The three dune sites within the Burry Inlet, Carmarthen Bay, provide a representative example of this habitat type in south Wales. They support areas of **Embryonic shifting dune** in which sand couch *Elytrigia juncea* is the dominant sand-binding species. There are well developed transitions to marram *Ammophila arenaria* dunes.

Dornoch Firth and Morrich More (265)

There are well marked lyme-grass *Leymus arenarius* dominated areas of this habitat type fronting the prograding sections of this site. It is one of three sites chosen as representative of embryonic dune vegetation on the east coast of Scotland and is the most northerly example of the habitat type in the site series. The process of continued progradation is central to the conservation of this habitat type at this site, which has the largest, most complete area of sand dune in the UK, in part owing to the exceptionally high rate of progradation.

Dorset Heaths (Purbeck and Wareham) and Studland Dunes (280)
Studland Dunes (323)

Embryonic shifting dunes initiate the very clear successional sequence of dune communities at these sites, which are representative of the habitat type in southern England. This is a part of the UK where this habitat type is rare, partly owing to intensive recreational use of the coast. The site is also of interest in that there are well developed examples of both sand couch *Elytrigia juncea* and lyme-grass *Leymus arenarius* dominated communities. The former occurs discontinuously along the whole shoreline, while the latter is locally abundant in disturbed locations at the northern end of the site.

Glannau M^n: Twyni/Anglesey Coast: Dunes (294)

This is one of two sites selected to represent the habitat type in north Wales. Embryonic dunes form a zone across a broad part of the beach/dune interface, making this site one of the most extensive examples of this habitat type in the UK. It is a site where, in contrast to some others in north Wales, recreational damage is minimal.

Morfa Harlech a Morfa Dyffryn (311)

Morfa Harlech a Morfa Dyffryn (Morfa Harlech and Morfa Dyffryn) is one of two north Wales sites selected. The embryonic dunes occur as long narrow zones mainly in the Morfa Harlech part of the complex. Both lyme-grass *Leymus arenarius* and sand couch *Elytrigia juncea* shifting dune vegetation have been recorded, but the latter is by far the more extensive of the two.

North Norfolk Coast and Gibraltar Point Dunes (276)

This is one of two sites chosen to represent this habitat type in East Anglia in the east of England (the other being Winterton - Horsey Dunes). It is a long, thin dune system, displaying both progradation and erosion. The exceptional length and variety of the dune/beach interface is reflected in the high total area of embryonic dune (over 40 ha or at least 14% of the national total). The process of continued progradation is central to the conservation of this habitat type at this site. Sand couch *Elytrigia juncea* is the most prominent sand-binding grass.

North Northumberland Dunes (237)

This site is representative of the habitat type in north-east England. The embryonic shifting dune vegetation of this long series of dunes is both extensive and varied. There are examples of all the main embryonic dune communities. Lyme-grass *Leymus arenarius* communities are particularly strongly represented, but sand couch *Elytrigia juncea* communities and strandline species are also present.

Sands of Forvie (143)

This is one of three sites on the east coast of Scotland, chosen as representative of the northern part of the habitat type's range in the UK. Sands of Forvie is one of the most geomorphologically active dune systems in the UK, and as a result, the site contains significant representation of dune types associated with shifting sand. Identifiable zones of both lyme-grass *Leymus arenarius* and sand couch *Elytrigia juncea* are present, although, as is common with this habitat type, they may be narrow and discontinuous.

Sandwich Bay (152)

The embryonic dunes at Sandwich Bay are representative of this habitat type in the south-east of the UK. The seaward edge of the north of this site displays a good sequence of embryonic shifting dune communities and there is a clear zonation within the dune habitat, with strandline species on the seaward edge and sand-binding grasses inland. Lyme-grass *Leymus arenarius* is extremely sparse and sand couch *Elytrigia juncea* is the dominant sand-binding species.

Sefton Coast (151)

The Sefton Coast in north-west England displays both rapid erosion and active progradation. Embryonic shifting dunes are of the northern, lyme-grass *Leymus arenarius*, type and are mainly associated with the areas of progradation, though vegetation dominated by lyme-grass is also found associated with areas of persistent, heavy disturbance further inland.

Torrs Warren - Luce Sands (141)

This site in south-west Scotland is an example of the northern variant of the habitat type, with lyme-grass *Leymus arenarius* dominant. The length of the dune front at this site, combined with its comparative inaccessibility, helps to ensure that there is an identifiable zone of embryonic shifting dune vegetation. Lyme-grass is well represented to the seaward edge of the fixed dune, which shows zonation to marram *Ammophila arenaria.*

Winterton - Horsey Dunes (144)

This is one of two sites chosen as representative of this habitat type in East Anglia. Embryonic shifting dune vegetation fronts some sections of this extensive dune system. Both sand couch *Elytrigia juncea* and lyme-grass *Leymus arenarius* communities are represented, and strandline species occur very locally.

2.2.2 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (16.212)

2.2.2.1 Background to selection

This habitat type is geographically widespread. It occurs throughout the coastline of the UK, although in many places it is restricted to a narrow strip. Sites have been selected to cover the geographical range of the habitat type and its ecological variation. Sites with the largest expanses of the habitat type, with active dune processes which maintain the structure and function of the habitat type, have been favoured. The resource is not evenly distributed around the coast, and more than one site has been chosen in north-east Scotland, north Wales and south-east England to take account of this.

This habitat type encompasses most of the vegetation of unstable dunes where there is active sand movement. Under these conditions sand-binding marram *Ammophila arenaria* is always a prominent feature of the vegetation and is usually dominant. The habitat type excludes the low, embryonic dunes where occasional exposure to saltwater flooding constrains the growth of marram and where plants of the strandline mingle with salt-tolerant, sand-binding grasses.

The species composition of shifting dunes is constrained by the harsh conditions, but the vegetation is by no means uniform. The most marked floristic variation relates to the degree of instability. Where sand accretion is extremely rapid it is possible to find vegetation that consists only of marram *Ammophila arenaria*. As rates of sand deposition decline the marram is joined by more species, first by other specialised dune plants, then by less specialised grasses, drought-tolerant annuals and a restricted number of specialised bryophytes such as the moss *Tortula ruralis* subsp. *ruraliformis*. This moss plays an important part in completing the stabilisation of the sand surface. Towards the seaward edge of the zone of shifting dunes, salt-tolerant plants such as sea sandwort *Honckenya peploides* may be prominent, along with the salt-tolerant sand-binding grass sand couch *Elytrigia juncea*. Further inland these species are rarely prominent. Sites that exhibit this zonation have been particularly favoured, as it is seen as indicative of good conservation of structure and function.

There is also geographical variation in the floristic composition of the habitat type. A number of typical shifting dune plants such as Portland spurge *Euphorbia portlandica* and sea-holly *Eryngium maritimum* are mostly confined to the south of the UK, while lyme-grass *Leymus arenarius* is much more abundant in the northern half of Britain. This variation has been encompassed in site selection.

Shifting dunes along the shoreline with *Ammophila arenaria* is a dynamic vegetation type maintained only by change. The habitat type can occur on both accreting and eroding dunes, but will rapidly change and disappear if stability is imposed. Structure and function is therefore a crucial factor in the selection of sites. This dune type rarely occurs in isolation because of its dynamic nature and because it is successionally related to other dune habitats. Well-developed shifting dune vegetation is almost always associated with a number of other dune habitats and the sites selected contain a range of such transitions to fixed dune, dune heath and dune slack habitats.

2.2.2.2 Site list

Barry Links (145)

Shifting dunes are found as an identifiable band along the coastal edge of this site on the east coast of Scotland. The site is mostly undisturbed and there are active coastal processes along the seaward edge resulting in significant dune accretion particularly along the southern edge of the site. These rapidly accreting dunes are dominated by marram *Ammophila arenaria*, and there are well developed transitions to dune grassland and heath.

Braunton Burrows (8)

This large site in south-west England contains a substantial area of mobile dune vegetation, including representative examples of most of the main variants found in the south-west of the UK. There are good numbers of characteristic specialist plants typical of this region, such as Portland spurge *Euphorbia portlandica*, sea spurge *Euphorbia paralias* and sea-holly *Eryngium maritimum*. Transitions to dune slack and fixed dune are a prominent feature of this site.

Burry Inlet: Dunes/Cilfach Burry: Twyni (292)

This site is representative of mobile dunes in south Wales and contains a very large area of shifting dunes, covering approximately 80 ha in total. In parts of the system (e.g. at Whiteford Burrows) dunes are actively accreting and there are clear zonations of embryonic dunes, shifting dunes and semi-fixed dunes. Uncommon species recorded within the shifting dunes include sea spurge *Euphorbia paralias*.

Dornoch Firth and Morrich More (265)

This large dune system on the east coast of Scotland is physically diverse, with areas of active accretion, areas of marine erosion and areas of internal instability. There are well-formed parabolic dunes in one area. All of these formations provide opportunities for shifting dunes with marram *Ammophila arenaria* to develop. As a result this habitat type is relatively extensive within the site. The vegetation is representative of northern mobile dune vegetation, with lyme-grass *Leymus arenarius* prominent in some stands. The site is largely undisturbed, resulting in a natural habitat structure.

Dorset Heaths (Purbeck and Wareham) and Studland Dunes (280)
Studland Dunes (323)

These sites provide representation of the habitat type in southern England. Shifting dunes form one part of the very well marked successional sequences. The seaward dune ridge supports marram *Ammophila arenaria* vegetation mainly of the red fescue *Festuca rubra* sub-community, though three other types are represented. There are transitions to embryonic dunes, which are rare on the south coast partly because of intense recreational pressure, as well as extensive transitions to decalcified fixed dunes and dune heath.

Glannau M^n: Twyni/Anglesey Coast: Dunes (294)

This is one of two north Wales sites selected. It contains one of the largest areas of lyme-grass *Leymus arenarius* shifting dune community in Wales. The mobile dunes at the southern end of the site support an abundance of sea-holly *Eryngium maritimum*, and there is well developed zonation of dune types, including both seaward transitions between mobile dune and foredune and landward transitions to fixed dune and dune slack.

Morfa Harlech a Morfa Dyffryn (311)

Morfa Harlech a Morfa Dyffryn (Morfa Harlech and Morfa Dyffryn) in north Wales (one of two sites chosen to represent the habitat type here) lies at the junction of two major marine sediment transport systems, and as a result it provides an excellent example of active accretion. Shifting dunes are therefore extensive, being particularly well developed at Morfa Dyffryn. Additional species recorded here include hound's-tongue *Cynoglossum officinale* and sand cat's-tail *Phleum arenarium*.

North Norfolk Coast and Gibraltar Point Dunes (276)

Shifting dunes form a major component of the complex of often linear dune systems that make up this site, which is representative of the habitat type in East Anglia. The site supports over 100 ha of shifting dune vegetation, 8% of the estimated total area of this habitat type in Britain. The shifting dune vegetation is also varied, containing examples of all the main variants found in the southern part of the geographical range.

Sands of Forvie (143)

The dunes that cover part of this site form one of three sites on the east coast of Scotland chosen to represent the habitat type. They are exceptionally mobile, with large areas of bare sand, and there are extensive areas of this habitat type on the site. The site is particularly noted for the substantial areas where sand accretion is so rapid that only marram *Ammophila arenaria* can survive. However, other types of shifting dune vegetation can be seen, reflecting different degrees of instability. For example, in areas where there is less sand accretion red fescue *Festuca rubra* may be found with the marram.

Sandwich Bay (152)

Shifting dune vegetation occurs along the seaward edge of the northern half of this extensive dune system. It is representative of shifting dune vegetation in the south-east of England, a region where the habitat type is very restricted in its distribution. Although the area of this habitat type is small by comparison with other listed sites, the shifting dune vegetation contains a good range of characteristic foredune species including sea bindweed *Calystegia soldanella*, sea spurge *Euphorbia paralias* and sea-holly *Eryngium maritimum*.

Torrs Warren - Luce Sands (141)

This is a very large site in south-west Scotland, with examples of two types of shifting dune vegetation. The foredunes are morphologically less active than other sites in this part of the UK, with less sand accretion and erosion. Nevertheless, there is sufficient sand accretion to support a narrow band of shifting dunes, dominated by marram *Ammophila arenaria*, with associated species such as sand sedge *Carex arenaria* and red fescue *Festuca rubra*. In addition, shifting dune vegetation with marram is found on blowouts, where active sand movement is occurring in the semi-fixed dunes that form the landward part of the site.

2.2.3 *Fixed dunes with herbaceous vegetation (grey dunes) (16.221 to 16.227)

2.2.3.1 Background to selection

This is an extremely complex habitat type. For the purposes of the Directive, **Fixed dune with herbaceous vegetation (grey dunes)** has been divided into a series of regional variants (DGXI 1996a). The UK is particularly important for Atlantic dune (*Mesobromion*) grasslands, and the site series reflects this.

Sites have been selected to ensure adequate coverage of the geographical range and ecological variation of this priority habitat type. The sites chosen are for the most part the largest examples of this habitat type in the UK and have the best conserved structure and function. The predominantly western distribution of the habitat type in the UK is also reflected in the site series. A substantial proportion of the national resource occurs on a relatively small number of sites, and these have been selected.

Fixed dune vegetation occurs mainly on the largest dune systems, being those that have the width to allow it to develop. It typically occurs inland of the zone dominated by marram *Ammophila arenaria* on coastal dunes and represents the vegetation that replaces marram as the dune stabilises and the organic content of the sand increases.

The herbaceous vegetation of fixed dunes in the UK exhibits considerable range and variation. The most widespread type is Atlantic dune grassland, consisting of a short sward characterised by red fescue *Festuca rubra* and lady's bedstraw *Galium verum* and typically rich in species of calcareous substrates. The vegetation shows considerable variation both from north to south and from east to west. In northern Scotland, Scottish primrose *Primula scotica* can occur in this community; in the south, several orchid species including pyramidal orchid *Anacamptis pyramidalis* and a rich variety of other species are found. In the south-west of England and in Wales wild thyme *Thymus polytrichus* often dominates this type of vegetation. A taller type of dune grassland vegetation, in which bloody crane's-bill *Geranium sanguineum* is prominent, is particularly characteristic of north-east England. In areas with a drier and more continental climate, such as Norfolk, and at the acidic end of the spectrum, the fixed dune vegetation is rich in lichens. The sites selected represent the main ecological variations in the habitat type in the UK.

2.2.2.2 Site list

Braunton Burrows 50)

Braunton Burrows, in south-west England, is one of the largest dune sites in the UK and is of particular importance because it is virtually intact and still active. There are very extensive areas of species-rich calcareous dune grassland with good examples of a variety of important communities. The short turf areas are extremely rich in herbs and lichens, including a number of nationally rare species. Flowering herbs such as large thyme *Thymus pulegioides*, common restharrow *Ononis repens* and common bird's-foot-trefoil *Lotus corniculatus* are locally dominant.

Burry Inlet: Dunes/Cilfach Burry: Twyni (292)

Within this south Wales site, Whiteford, Pembrey Coast and Laugharne aand Pendine Burrows are important dune systems with actively forming spits and well conserved structure and function. The vegetation includes extensive areas of fixed dune grassland with red fescue *Festuca rubra* and lady's bedstraw *Galium verum* and semi-fixed dune grassland with marram *Ammophila arenaria* and red fescue.

Durness (64)

This site contains one of the largest sand dune systems in the north of Scotland. It is an example of an extreme northern variant of the habitat type. The site is maintained by very active physical and biological processes. Fixed dune vegetation at this site occurs on an extensive and diverse sequence of dunes and on soils covered with blown sand. A rich variety of calcareous dune grassland species grow here in association with arctic-alpine plants such as mountain avens *Dryas octopetala*.

Glannau M^n: Twyni/Anglesey Coast: Dunes (294)

Within this dune complex in north Wales are extensive areas of both fixed dune vegetation with red fescue *Festuca rubra* and lady's bedstraw *Galium verum* and semi-fixed dune grassland with marram *Ammophila arenaria* and red fescue. Despite the fact that a large proportion of the open vegetation has been afforested, the remaining communities retain considerable interest. Notable species of the site include early sand-grass *Mibora minima*.

Invernaver (142)

This is one of the two largest dune sites in north Scotland, and it is actively accreting owing to its exposed location. Dunes merge into areas of sand that have been blown up and over the cliffs by strong winds as so-called 'climbing dunes', giving mosaics of fixed dune with grassland or heathland communities. Transitions from calcareous grassland to heath are well developed. The presence of a number of arctic-alpine species such as mountain avens *Dryas octopetala* and purple oxytropis *Oxytropis halleri*, as part of the fixed dune vegetation, is particularly important. The nationally scarce endemic Scottish primrose *Primula scotica* is also present.

Kenfig/Cynffig (7)

This is a largely intact dune system in south Wales with extensive areas of fixed dune vegetation with red fescue *Festuca rubra* and lady's bedstraw *Galium verum* and semi-fixed dune grassland with marram *Ammophila arenaria* and red fescue. There is also a relatively large area of more acidic vegetation dominated by sand sedge *Carex arenaria*, sheep's fescue *Festuca ovina* and common bent *Agrostis capillaris*.

Magilligan (219)

This representative site in Northern Ireland is one of the largest calcareous dune systems in the UK, with a well developed and largely undisturbed system of ridges and slacks. Fixed dune vegetation with red fescue *Festuca rubra* and lady's bedstraw *Galium verum* is very extensive and dominates most of the site. Much of the grassland is tall, with downy oat-grass *Helictotrichon pubescens* prominent, but the more open areas have wild thyme *Thymus polytrichus* and are notable for an abundance of the moss *Rhytidium rugosum*.

North Norfolk Coast and Gibraltar Point Dunes (276)

This site on the east coast of England contains a large, active series of dunes on shingle barrier islands and spits and is little affected by development. The fixed dune vegetation of North Norfolk represents one of the principal variants of this vegetation type in the UK, as many of the swards are rich in lichens and drought-avoiding winter annuals such as common whitlowgrass *Erophila verna*, early forget-me-not *Myosotis ramosissima* and common cornsalad *Valerianella locusta*. The main communities represented are marram *Ammophila arenaria* with red fescue *Festuca rubra* and sand sedge *Carex arenaria*, with lichens such as *Cornicularia aculeata*.

North Northumberland Dunes (237)

This site provides a representation of fixed dune vegetation in north-east England. It is an active site with extensive calcareous fixed dunes locally grading into more acidic fixed dune vegetation and dune heath. The site has been chosen particularly as a representative of the north-eastern variant, in which bloody crane's-bill *Geranium sanguineum* is prominent.

Penhale Dunes (6)

This site, like Braunton Burrows, is in south-west England and also has a large area of fixed dune vegetation on an extensive and exposed calcareous dune system where active geomorphological and successional processes occur. However, of particular interest are the communities developing on sand overlying the adjacent hillsides, which has been blown inland by strong winds. In this respect the site is functionally similar to Invernaver, on the north coast of Scotland, though the vegetation is very different owing to climatic differences.

Sandwich Bay (152)

This site is a largely inactive dune system with a particularly extensive representation of fixed dune grassland. It is the only large area of fixed dune grassland in the extreme south-east of England. The vegetation is extremely species-rich and the site has been chosen because it includes a number of rare and scarce species, such as fragrant evening-primrose *Oenothera stricta,* bedstraw broomrape *Orobanche caryophyllacea* and sand catchfly *Silene conica,* as well as the UK's largest population of lizard orchid *Himantoglossum hircinum*.

Sefton Coast (151)

This is a large area of predominantly calcareous dune vegetation selected to represent the type in north-west England. The sequence of habitats from foredunes to dune grassland and dune slack is extensive, and substantial areas of open dune vegetation remain. There are large areas of semi-fixed and fixed dune with herbaceous vegetation exhibiting considerable variation from calcareous to acidic. In the calcareous areas common restharrow *Ononis repens* is prominent. There are small but significant areas of decalcified sand with grey hair-grass *Corynephorus canescens,* a species more characteristic of decalcified fixed dunes in the east of England and around the Baltic.

2.2.4 *Decalcified fixed dunes with *Empetrum nigrum* (16.23)

2.2.4.1 Background to selection

In the UK this priority habitat type is confined to Scotland, where it is widespread but local. Elsewhere in Europe this type is restricted to the coasts northwards from Denmark. The nature of the dune heath varies considerably depending on physical conditions, degree of leaching, type of substrate, geographic position and grazing intensity. Sites have been selected to represent this range of geographic and ecological variation. A substantial proportion of the national resource occurs on relatively few sites, and the largest and most important have been selected. For the most part, sites chosen are the largest examples of the habitat type and those least modified by human activities, so that they are inherently stable in terms of structure and function. Fixed dune vegetation tends to occur on the larger dune systems, which have the width to allow it to develop.

Decalcified fixed dunes with *Empetrum nigrum* represent the later, more mature, stages of the well-marked successional sequence characteristic of sand dunes. Exposure to rainfall over long periods means that there is leaching of the surface layers, causing a loss of calcium carbonate and increased soil acidity. Where the shell content of the sand is low, the original calcium carbonate content of the soil will be low and acidic conditions develop more rapidly. This is particularly the case in the north and west, where a combination of a wetter climate and a more widespread occurrence of dune sand composed of acidic silica sand grains encourages the development of more extensive areas of acidic dune vegetation. In such conditions, dune communities tend to be dominated by heather *Calluna vulgaris* and crowberry *Empetrum nigrum*, with the relative abundance of these two species varying with site conditions. This habitat type corresponds to the *Calluna vulgaris-Carex arenaria* heath *Empetrum nigrum* subsp. *nigrum* sub-community of the NVC. It tends to occur in mosaics with other habitats, depending on local physical and soil conditions, and often occurs in close association with **Eu-Atlantic decalcified fixed dunes,** with wet heath, dune heath, dune slack and fixed dunes with herbaceous vegetation. Acidic grasslands are associated with dune heath, forming transitions with it, and in drier conditions are often precursors to its development.

Grazing helps to maintain the open nature of the vegetation, which would otherwise develop into scrub and woodland through the process of succession. However, it is vulnerable to over-grazing, and planting of trees can lower the water table, which in turn will suppress open dune heath vegetation.

The Annex I habitat types **Decalcified fixed dunes with *Empetrum nigrum*** and **Eu-Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)** are similar in composition. Indeed, they may succeed oneanother in the same location over time. **Decalcified fixed dunes with *Empetrum nigrum*** has a more restricted distribution, being found mainly in Scotland in relatively wetter and more base-poor conditions. **Eu-Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)** is more widespread, tolerating a wider range of conditions. At some Scottish sites it is difficult and scientifically inappropriate to allocate stands of dune heath to one Annex I habitat type or the other, as the vegetation forms a continuous spectrum of variation within complex habitat mosaics.

2.2.4.2 Site list

Barry Links (145)

This large site has some of the largest and most diverse examples in the UK of **Decalcified fixed dunes with *Empetrum nigrum*** and is selected as the most south-easterly example of this habitat type in Scotland. The habitat type occurs in a complex of dune grassland with a substantial area of **Eu-Atlantic decalcified fixed dune** vegetation in drier areas. The fixed dunes are part of a full successional transition from embryonic foredune. The pattern of development of *Calluna* heath suggests that decalcification has occurred through leaching of the sand over an extended period of time. This is in contrast to most other sites with extensive dune heath. Usually these sites are composed of sand with an extremely low initial calcium carbonate content, and decalcification is a relatively rapid process.

Dornoch Firth and Morrich More (265)

In this part of the Dornoch Firth, in the north-east of Scotland, dune vegetation has developed on a coastline that has been generally rising relative to sea level in the 7,000 years since the last glaciation. A combination of leaching, stabilisation and the decreased influence of salt water has produced a sequence of dry, stable dune ridges, interspersed with wet dune hollows. There is a large area of **Decalcified fixed dunes with *Empetrum***

nigrum vegetation on this site, occurring in a complicated mosaic of acidic fixed dune vegetation types, principally **Eu-Atlantic decalcified fixed dunes *(Calluno-Ulicetea)***. Within this complex of habitats there are examples of dune, saltmarsh and transitional communities that include large populations of several northern dune species, such as Baltic rush *Juncus balticus*. This is the most important acidic dune site in Scotland because of its size and the exceptional diversity of habitats within it. Despite some industrial development, structure and function are well conserved at this site and accretion is continuing.

Invernaver (142)

There is a very exposed and active dune system on this site on the extreme north coast of Scotland. Areas of sand have been blown up and over the cliffs by strong winds and support a highly complex mosaic of fixed dune grassland and heathland communities that include a number of arctic-alpine species. There are extensive areas of **Decalcified fixed dunes with *Empetrum nigrum*** that represent an extreme northern example of the ecological and geographic range of this habitat type. It is of interest because it forms a transition between the typical northern acidic dune heath vegetation and the arctic vegetation that is widespread further north. It is therefore considered to be particularly important in the European range of ecological variation of dune vegetation.

Sands of Forvie (143)

This large and mature site on the east coast of Scotland includes a sequence of decalcified, fixed dune ridges that have developed over a period of several hundred years. The dune heath complex within the site can, in this case, be confidently defined as **Decalcified fixed dunes with *Empetrum nigrum,*** because it is dominated by crowberry *Empetrum nigrum.* It is one of the best examples of the type in the UK because of the extent and diversity of the crowberry community and the diversity of transitions to other habitats. The free-draining heath is interspersed with a number of wet hollows in which important examples of acidic **Humid dune slacks** are present, typically with cross-leaved heath *Erica tetralix,* an Annex I habitat type for which this site is proposed in its own right. There are transitions to acidic dune grassland and wet heath, grading into dune slack.

Torrs Warren - Luce Sands (141)

This site is the largest acidic dune system in south-west Scotland and provides a very extensive area of decalcified fixed dune occurring within a complex mosaic of acidic dune habitats. It is the most southerly example in the site series. **Decalcified fixed dune with *Empetrum nigrum*** occurs in close association with **Eu-Atlantic decalcified fixed dunes**. The decalcified fixed dunes dominated by heath occur with extensive acidic grassland in drier situations. Apart from localised military use there has been little disturbance to the dune structure and the dunes are more or less free from grazing by domestic livestock.

2.2.5 *Eu-Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)** (16.24)

2.2.5.1 Background to selection

Eu-Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) are widespread in Europe, and the UK lies at the centre of the north - south range of this habitat type. It is well represented in the UK and there is considerable variation in the vegetation of this habitat type, both between northern and southern sites and between sites on the east and west coasts. Sites have been selected to represent the ecological variability and geographic range of this habitat type. Sites chosen tend to be the largest examples of the habitat type, with substantial areas of dune heath occurring in a mosaic of dune habitats. These sites are the least modified and tend to be inherently stable in terms of structure and function. A large proportion of the area of this habitat type occurs on a relatively small number of sites, the largest of which (Morrich More) is in Scotland.

This habitat type occurs on mature, stable dunes where the initial calcium carbonate content of the dune sand is low. The surface soil layers rapidly lose their remaining calcium carbonate through leaching and become acidified. The Annex I habitat types **Decalcified fixed dunes with *Empetrum nigrum*** and **Eu-Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)** are very similar in composition. Indeed they may succeed one another in the same location over time. Within the UK **Decalcified fixed dunes with *Empetrum nigrum*** has a more restricted distribution, being confined to Scotland, in relatively wetter and more base poor conditions. **Eu-Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)** is more widespread, tolerating drier and warmer conditions. At some Scottish sites it is difficult and scientifically inappropriate to attempt to allocate stands of dune heath to one of these Annex I habitat types or the other, as the vegetation forms a continuous spectrum of variation within complex habitat mosaics.

The most characteristic community is dune heath in which heather *Calluna vulgaris* is found in combination with sand sedge *Carex arenaria*. The main species present in these communities vary considerably throughout the UK. Bell heather *Erica cinerea* is abundant in dune heath on west coast sites, but much scarcer in the east, where heather *Calluna vulgaris* predominates. Associated with the heathland in drier conditions, and forming transitions with it, is acidic dune grassland. This is often a precursor to heath development and in these drier conditions is usually characterised by a combination of the fine-leaved grasses such as sheep's fescue *Festuca ovina* and common bent *Agrostis capillaris*, with sand sedge *Carex arenaria*. On very nutrient-poor sand that is also subject to severe drought the heath tends to be dominated by lichens, which form a continuous grey carpet over the ground.

Grey hair-grass *Corynephorus canescens* is a prominent feature of the small number of fixed, decalcified dune systems in eastern England. This species is more typical of the dry acidic dunes of the Baltic and inland dunes and represents an interesting outlier in the UK of a dune type much more widespread on the continent.

At most of the sites at which **Eu-Atlantic decalcified fixed dune** vegetation occurs, it forms a mosaic with other Annex I habitat types. Fixed dune vegetation tends to occur on the larger dune systems, which have the width to allow it to develop. A substantial proportion of the national resource occurs on a relatively small number of sites, and these have been selected.

2.2.5.2 Site list

Barry Links (145)

This is a large site on the east coast of Scotland and has a relatively extensive area of **Eu-Atlantic decalcified fixed dune**. The dunes are part of a full successional transition from embryonic foredune to heath on fixed dune. There is a complex of dune grassland with **Decalcified fixed dunes with *Empetrum nigrum*** as well as **Eu-Atlantic decalcified fixed dune vegetation**. The pattern of development of *Calluna* heath suggests that decalcification has occurred through leaching of the sand over an extended period of time. This is in contrast to most other sites with extensive dune heath. Usually these sites are composed of sand with an extremely low initial calcium carbonate content, and decalcification is a relatively rapid process. In addition there are transitions to wet heath, which in turn grades into dune slack.

Dornoch Firth and Morrich More (265)

This site provides a representation of the habitat type in north-east Scotland, with dune heath containing heather *Calluna vulgaris* and sand sedge *Carex arenaria*. At this site, dune vegetation has developed on a coastline that has been generally rising relative to sea level in the 7,000 years since the last glaciation. A combination of leaching, stabilisation and the decreased influence of saltwater has produced a sequence of dry, stable dune ridges, interspersed with wet dune hollows. The **Eu-Atlantic decalcified fixed dune** vegetation covers a large area on this site and forms part of a complex mosaic of fixed dune vegetation types, principally **Decalcified fixed dunes with *Empetrum nigrum*,** together with saltmarsh and transitional communities that include large populations of several northern dune species, such as Baltic rush *Juncus balticus*. This is the most important acidic dune site in Scotland, owing to its size and the exceptional diversity of habitats within it. Despite some industrial development, structure and function are well conserved at this site and accretion is continuing.

Dorset Heaths (Purbeck and Wareham) and Studland Dunes (280)
Studland Dunes (323)

These sites comprise the only large dune heath site in the south and south-west of Britain. The heathland occupies a series of dune ridges, which have developed over a period of several hundred years. The development of these ridges was the subject of a classic study and the processes are still active today. Structure and function of the heathland communities are therefore well preserved. The dry open heath is an important habitat for rare reptiles such as the sand lizard *Lacerta agilis*. At the western margin of the dune ridges the dry dune heath grades into wet heath in which cross-leaved heath *Erica tetralix* is prominent, while at the northern end it grades into the southern heathland types of inland Dorset.

Drigg Coast (139)

This site provides representation of the habitat type in north-west England. There are substantial areas of **Eu-Atlantic decalcified fixed dunes** that show a wide range of ecological variation. Some areas are dominated by heather *Calluna vulgaris* and bell heather *Erica cinerea.* Within the dry dune heath are wetter areas in which cross-leaved heath *Erica tetralix* is prominent. There are large areas of acidic dune grassland with a prominent lichen component and also areas where sand sedge *Carex arenaria* grows in carpets of the moss *Racomitrium canescens.*

Invernaver (142)

This very exposed and active dune system is an extensive representative of the habitat type on the north coast of Scotland and is an extreme northern variant of the habitat type. Areas of sand have been blown up and over cliffs by strong winds to form 'climbing dunes'. This situation is functionally similar to the blown sand of Penhale Dunes, although the communities present are very different because of climate and location. These dunes support a highly complex mosaic of fixed dune grassland and heathland communities. **Eu-Atlantic decalcified fixed dunes** exist in a matrix of other dune heath communities that include a number of arctic-alpine species. This is the largest example of an extreme northern variant of this vegetation type and is of interest because it forms a transition between the typical northern acidic dune heath vegetation and the arctic vegetation that is widespread further north. It is therefore considered to be particularly important in the European range of ecological variation of dune vegetation.

Murlough (218)

This site is the largest and most important dune heath site in Northern Ireland. The site is an old dune system with acidic sands and a long history of traditional management. The vegetation is dominated by heather *Calluna vulgaris* and bell heather *Erica cinerea,* with some areas of acidic dune grassland and other areas dominated by mosses and an abundance of lichens. These areas of heath grade into fixed grey dune vegetation and gorse scrub.

Torrs Warren - Luce Sands (141)

This site is the largest acidic dune system in south-west Scotland and supports extensive areas of this habitat. It contains a variety of dune landforms and therefore a complex mosaic of dune habitats. **Eu-Atlantic decalcified fixed dunes** dominated by heather *Calluna vulgaris* is extensive and occupies the drier dune areas, closely associated with **Decalcified fixed dunes with *Empetrum nigrum***. The dunes are relatively undisturbed and are more or less free from grazing by domestic stock, resulting in relatively stable vegetation communities.

Winterton - Horsey Dunes (144)

This is the only significant area of dune heath on the east coast of England and also includes areas of acidic dune grassland as an associated acidic habitat. The contrast with the nearby calcareous and species-rich dunes of north Norfolk is marked. The vegetation is characteristic of dune heath in an eastern locality with low rainfall. The drought-resistant grey hair-grass *Corynephorus canescens* is a characteristic species of the open dry dune soils.

2.2.6 Dunes with *Salix arenaria* (16.26)

2.2.6.1 Background to selection

This habitat type is widespread in the dunes of northern and western Europe. In the UK it is widespread but rare, being estimated to cover less than 1,000 ha, and has a limited range of ecological variation. Sites have been selected to take account of the rarity of the habitat type in the UK and its wide geographical range.

This habitat type comprises dunes or parts of dunes where creeping willow is abundant or dominant. Creeping willow *Salix arenaria* (known in the UK as *Salix repens* subsp. *arenaria*) is found in dunes throughout the UK. It grows predominantly in and around dune slacks, though on some sites it may spread up the drier dune ridges.

This type of vegetation marks the mature phase in the life cycle of calcareous dune slacks. When found with other wetland and dry dune vegetation it indicates that successional processes are still active and that the structure and function of the dune system are well conserved. On most of the highest quality sites this habitat type occurs alongside a number of others, particularly humid dune slack, calcareous and acidic fixed dune vegetation and, locally, dune heath.

Creeping willow is often found in dune slack vegetation and the boundaries between **Dunes with *Salix arenaria*** and **Humid dune slacks** are often diffuse and difficult to define on the ground. The examples chosen to represent the former are all ones where creeping willow is dominant, forming prominent, low, scrubby growth, sometimes referred to as 'hedgehog dunes'. This type of vegetation tends to occur in and around mature slacks where there has been little or no sand movement for some time and where grazing is light. Creeping willow tends to grow most vigorously at the drier end of the spectrum of slack vegetation types and it is also mainly associated with calcareous dune sites. The habitat type is best developed in the southern half of the UK, therefore most of the sites selected are in England and Wales. Most examples of creeping willow on dunes in Scotland have been allocated to the Annex 1 habitat type **Humid dune slacks**. Only one site in Scotland, Invernaver, can be confidently allocated to the **Dunes with *Salix arenaria*** habitat type, because of the abundance of *Salix*. Elsewhere in the UK, **Dunes with *Salix arenaria*** is of only local occurrence on most sites, Sefton Coast being exceptional in supporting a substantial area, with creeping willow extending out of the slacks onto the adjoining dry dunes.

2.2.6.2 Site list

Braunton Burrows (8)

This is one of the largest virtually intact dune sites in the UK and is representative of the habitat type in south-west England. **Dunes with *Salix arenaria*** are scattered across the site and form part of a complex mosaic of vegetation containing creeping willow, including early and mature successional stages of dune slack vegetation. There are transitional stages between this type and more mature scrub vegetation.

Burry Inlet: Dunes/Cilfach Burry: Twyni (292)

This site is representative of the habitat type in the south Wales part of its range. Three dune systems associated with the Burry Inlet - Whiteford and Pembrey Dunes, Laugharne and Pendine Burrows - contain examples of **Dunes with *Salix arenaria***. This habitat type forms part of the range of dune habitats on the site.

Drigg Coast (139)

The Drigg Coast contains a number of **Dunes with *Salix arenaria***. These span a range of hydrological conditions from very wet to relatively dry. The slacks also grade into more acidic **humid dune slacks** with some interesting intermediate types. This site is representative of this habitat type in northern England.

Glannau M^n: Twyni/Anglesey Coast: Dunes (294)

This site comprises an extensive area of dunes in north Wales with a complete range of dune vegetation, including substantial areas of slack vegetation dominated by creeping willow *Salix arenaria*. Despite the extent of afforestation, the dune aquifer retains its overall integrity, although changes in water table, partly attributable

to the growth of the forest, have influenced the development of the dune slacks. There is long-term potential for further improvement.

Invernaver (142)

This is the only Scottish site that can be confidently allocated to the habitat type, because of the relative density of creeping willow. The site is an extreme northern variant of the habitat type and contains a wide range of sand dune habitats. **Dunes with *Salix arenaria*** occurs in hollows among hummocky dunes and within narrow blowouts in two main areas and extends into areas of 'climbing dunes' where sand has been blown up onto cliffs.

Kenfig/Cynffig (7)

This site contains one of the largest series of dune slacks in Wales. The dune slacks are species rich and there are extensive areas of **Dunes with *Salix arenaria***, which represent a mature phase in dune slack development. This site is in the central part of the range of this community on the west coast and is a highly representative example of this habitat type.

Magilligan (219)

This is one of the largest calcareous dune systems in the UK. It has an extensive and well developed series of dune slacks which contain virtually all of the dune slack vegetation in Northern Ireland. Most of the slack vegetation is dominated by creeping willow *Salix arenaria*, although more open humid slacks and older hollows filled with mire vegetation also occur.

Morfa Harlech a Morfa Dyffryn (311)

Both Morfa Harlech and Morfa Dyffryn have comparatively large areas of **Dunes with *Salix arenaria*** and Yorkshire-fog *Holcus lanatus*, especially in some of the older, more inland parts of the system. In addition, there are two other dune slack communities that support creeping willow.

North Northumberland Dunes (237)

The dunes of Holy Island and Ross Links are calcareous and this site has been chosen to represent the **Dunes with *Salix arenaria*** habitat type on the north-east coast of England. Creeping willow *Salix arenaria* dominates the more mature dune slacks and a number of rare plant species are associated with this type of vegetation. The mature slacks contribute to the wide range of habitats found on this site and form part of a well-developed successional series.

Penhale Dunes (6)

This large hindshore dune system contains well-developed dune slacks supporting a range of dune slack vegetation, including some that are dominated by creeping willow *Salix arenaria*. The site has been selected to represent the **Dunes with *Salix arenaria*** habitat type in the extreme south-west of its range in the UK. Geomorphological and successional processes are active on the site and its structure and function are well conserved.

Sandwich Bay (152)

The small area of **Dunes with *Salix arenaria*** found at this site is of interest as it is the only example found in the dry south-east of England and is representative of this habitat type in a near continental climate.

Sefton Coast (151)

There are extensive dune slacks dominated by creeping willow *Salix arenaria* on this site, which is particularly important for the **Dunes with *Salix arenaria*** habitat type. A recent survey of dune vegetation in England showed that 43% of the total area (99 ha) of the main dune slack community dominated by creeping willow occurred here on the west coast of England. The species also dominates areas of free-draining dune grassland to a much greater extent than at most other UK sites. Despite some urban and recreational development, both successional and geomorphological processes are still active and the structure and function of the site as a whole

is still well conserved. Management, including partial deforestation, has taken place in recent years to maintain and enhance these processes.

2.2.7 Humid dune slacks (16.31 to 16.35)

2.2.7.1 Background to selection

Dune slacks are widespread but local in the UK and the habitat type exhibits considerable ecological variation. Mainly owing to the cool wet climate of the UK, humid dune slacks are a more prominent feature of dunes in the UK than in many other European countries, and the UK has a significant proportion of the EC resource. Site selection has been carried out to take account of the geographical range and ecological variation of this habitat type, as well as the fact that the UK has special responsibilities for its conservation.

Dune slacks are low-lying areas within dune systems that are seasonally flooded and where nutrient levels are low. They occur primarily on the larger dune systems in the UK, especially in the west and north, where the wetter climate favours their development when compared with the generally warmer and/or drier continent. The range of communities found is considerable and depends on the structure of the dune system, the successional stage of the dune slack, the chemical composition of the dune sand and the prevailing climatic conditions. Creeping willow *Salix arenaria* is often found in dune slack vegetation and the boundaries between **Humid dune slacks** and **Dunes with *Salix arenaria*** are often diffuse and difficult to define. While **Humid dune slacks** include creeping willow, the habitat type excludes those sites where the species is dominant. It is variously associated with Yorkshire-fog *Holcus lanatus* and the bryophytes *Campylium stellatum* and *Calliergon cuspidatum*. A further community is typified by silverweed *Potentilla anserina* and common sedge *Carex nigra.* Site selection for this habitat type has attempted to encompass the full range of this variation.

True dune slacks are fed mainly by rain water and are characterised by a pattern of pronounced annual fluctuation of the water table, related to the land form of the dune system as well as climate and the nature of the underlying sediment - whether porous shingle or impervious clay. Variations in the extent and duration of flooding of the dune surface are very important in determining the vegetation and influence the breeding of aquatic species, including the rare natterjack toad *Bufo calamita.* A range of other wetland types, especially swamp, mire and tall herb fen communities, occur on some dunes. These communities are not confined to dunes, although they comprise an important part of the mosaic of vegetation characteristic of dune slack and are dominant at a few dune sites.

In selecting sites, preference has been given to specialist plant communities of wetter and more frequently flooded slacks, and those at an early successional stage. These dune slacks are often rich in plant species, particularly rare and local species. Several species, such as the fen orchid *Liparis loeselii* and round-leaved wintergreen *Pyrola rotundifolia,* are found mainly in this habitat type. Humid dune slacks occur on calcareous sand, where the slack vegetation is similar to that of small sedge mires (mires with low-growing sedges), or on acidic dunes where the vegetation may have affinities to wet heath. This variation has been encompassed within the site selection.

Successional and hydrological processes are crucial to the maintenance of the structure and function of humid dune slacks. The sites where these two processes are least restricted have special value in terms of long-term conservation and so have been selected.

2.2.7.2 Site list

Barry Links (145)

This is a virtually intact dune system, composed predominantly of base-poor sand on the east coast of Scotland. The slacks range from species-rich, open types to those with a closed canopy of scrub. The hydrology of the site is well conserved and successional processes can be seen operating. The site has some morphological similarities to Braunton Burrows, though the range of communities is different owing to the different soil base status and climate. The **Humid dune slacks** occur in a complex mosaic with other sand dune habitats, several of which have been proposed as Annex I habitat types in their own right.

Braunton Burrows (8)

This is one of the largest virtually intact dune sites in the UK, with an exceptionally large area of **Humid dune slack** vegetation, representing a significant proportion of the national resource. The slacks have formed in base-rich sand and are rich in species such as marsh pennywort *Hydrocotyle vulgaris,* marsh helleborine *Epipactis*

palustris and round-leaved wintergreen *Pyrola rotundifolia.* Vegetation types range from those with almost permanent water to those dominated by scrub. The site contains representative examples of most of the communities of base-rich humid slacks in south-west England, namely those characterised by creeping willow *Salix arenaria,* those with bryophytes or those with Yorkshire-fog *Holcus lanatus*.

Dornoch Firth and Morrich More (265)

Morrich More in north-east Scotland is one of the largest acidic dune sites in the UK. The sequence of development has resulted in the formation of extensive humid slack communities of an acidic character which lie as parallel hollows between the dune ridges and form part of a complex mosaic of dune habitats, several of which have been proposed as Annex I habitat types in their own right. This is the most important acidic dune system in Scotland, owing to its size and the exceptional diversity of the habitats within it.

Glannau M^n: Twyni/Anglesey Coast: Dunes (294)

This site provides representation of dune slack vegetation in north Wales. There are large areas of open dune vegetation and many **Humid dune slacks** remain, although there have been changes in the water table that are partly attributable to the growth of the commercial forest. The changes have influenced the development of humid dune slacks, which nonetheless retain most the essential features of the habitat type.

Kenfig/Cynffig (7)

This site contains the most important example of humid dune slack in the UK, owing to the extent of the habitat type and the conservation of its structure and function. These calcareous dune slacks are also amongst the most species-rich in the UK and provide representation of the habitat type in south Wales. They support communities dominated by a variety of mosses and a number of rare plants, notably the fen orchid *Liparis loeselii,* for which the site has been separately selected. Some of the dune slacks on the site are still in the early successional stage of development.

Magilligan (219)

This site is one of the largest dune systems in the UK and provides a representation of this habitat type in Northern Ireland. It has an extensive and well developed series of dune slacks, which contain virtually all of the dune slack vegetation in Northern Ireland. The dunes are of an acidic character. A wide range of slack vegetation occurs on the site, including wet open dune slacks at an early successional stage, slacks dominated by creeping willow *Salix arenaria* and older hollows filled with mire vegetation. The hydrology of the site is little modified and the structure and function of the site are therefore well conserved.

Morfa Harlech a Morfa Dyffryn (311)

Morfa Harlech a Morfa Dyffryn (Morfa Harlech and Morfa Dyffryn) is one of two sites chosen as representative of dune slack vegetation in north Wales. Examples of three different humid dune slack communities have been recorded within the complex. The dune slack vegetation with silverweed *Potentilla anserina* and common sedge *Carex nigra* is particularly well developed.

North Norfolk Coast and Gibraltar Point Dunes (276)

The slacks within this site are comparatively small and the Yorkshire-fog *Holcus lanatus* community predominates. The slacks provide representation of the habitat type on the dry east coast of England and present an extreme of the geographical range and ecological variation of humid dune slacks within the UK. They are calcareous and complement the acidic dune slacks at Winterton-Horsey Dunes, also in eastern England. The dune slack communities occur in association with swamp communities.

North Northumberland Dunes (237)

This site represents a rare example of well-developed slack vegetation on the east coast of England. Holy Island contains a number of calcareous, species-rich dune slacks, which support a number of rare species, such as coralroot orchid *Corallorhiza trifida,* dune helleborine *Epipactis leptochila* var. *dunensis* and seaside centaury *Centaurium littorale*. Active slack formation is continuing at this site and a range of successional stages are present. The humid dune slacks of nearby Ross Links contain vegetation typical of more base-poor conditions.

The site as a whole therefore contains an exceptional range of humid dune slack types, including 40 ha of the full range of slack vegetation types characterised by common sedge *Carex nigra.*

Sands of Forvie (143)

This site is representative of dune slack in north-east Scotland and is an example of an acidic dune system. The humid dune slack vegetation is mainly of an acidic type, with extensive areas of wet heath, characterised by crowberry *Empetrum nigrum* and cross-leaved heath *Erica tetralix,* and transitions to dune heath. Early stages in slack development occur, with the dune slack flora characterised by common sedge *Carex nigra* and marsh pennywort *Hydrocotyle vulgaris.* Higher zones have more creeping willow *Salix arenaria,* which tends to invade and replace the wet heath.

Sefton Coast (151)

This is a large area of predominantly calcareous dune vegetation, containing extensive areas representative of humid dune slacks in north-west England. Some active slack formation can still be seen and a variety of successional stages are represented. The sequence from foredunes to dune grassland and dune slack is extensive. The site contributes to the range and variation of humid dune slack vegetation, being a large and representative base-rich system toward the northern limit for some humid dune slack communities along the west coast of Britain.

Winterton - Horsey Dunes (144)

The slacks within this site are chiefly of interest because they occur on an extremely base-poor dune system on the dry coast of East Anglia in eastern England. Because of their acidic soils, the dunes support swamp and mire communities, in addition to small areas of typical dune slack vegetation characterised by creeping willow *Salix arenaria* with *Calliergon cuspidatum* and Yorkshire-fog *Holcus lanatus*. As a result they represent an extreme of the geographical range and ecological variation of humid dune slacks within the UK.

2.2.8 **Machair** (1.A)

2.2.8.1 Background to selection

Machair is a distinctive sand dune formation that is found nowhere else in the world but the north and west of Scotland and western Ireland. It is estimated that more than two-thirds of the machair resource is found in Scotland. Therefore, the UK and Ireland have particular responsibility for the protection of this habitat type. Machair is a priority habitat in Ireland but not in the UK. Site selection takes account of the UK's special responsibility for the conservation of this habitat type.

The machair of the UK shows a wide range of variation, far greater than occurs in Ireland. Site selection takes account of this variation in physical type and the mainly Scottish distribution of the geographic centres. The largest sites have been selected, as these include the most diverse examples of transition to other habitats. The sites selected cover approximately 50% of the entire Scottish and world resource.

Machair is formed by a particular combination of physical factors, including climate and landform. Sand with a high shell content is blown onshore by the westerly winds that prevail in the north and west of Scotland, onto a low lying coastal plain. Vegetation develops that is typical of calcareous to neutral sandy grassland. In these northern locations the machair grassland has a number of species extending their southern range on the west coast. The most extensive and floristically rich formations occur as a mosaic of driftline, foredune, machair plain and transitions to saline lagoons and saltmarsh, or to calcareous lochs, acidic grasslands, fens, heath or bog.

It is believed that machair grassland has been modified by man throughout its development on the sandy coastal plains of north-west Scotland. Therefore, traditionally, machair supports extensive grazing regimes and unique forms of cultivation that rely on low-intensity systems of rotational cropping. This traditional agriculture sustains a rich and varied dune and arable weed flora. Some of the arable weed species are now largely restricted in the UK to these traditionally managed areas. The habitat type also supports large breeding bird populations and is particularly important for waders and the corncrake *Crex crex*.

Machair complexes occur in the Outer and Inner Hebrides and to a smaller extent on the mainland and the Northern Isles. The Outer Hebrides supports the largest and richest examples of cultivated machair and a variety of uncultivated machair types. The Inner Hebrides machair complexes are largely uncultivated, as are those in Ireland. The largest and best developed area of machair on the mainland is Sheigra - Oldshoremore.

2.2.8.2 Site list

Coll Machair (183)

This machair complex is uncultivated, seasonally grazed in parts and has a high species diversity. The site is a complex of dune, wetland and machair habitats. It has a particularly diverse series of transitions to other habitats because of its complex physical structure. Coll Machair is representative of this habitat type in the Inner Hebrides and is the second largest area of machair in this part of Scotland. On Totamore Dunes, a foredune ridge is succeeded by a series of erosion and accretion features, dominated by a mosaic of semi-fixed dune and particularly species-rich slack communities. On the landward side, Machair Mhor is the best example of a machair plain on Coll, grading from dry to wet machair and then into swamp communities. In the north the dune system has dammed a valley, resulting in the formation of Loch Ballyhaugh. Slender naiad *Najas flexilis* is found in the loch, and the site has been proposed for this Annex II species in its own right. Semi-fixed dune communities dominate Crossapol and Gunna, interspersed with a mosaic of fixed dune communities that are particularly species-rich. On the edge there are transitions from wet machair and dune slacks to wet heath, and a complex of small, species-rich machair lochs.

Monach Islands (35)

This complex is representative of machair types found in the Outer Hebrides of Scotland and is similar to that found on North Uist. These islands consist almost entirely of machair and support some of the best examples of grazed uncultivated machair in the Outer Hebrides. There are rich calcareous grasslands as well as transitions to loch and acidic grassland. The islands are separated from outside human influences by 10 km of sea, and have been uninhabited and uncultivated since 1947. There are few human visitors, compared with other machair

systems, and therefore little interference with ecological processes. They provide a reference point for measuring the impact of human activities on machair systems.

North Uist Machair (264)

North Uist contains very extensive areas of both wet and dry machair. The machair in North Uist is different from that found on South Uist because of local differences in traditional methods of cultivation. A high proportion of the machair on North Uist has been traditionally cultivated or used for rough pasture, although areas of uncultivated machair found at Baleshare and Kirkibost are of interest because of their high species diversity. The site supports the second largest extent of machair in the Outer Hebrides. There is a mosaic of other habitats, with well-developed lochs and fens (e.g. at Balranald Bog) and transition to saltmarsh and sediment flats (e.g. Baleshare and Kirkibost, and Vallay). Machairs Robach and Newton is regarded as the most dynamic system in the Uists. The wet machair supports an unusual population of the southern species sea rush *Juncus maritimus*, its only occurrence in the Uists.

Oldshoremore and Sandwood (149)

This complex is one of the largest and least disturbed examples of machair on mainland Scotland. It is perhaps the most species rich in the site series for the habitat type. The areas of machair grassland within the site are uncultivated and, mostly, grazed. They represent floristic communities not found on any other machair, for example mountain avens *Dryas octopetala* heath. Mainland plant communities tend to be more varied than those on the islands and the machair flora of this area is particularly species-rich.

South Uist Machair (39)

This is the most extensive cultivated machair system in Scotland, extending the whole length of the island and up to 2 km inland. There is extensive grazing, and rotational cultivation, mainly to provide cattle fodder. The area is very diverse in physical form and is extremely rich in plant species. Extensive areas of wet machair include transitions to machair lochs or wet heath, marshes and peatland. The site is proposed for several of these Annex I habitat types in their own right. The standing waters within the site exhibit a wide range of pH and salinity. Slender naiad *Najas flexilis* occurs in a number of them and the site is proposed for this Annex II species in its own right.

Tiree Machair (186)

This site is considered to be the most extensive and diverse area of machair beyond the Outer Hebrides. 24% of the total area of the island is machair. The complex of machair on Tiree is uncultivated and has a long history of seasonal grazing. There is a diverse series of physical machair formations. The Tiree complex is also noteworthy as one of the few examples of rabbit-free machair anywhere in Scotland. An Fhaodhail & The Reef is an extensive area of wet machair grading into an extensive marsh and wetland (An Fhaodhail), and is the only site in the Inner Hebrides that is influenced by saline water, although this has recently been restricted by the insertion of a tidal flood gate. The site is unusual in that it is grazed only by cattle, a traditional management practice that has maintained an extremely rich and varied flora. In contrast, Hough Bay - Balevullin is a complex of dry machair and hummocky dunes forming an intricate mosaic with wet machair and dune slack vegetation.

2.2.9 *Dune juniper thickets (*Juniperus* spp.)* (16.27)

2.2.9.1 Background to selection

Dunes with juniper *Juniperus* spp. are widespread but uncommon on the coasts of Europe and rare in the UK. Northern variants of the community, with juniper *Juniperus communis*, occur in Britain and Denmark, while different species of juniper occur on the Iberian and Mediterranean coasts. Both prostrate and erect forms of juniper can be found and stands occur in a mosaic with dune grassland and heath. Stands are usually very small, occur only occasionally and are intimately mixed with other Annex I habitat types. There is complete range from discrete stands to more scattered and occasional individuals, which occur within habitat types defined as fixed dunes. Only two UK sites are known, both in Scotland, and both have been selected.

2.2.9.2 Site list

Dornoch Firth and Morrich More (265)

Morrich More is the most important site in the UK for juniper *Juniperus* spp. stands on dune. Stands of juniper cover approximately 10 ha, with scattered individuals over a larger area. The juniper is extremely well developed on the dry ridges and transitions to dune slacks. The best stands occur in grasslands in the southern sector, but prostrate individuals also extend into wet heath and slack habitats within the site.

Invernaver (142)

Invernaver contains a high density of dune habitats in a relatively small area, with an extensive transition zone to non-dune conditions. **Dune juniper thickets** occur in their more dispersed form, with scattered individuals occurring relatively widely. Of particular interest is the occurrence of the scattered form of dune juniper thickets on 'climbing dunes' found where sand has been blown onto cliff slopes, giving complex transitions from dune to cliff habitats and mountain avens *Dryas octopetala* heath. Juniper is also found as more discrete areas of low scrub in the dunes, extending as more scattered individuals into the non-dune habitats of this site.

2.2.10 Open grassland with *Corynephorus* and *Agrostis* of continental dunes (64.1 x 35.2)

2.2.10.1 Background to selection

This is an extremely rare habitat in the UK that is found in one small part of the Breckland area of East Anglia, eastern England. One site has been selected; it includes some of the few small remnants of the inland sand dunes that once occurred over a wider area of Breckland.

Dune grassland containing grey hair-grass *Corynephorus canescens* occurs on the coast and very rarely inland in the UK. However, the term 'continental' is interpreted by the EC Habitats Committee to correspond only to inland examples of the habitat type, and this is reflected in site selection.

2.2.10.2 Site list

Breckland (287)

Wangford Warren and adjoining parts of RAF Lakenheath are included in the Breckland site as the only occurrence of this habitat type in the UK.

Section 2.3: Freshwater habitats

2.3.1 Oligotrophic waters containing very few minerals of Atlantic sandy plains with amphibious vegetation: *Lobelia, Littorella* and *Isoetes* (22.11 x 22.31)

2.3.1.1 Background to selection

This is a rare habitat type throughout the Atlantic biogeographic region of Europe and also in the UK, as it is restricted to sandy plains that are acidic and low in nutrients. The only known high quality examples of this habitat type occur on fluvio-glacial deposits in the New Forest and on the Cheshire Plain, and on more recent sand deposits of marine origin in the Outer Hebrides. Only three sites have been identified that are considered to represent high quality examples of this habitat type and all three sites have been selected.

This type of water body contains soft water with few plant nutrients, and sediments that are low in nutrients. The catchment area of the machair lochs in the Outer Hebrides is acid moorland and that of the other sites is acid lowland heathland. The water is typically very clear and moderately acid. Destruction of lowland heaths, land drainage and nutrient enrichment have contributed to the scarcity of the habitat type.

The habitat type is characterised by the presence of *Littorelletalia*-type vegetation. Such vegetation is characterised by the presence of water lobelia *Lobelia dortmanna*, shoreweed *Littorella uniflora*, quillwort *Isoetes lacustris* or spring quillwort *I. echinospora*. Only one species needs to be present to conform with the definition of this Annex I type and typically the vegetation consists of zones in which the individual species form submerged, monospecific lawns.

It should be noted, however, that away from sandy plains, oligotrophic waters are widespread and locally abundant. In the uplands of Scotland and Wales, this type of plant assemblage is relatively common. In England the upland equivalents of this habitat type are found mainly in the Lake District.

2.3.2.1 Site list

Oak Mere (128)

Oak Mere is a lake, in the West Midlands of England, formed within sediments that are low in nutrients and oligotrophic. It is a large water body that has formed in a kettle hole in the fluvo-glacial sands of the Cheshire Plain. The site has clear water of low nutrient status characteristic of oligotrophic waters and a marginal zone of shoreweed *Littorella uniflora*. The site supports an assemblage of plants that are now rare in the lowlands of England, including floating mats of bog moss *Sphagnum* spp. and the scarce narrow small-reed *Calamagrostis stricta.*

South Uist Machair (39)

This site encompasses a series of oligotrophic lochs on the machair plains of the west coast of South Uist in the Outer Hebrides, Scotland. It is considered to be the most important site in the UK for the conservation of this habitat type, owing to the diversity and extent of the habitat type and because these lochs contain all three characteristic plant genera (water lobelia *Lobelia*, shoreweed *Littorella* and quillwort *Isoetes*). The oligotrophic lochs form one element of a series of lochs, which range from dystrophic lochs on inland peat bogs, through oligotrophic lochs of this type in areas of transitions between peat and calcareous sands, to calcareous lochs of the main machair plain and brackish sea lochs closest to the sea. Oligotrophic waters in this composite site are Lochs Fada, na Tanga, na Cuithe Moire, a'Phuirt-ruaidh, a'Chnoic Bhuidha and Schoolhouse Loch.

The New Forest (5)

Hatchet Pond in the New Forest in the south of England is in fact three ponds, one of which is an example of an oligotrophic water body amidst wet and dry lowland heath developed over fluvial deposits. It contains shoreweed *Littorella uniflora* and isolated populations of northern species such as bog orchid *Hammarbya paludosa* and floating bur-reed *Sparganium angustifolium*, alongside rare southern species such as Hampshire-purslane *Ludwigia palustris.* Hatchet Pond is therefore important as a southern example of this lake type where northern species, more common in the uplands of the UK, co-exist with southern species.

2.3.2 Oligotrophic waters in medio-European and perialpine areas with amphibious vegetation: *Littorella* and *Isoetes* or annual vegetation on exposed banks (*Nanocyperetalia*) (22.12) + (22.31 & 22.32)

At their meeting on 5 December 1994, the EC Habitats Directive Scientific Working Group revised the definition for this type, extending it to include the UK. The revised wording is: "Oligotrophic to mesotrophic standing waters of plains to subalpine levels of the Continental and Alpine Region and mountain areas of other regions, with vegetation belonging to *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*."

2.3.2.1 Background to selection

This type of water body occurs in the majority of Member States and is relatively abundant in the more mountainous areas of Europe. In the UK this freshwater habitat type is largely confined to the mountainous regions of the north and west and is characterised by two intergrading types: oligotrophic and mesotrophic waters. While each supports a characteristic plant community, the dominant substrate types of both oligotrophic and mesotrophic waters are silt, sand, gravel, stones and boulders.

Sites have been selected to include representatives from each of the main mountain areas in the UK. Preference has been given to sites where the characteristic plant species are abundant and water quality is high. The presence of arctic fish and invertebrate populations has also been favoured in site selection. However, only a small part of the EC resource of this habitat type occurs in the UK, and this is reflected in the number of sites selected.

The clear, soft water which characterises this habitat type contains low to moderate levels of plant nutrients and supports a characteristic assemblage of plant species. The vegetation community is characterised by amphibious short perennial vegetation, with shoreweed *Littorella uniflora* being considered a defining component. This species often occurs in association with water lobelia *Lobelia dortmanna*, bog pondweed *Potamogeton polygonifolius*, quillwort *Isoetes lacustris*, bulbous rush *Juncus bulbosus*, needle spike-rush *Eleocharis acicularis*, alternate water-milfoil *Myriophyllum alterniflorum* and floating bur-reed *Sparganium angustifolium*. Taxa such as yellow water-lily *Nuphar lutea*, amphibious bistort *Persicaria amphibia*, stoneworts *Chara* spp., least bur-reed *Sparganium natans* and other pondweed *Potamogeton* species may be present in more mesotrophic conditions. Most of these species are common components of the aquatic flora of standing waters in the mountainous regions of the north-west. Floating water-plantain *Luronium natans* and pillwort *Pilularia globulifera* are two nationally scarce plants that occur in this plant assemblage. The marginal components of this community can be exposed on the lake shores during the summer.

Standing waters qualifying for selection for this habitat type are those classified as oligotrophic (Types 2 and 3) and mesotrophic (Type 5) according to the Nature Conservancy Council classification (Palmer 1989).

2.3.2.2 Site list

Cairngorms (209)

The Cairngorm mountains, Scotland, contain the highest oligotrophic water bodies in the UK. This complex of lochs has a range of high altitude conditions. The very highest waters (the corrie and plateau lochs at >900 m) have rocky substrates and very low nutrient status and suffer the harshest climate. In combination, these factors lead to low species diversity and the absence of aquatic macrophytes. This is an extreme variation of the habitat type. Lochs in the valley floors enjoy more sheltered conditions and the occurrence of finer sediments allows limited establishment of higher plants, although these are still extremely oligotrophic systems. Key species for this habitat type are present in Loch Einich (altitude 500 m). The lochs in this area are classified as Type 3 or in some cases Type 2.

Eryri/Snowdonia (118)

Llyn Idwal, north Wales, is selected as an oligotrophic water (Type 3) chosen to represent this habitat type in the mountains of Snowdonia. It is a relatively small, shallow, upland corrie and complete ice cover has been recorded in winter. No overall change in the lake's water chemistry has been found between the mid 1800s and 1995, when the loch was last sampled, and the water quality is considered to be high. The site has a good representation of typical plant species, including quillwort *Isoetes lacustris*, water lobelia *Lobelia dortmanna*,

shoreweed *Littorella uniflora,* bulbous rush *Juncus bulbosus,* alternate water-milfoil *Myriophyllum alterniflorum* and intermediate water-starwort *Callitriche hamulata.* Bog pondweed *Potamogeton polygonifolius* has been recorded from stream inlets, and pillwort *Pilularia globulifera* is reported from this site. Emergent and floating vegetation is mainly confined to the shallow sub-basin at the south end of the site, where floating bur-reed *Sparganium angustifolium* forms extensive mats, alongside stands of common reed *Phragmites australis,* water horsetail *Equisetum fluviatile* and bottle sedge *Carex rostrata.*

Llyn Cwellyn (308)

Llyn Cwellyn, north Wales, is an oligotrophic glacial lake (Type 3) that has been selected to represent mountainous oligotrophic lakes found in Snowdonia. It is a relatively large, deep lake in contrast to Llyn Idwal, also in Snowdonia. Because of its depth the lake stratifies during the summer, with a thermocline developing at 10-15 m that has a marked effect upon the ecology of the site. Although the site has acidified since the late 1800s, water quality remains high and Llyn Cwellyn supports one of the few native Welsh populations of Arctic charr *Salvelinus alpinus* (*Torgoch* in Welsh). The macrophyte flora of Llyn Cwellyn is characterised by abundant shoreweed *Littorella uniflora,* water lobelia *Lobelia dortmanna,* quillwort *Isoetes lacustris,* bulbous rush *Juncus bulbosus* and alternate water-milfoil *Myriophyllum alterniflorum*. The rare awlwort *Subularia aquatica* is abundant in places and floating water-plantain *Luronium natans* was recorded at this site in 1994. Six-stamened waterwort *Elatine hexandra* has been recorded in shallow water off the north shore and bog pondweed *Potamogeton polygonifolius* occurs in stream inflows in the south.

Lough Melvin (309)

Lough Melvin is a large mesotrophic lough that has been selected to represent this habitat type in Northern Ireland. The north-east corner of the lough is in Fermanagh but the majority lies in Leitrim in the Republic of Ireland. It is the least disturbed of the large loughs of Northern Ireland, the other sites having suffered from eutrophication and hydrological manipulation. The macrophyte flora is typical of a mesotrophic lake with affinities to oligotrophic waters. The flora is indicative of high water quality and is characterised by quillwort *Isoetes lacustris,* shoreweed *Littorella uniflora,* water lobelia *Lobelia dortmanna,* alternate water-milfoil *Myriophyllum alterniflorum* and a variety of pondweeds, including various-leaved pondweed *Potamogeton gramineus,* perfoliate pondweed *P. perfoliatus* and bright-leaved pondweed *P.* x *nitens,* which are widespread. The Lough also supports important native fish populations. The Arctic charr *Salvelinus alpinus* occurs here at its only remaining Northern Ireland site and the Lough contains three genetically distinct populations of brown trout *Salmo trutta.*

River Derwent and Bassenthwaite Lake (297)

Bassenthwaite Lake in the Lake District, England, is chosen as an example of a mesotrophic water body (Type 5), an unusual type to find in mountain areas. It is a large lake with an extensive catchment area and consequently is subject to rapid through-flow of water and moderate nutrient status. A wide variety of pondweeds *Potamogeton* spp. are found, including perfoliate pondweed *P. perfoliatus*, small pondweed *P. berchtoldii* and curled pondweed *P. crispus*, which are widespread, whilst red pondweed *P. alpinus*, various-leaved pondweed *P. gramineus* and lesser pondweed *P. pusillus* are more locally distributed. Uncommon species present in the community are the autumnal water-starwort *Callitriche hermaphroditica* and the six-stamened waterwort *Elatine hexandra.* The shorelines are extensive and relatively undisturbed compared with other major Cumbrian lakes. Much of the shore is of shingle or gravel, but soft peat has accumulated around Bowness Bay. Several sedge species are found in such areas, including a local northern species, the water sedge *Carex aquatilis*. On stony shores the common spike-rush *Eleocharis palustris* is locally abundant amongst species such as the globe-flower *Trollius europaeus*, saw-wort *Serratula tinctoria* and the nationally rare thread rush *Juncus filiformis.* The lake also supports one of only two UK populations of a rare fish, the vendace *Coregonus albula*. Now extinct in Scotland, the only other known population of vendace is found in Derwentwater in the Lake District, England.

Wast Water (320)

Wast Water is chosen as a relatively large and deep example of an oligotrophic water body (Type 3) in the Lake District, England. Except for a small portion on Eskdale granite, Wast Water lies entirely on the Borrowdale volcanic rocks, and rocky substrates predominate along 73% of its shoreline. The submerged macrophyte communities of Wast Water are typical of oligotrophic lakes. Species such as bulbous rush *Juncus bulbosus,* quillwort *Isoetes lacustris,* shoreweed *Littorella uniflora,* awlwort *Subularia aquatica* and stoneworts *Nitella*

spp. are known to occur. Least bur-reed *Sparganium natans* and floating bur-reed *S. angustifolium* occur in more sheltered bays and are more typical of mesotrophic situations. Blunt-leaved pondweed *Potamogeton obtusifolius* has been recorded and bog pondweed *P. polygonifolius* occurs in the steam outlets. The macro-invertebrates of Wast Water are typical, including species of gastropod (wandering snail *Lymnaea peregra* and river limpet *Ancylus fluviatilis*), the leech *Erpobdella octoculata* and the triclad *Polycelis nigra*. Arctic charr *Salvelinus alpinus* occur in the lake.

2.3.3 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* formations (22.12 + 22.44)

2.3.3.1 Background to selection

Hard oligo-mesotrophic waters with benthic growths of stoneworts *Chara* spp. are scarce in the UK, and the best examples of this habitat type are restricted to the north and west. The sites selected represent the geographic range and ecological variation of the habit type and reflect its scarcity in the UK. In addition, selection has favoured examples with high water quality, particularly those likely to be unaffected by nutrient enrichment.

This habitat type is characterised by water with a high base content, most often calcium but very rarely magnesium, and is usually confined to areas of limestone and other base-rich substrates, from which the dissolved minerals are derived. In part the rarity of the habitat type is due to the fact that since calcareous rocks are free-draining, freshwater bodies occur on the surface of these rocks only very rarely. In addition, such water bodies are characterised by very clear water and low nutrient status. They are therefore largely restricted to situations where the catchment or aquifer from which they are supplied with water remains relatively unaffected by intensive land-use or other sources of nutrients, and they are most often found in areas supporting mosaics of semi-natural vegetation.

Charophytes (stoneworts) are typically the most prominent component of the vegetation; they can occur as dense beds that cover a significant part of the lake bottom over muddy marl deposits. The selected sites each contain a number of rare and local *Chara* species.

This habitat type occurs in three main situations and each is represented in the list of selected sites:

Lakes on a predominantly limestone substrate.
Coastal sites based on calcium-rich shell sands, also known as machair lochs.
Lakes with nutrient inputs from other base-rich influences, e.g. serpentine.

The first of these variants is most common and this is reflected in the site selection. Sites have been selected to represent the wide geographic range and variety of topographic situations in which this variant may occur in the UK. One machair loch site and one serpentine site are selected to cover the range of ecological variation. Examples of this habitat type also occur in abandoned mineral workings, dammed river valleys (i.e. Bosherston Lakes, Wales) and other artificial situations, but these have not been considered for selection because of their non-natural character.

2.3.3.2 Site list

Corsydd Môn/Anglesey Fens (96)

Within this site, Llyn Yr Wyth Eidion is a small active marl-producing lake in north Wales and is an example of a lake on limestone. It is surrounded by the extensive calcareous valley mire of Cors Erddreiniog, which overlies limestone and protects the lake against nutrient enrichment, resulting in water of high quality. The stoneworts *Chara pedunculata* and the rare *C. rudis* have been recorded at this site.

Craven Limestone Complex (190)

Malham Tarn in northern England is considered the best example of an upland stonewort *Chara*-dominated lake in England. It is the highest marl lake in the UK and is an example of a lake on limestone. The water drains from surrounding Carboniferous limestone and is calcareous and low in plant nutrients, although the Tarn has a large catchment and some nutrient enrichment to the system has occurred in the past, slightly reducing the floristic richness.

Durness (64)

This site contains a cluster of three marl lochs (Croispol, Borralie and Caladail) on the Durness limestone in the extreme north of Scotland. The water is very clear, low in nutrients and with little phytoplankton production. There are extensive growths of submerged macrophytes, including seven species of pondweed *Potamogeton* and three species of stonewort *Chara*. These are the northernmost examples of marl lakes in the UK and one of the

few high quality occurrences of the habitat type in Scotland. In addition, Borralie is the only marl lake in the UK with a population of Arctic charr *Salvelinus alpinus.*

Lismore Lochs (129)

This series of marl lochs (Loch Baile a'Ghoibbainn, Kilchernan Loch and Loch Fiart) is situated on metamorphic Dalradian limestone on the island of Lismore in Argyll, Scotland. They represent lakes on a limestone substrate and are one of the few high quality occurrences of this habitat type in Scotland. The component lakes have very clear water and are low in nutrients but with high alkalinity. The clarity of the water is reflected in the occurrence of long-stalked pondweed *Potamogeton praelongus* in Loch Baile a' Ghoibbainn at unusual depths - in excess of 6 m. The rare stoneworts *Chara rudis* and *C. curtis*, as well as the scarce *C. pedunculata*, have been recorded.

Magheraveely Marl Loughs (225)

These four loughs in County Fermanagh, Northern Ireland, are small inter-drumlin marl lakes fed by lime-rich water. They are examples of lakes on a predominantly limestone substrate. In comparison with other lakes in this part of Northern Ireland this site is important because the water has not been influenced by nutrient enrichment and remains clear, with a high lime content and low plant nutrient content. Stoneworts are the dominant submerged vegetation and include several rare and local species, including *Chara aspera, C. curta, C. hispida* and *C. pedunculata.*

Morecambe Bay Pavements (191)

Hawes Water is a lowland lake within the Morecambe Bay Pavements site in northern England. It has a foundation of deep lacustrine shell marl on Carboniferous limestone and is a lake on predominantly limestone substrate. The water is highly calcareous and the lake is fed by springs within it. This site is considered to be the best example of a lowland hard oligo-mesotrophic lake with *Chara* spp. in England, owing to the clarity, low nutrient status and high calcium content of its water. The rare stonewort *Chara rudis* and scarce species *C. aspera, C. hispida* and *C. pedunculata* occur here.

South Uist Machair (39)

This site in the Outer Hebrides, Scotland, contains oligo-mesotrophic waters of the machair loch type which derive the calcium content of their nutrient-poor waters from calcareous shell sand. This complex of high quality calcareous machair lochs occurs in an intermediate zone between the oligotrophic inland lochs and the eutrophic lochs found nearer the coast. As a result the site is proposed for several different Annex I habitat types in their own right. The lochs are the most extensive and diverse examples of calcareous machair lochs in Scotland and support a number of stoneworts, including the scarce *Chara aspera* and *C. hispida*. A strong maritime influence is discernible from their water chemistry and all sites have extensive areas of shell sand substrate. Owing to their location, these lochs are subject to a mixture of influences from peat and shell-rich sand. The lochs of this type within the South Uist Machair are: Loch Hallan, Grogarry Loch, Loch an Eilean, Mid Loch Ollay and Loch Toronish.

The Lizard (70)

The coastal peninsula of The Lizard in south-west England supports a nationally unique series of oligo-mesotrophic water bodies in which high base status is not due to limestone or shell sand. The Lizard is partly underlain by igneous serpentine rock which gives rise to calcium-deficient ground waters that are rich in magnesium. The groundwaters drain from adjoining wet and dry serpentine heaths to feed the oligo-mesotrophic water bodies in which another unusual feature is the occurrence of stoneworts *Chara* species typical of calcareous lakes, together with species normally associated with acid conditions, such as bog pondweed *Potamogeton polygonifolius*. Stoneworts present include three Red Data Book species - *Chara baltica*, *C. curta* and *C. fragifera*.

2.3.4 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation (22.13)

2.3.4.1 Background to selection

It is likely that natural eutrophic lakes are now uncommon in the EC, owing to pollution, but the exact status of the habitat type is unknown. In the UK lakes of this type are comparatively rare, although they have a wide and scattered distribution. Very few examples occur above 300 m. These water bodies have nutrient levels that are higher than those of oligotrophic, dystrophic or mesotrophic lakes, resulting in higher natural productivity, and are typically species-rich. However, very many such lakes have been damaged by over-enrichment with nutrients, resulting in hypertrophic conditions and a reduction in species richness. In Eastern England most of the lakes are polluted, but the peripheral grazing marsh and ditch systems contain relict eutrophic communities.

Sites have been selected to encompass the ecological variation and geographical range shown by this habitat type. The sites selected are amongst the largest examples of the habitat type, but selection has particularly favoured those examples that are least modified by human activity, particularly with regard to water quality, although few lakes of this type remain totally unaffected by artificial nutrient enrichment.

In the UK, *Hydrocharition*-type vegetation is rare in lakes and seems to be confined to Northern Ireland. In the rest of the UK the most complete expression of this community type is found in the ditch systems of the Norfolk Broads. The UK selection was based largely on the presence of remnants of the *Hydrocharition* (mainly duckweeds *Lemna* spp.) and a good representation of the *Magnopotamion*. Therefore, in the UK, eutrophic lakes typically contain aquatic macrophyte communities dominated by associations of stoneworts *Chara* spp., pondweeds *Potamogeton* spp., spiked water-milfoil *Myriophyllum spicatum* and yellow water-lily *Nuphar lutea*. Except in the most northerly areas, many eutrophic lakes are fringed by reedmace-common reed *Scirpo-Phragmitetum* associations. More northern shorelines may have reed canary-grass-shoreweed-spike-rush *Phalaris-Littorella-Eleocharis* associations. Most eutrophic lakes are formed on soft rocks but wave-washed rocky shores form an important part of the habitat on larger lakes.

Three main types of eutrophic lake can be identified and are represented in the list of sites selected:

southern eutrophic lakes
northern or western eutrophic lakes
coastal eutrophic lakes.

2.3.4.2 Site list

Breckland (287)

The Breckland Meres in Norfolk provide a representation of the habitat type in the east of England. They are examples of hollows within glacial outwash deposits and are fed by water from the underlying chalk aquifer. Natural fluctuations in groundwater tables mean that these lakes occasionally dry out. The flora is dominated by stonewort-pondweed *Characeae-Potamogetonaceae* associations.

Llangorse Lake/Llyn Syfaddan (131)

This is the largest lake in south Wales and is an example of a northern or western eutrophic lake of glacial origin, in this case lying on Old Red Sandstone. The flora is dominated by the pondweed - yellow water-lily *Potamogetonaceae-Nupharetum* associations, and the shoreline flora is a good example of the club-rush - common reed *Scirpo-Phragmitetum* association. Llangorse Lake has a different flora from that of Loch Watten, the other lake of this type selected, being richer in more southern elements such as shining pondweed *Potamogeton lucens.*

Loch Watten (130)

Although not the largest eutrophic lake in Scotland (the largest being Loch Leven), this large loch is one of the least affected by nutrient enrichment in Scotland. It is the largest of a series of kettle hole lochs overlying the Old Red Sandstone of the Caithness plain in the north of Scotland. The site is representative of a northern or western eutrophic loch of glacial origin in Scotland. The flora contains stonewort - pondweed - water-

milfoil *Characeae-Potamogeton-Myriophyllum* associations, with pondweeds well represented, and is rich in northern species. The shoreline is fringed by reed canary-grass - shoreweed - spike-rush *Phalaris-Littorella-Eleocharis* associations.

South Uist Machair (39)

This site is representative of the habitat type in the Outer Hebrides, Scotland, and contains a series of coastal eutrophic lakes formed on calcareous marine sediments on the machair plain. These lakes are the best examples of their type in the UK, owing to the richness of their flora. Stoneworts *Chara* spp. and pondweeds *Potamogeton* spp. dominate the aquatic community, and shorelines contain spike-rush *Eleocharis* associations. Lochs of this type within the site are: Loch Roag, West Loch Ollay, Loch Ardvule, Loch Stilligarry and Loch na Liana Moire. The South Uist Machair supports a unique transition from oligotrophic lochs on peatland towards the centre of the island, through mixed oligotrophic and mesotrophic lochs where the blacklands meet the machair, to eutrophic lochs over calcareous sand and brackish lochs on the west coast. This site has been proposed for many of these Annex I habitat types in their own right.

The Broads (166)

This site in East Anglia, England, contains several examples of southern eutrophic lakes. Although artificial, having arisen from peat digging in medieval times, these lakes and the ditches in areas of fen and drained marshlands support relict vegetation of the original fenland flora, and collectively this site contains one of the richest assemblages of rare and local aquatic species in the UK. The stonewort - pondweed - water-milfoil-waterlily *Characeae-Potamogeton-Myriophyllum-Nuphar* associations are well represented, as are club-rush - common reed *Scirpo-Phragmitetum* associations. Some Broads, such as Martham North, Martham South and Upton Broad, have escaped the problem of enrichment that has so affected the flora and fauna on many of the other Broads. Others, such as Hickling Broad, are recovering from these effects as a result of remedial measures. Martham North, Martham South, Upton and Hickling Broad contain holly-leaved naiad *Najas marina*, a national rarity. The dyke (ditch) systems support vegetation characterised by water soldier *Stratiotes aloides*, whorled water-milfoil *Myriophyllum verticillatum* and broad-leaved pondweed *Potamogeton natans.*

Upper Lough Erne (220)

Upper Lough Erne in Northern Ireland is a very large eutrophic lake situated in a drumlin landscape and has a predominantly limestone catchment. The site is an example of a northern or western eutrophic lake of glacial origin in Northern Ireland. The lake has a very long shoreline and numerous associated satellite lakes, many of which are included in the site. Aquatic vegetation of the *Magnopotamion* and *Hydrocharition* type is extensively developed. Both club-rush - common reed *Scirpo-Phragmitetum* and reed canary-grass - shoreweed - spike-rush *Phalaris-Littorella-Eleocharis* associations are well developed on the shore. There are transitions to swamp and fen vegetation.

2.3.5 Dystrophic lakes (22.14)

2.3.5.1 Background to selection

The status of this habitat type in the EC is unknown. In the UK **Dystrophic lakes** are widespread in the north-west and scarce in the south. Sites have been selected to take account of this distribution and to reflect the narrow range of ecological variation exhibited by this habitat type. The selected sites each contain a number of dystrophic water bodies. Sites with relatively large examples of the habitat type have been chosen.

Dystrophic systems most often occur on blanket bog and may include isolated seasonal pools, random collections of irregularly-shaped waters and ordered linear or concentric arrays of pools and small lochs. Dystrophic pools may be also found on raised bogs situated mainly on plains and valley bottoms.

These lakes are very acidic and poor in plant nutrients. Their water has a high humic acid content and is usually stained dark brown through exposure to peat. Most dystrophic lakes are small (less than 5 ha in extent) and shallow and contain a limited range of flora and fauna. The pools are naturally species-poor and a littoral zone is often absent. Fringing vegetation is that characteristic of the habitat in which the pools occur.

Dystrophic waters are a common feature of Scottish blanket bog, and the selected sites reflect the distribution of this habitat. Only a small number of dystrophic pools occur in the lowlands of England; those associated with bogs in the West Midlands of England have been seen as having particular value for nature conservation because of the rarity of the habitat type in this part of the UK. These pools are remnants of shallow glacial lakes that have largely become infilled owing to natural bog development.

2.3.5.2 Site list

Caithness and Sutherland Peatlands (174)

This site provides a representation of dystrophic lakes and pools on blanket bog in the north of Scotland. The scale and diversity of the peatlands of Caithness and Sutherland in northern Scotland (widely known as the Flow Country) make them unique in Europe. They form the largest peat mass in the UK and are three times larger than any other peat mass in the UK. Dystrophic waters are especially common in the Flow Country. By comparison with most other blanket bog systems, a this site water bodies account for a high proportion of the bog surface, owing to the presence on level or gently sloping ground of intricate patterns of ridges and hollows filled with dystrophic pools. Surface patterns and pool complexes occur in a variety of forms, reflecting different climatic and hydrological conditions within the site. A typical pattern has a cluster of larger, rounded pools on flat or slightly rounded summits, spurs or terraces. As the bog surface slopes away, the pools become smaller and elongated or curvilinear along the contour. Together with their intervening ridges they form concentric or eccentric patterns, usually decreasing in scale down the slope. Such a diversity of these features is not known elsewhere.

Rannoch Moor (92)

This site in the southern Highlands of Scotland is representative of dystrophic pools formed in upland blanket bog. The dystrophic lochans of this site exhibit considerable diversity in size, depth and shoreline type, including those with mineral shorelines, a relatively uncommon variant. These upland dystrophic waters are characteristically shallow and base-poor, with an impoverished flora and fauna.

West Midlands Mosses (172)

This site contains three pools, one at Clarepool Moss and two at Abbots Moss, that are examples of dystrophic lakes in the lowlands of England and Wales, where this habitat type is rare. The lake at Clarepool Moss is unusual as a dystrophic type on account of its relatively base-rich character, which is reflected in the presence of a diverse fauna and flora. The two at Abbots Moss are more typical, base-poor examples of dystrophic lakes. The dystrophic lakes at this site are associated with Schwingmoor development, a characteristic of this habitat type in the West Midlands. Schwingmoor is an advancing floating raft of *Sphagnum*, often containing *Eriophorum angustifolium* bog pool community, which grows from the edge of the pool and can completely cover over the pool, and the site has also been selected for this feature (**Transition mires and quaking bogs**) in its own right.

2.3.6 *Mediterranean temporary ponds (22.34)

2.3.6.1 Background to selection

Only two sites have been identified in the UK as supporting significant examples of this priority habitat type; both are in England and both have been selected.

This habitat type consists of winter flooded areas, which dry out to give vegetation rich in annuals, many of them of southern European distribution, nationally rare, and principally confined to this habitat type, for example pygmy rush *Juncus pygmaeus*, pennyroyal *Mentha pulegium*, and yellow centaury *Cicendia filiformis*. Only two sites in the UK are known to contain significant areas of this habitat type with the rich assemblage of the rare and local species for which the habitat type is noted.

There are two main pool types: a more acid community of trampled and grazed areas, often found on flooded trackways, and a basic type on serpentine rock found only at the Lizard, Cornwall.

2.3.6.2 Site list

The Lizard (70)

There are widespread examples of the serpentine variant of this habitat type on the Lizard heaths. A number of rare species, including chives *Allium schoenoprasum*, dwarf rush *Juncus capitatus* and land quillwort *Isoetes histrix*, occur in this habitat type. The acid pool type is the main locality on the Lizard for an important assemblage of rare species, including pigmy rush *Juncus pygmaeus*, three-lobed crowfoot *Ranunuculus tripartitus* and yellow centaury *Cicendia filiformis*. However, the habitat type is much reduced, owing to lack of adequate grazing and other disturbance in many parts of the heathlands.

The New Forest (**6**)

This site holds examples of acid to eutrophic temporary ponds with a range of plants characteristic of this habitat type, including coral-necklace *Illecebrum verticillatum*, allseed *Radiola linoides* and chaffweed *Anagallis minima*, in the more acid sites, and pennyroyal *Mentha pulegium* and small fleabane *Pulicaria vulgaris*, occurring in association with the more eutrophic ponds maintained by grazing and other disturbance. Some of these seasonal ponds are important for rare invertebrates such as the fairy shrimp *Chirocephalus diaphanus* and tadpole shrimp *Triops cruciformis.*

2.3.7 Floating vegetation of *Ranunculus* of plain and sub-mountainous rivers (24.4)

2.3.7.1 Background to selection

Floating mats of water-crowfoot *Ranunculus* spp. - sub genus *Batrachium* - are widespread in rivers and often constitute an important structural feature of the river channel. They may modify water flow, promote fine sediment deposition and provide shelter and food for fish and invertebrate animals. For these reasons, the interest is defined as a habitat type, although its most recognisable feature is the dominant plant species within it.

The habitat type is widespread in rivers in the UK, especially on softer and more mineral rich substrates. It is absent from areas underlain by acid rock types (principally in the north and west), as well as from rivers seriously affected by pollution and siltation.

There are many variants of this habitat type in the UK, but the two main subtypes are defined by substrate and dominant species within the *Ranunculus* community.

Subtype 1: This variant is found on rivers on chalk substrates. The community is characterised by *Ranunculus peltatus* in headwaters, stream water-crowfoot *Ranunculus pencillatus* subsp. *pseudofluitans* in the middle reaches and river water-crowfoot *R. fluitans* in the downstream sections.

Subtype 2: This variant is found on other substrates, ranging from lime-rich substrates such as oolite, through soft sandstone and clay to more mesotrophic and oligotrophic rocks. There is considerable geographic and ecological variation in this subtype. For example, rivers in Wales and south-west England are significant for the occurrence of *R. penicillatus* subsp. *penicillatus.* Rivers elsewhere in the UK contain a mixture of species, and often hybrids, but rarely support *R. peicillatus* subsp. *penicillatus* or *R. fluitans.*

The two variants have very different distributions and have different significance for conservation in a European context. Subtype 1 has a very limited distribution in the UK, being found only in those areas where chalk is present. For this reason it is found only in southern and eastern England. Chalk rivers are rare in Europe and so representation of this habitat in the UK is particularly important.

Subtype 2 is widespread in those parts of the UK where the substrate is suitable, and is also widespread in Europe. Sites have been selected as representative examples of the geographical range, range of substrate and of ecological variation. The presence of characteristic communities (for example association with water-starworts *Callitriche*) are considered important and the selection also includes the biologically richest examples of the subtype in the UK. Rivers that show a transition from one substrate to another as geology changes from chalk to clay have also been included.

2.3.7.2 Site list

The list of sites for this habitat type is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

River Avon (135)

The River Avon in southern England is a large, lowland river that includes sections running through chalk and clay with transitions between the two. It is considered to be the best example of the Subtype 1 chalk river variant in the UK, because of its relative naturalness and species diversity, and is of high European significance. Five aquatic *Ranunculus* species occur in the river system, where stream water-crowfoot *Ranunculus penicillatus* subsp. *pseudofluitans* and river water-crowfoot *R. fluitans* are the main dominants.

River Eden (23)

This has been chosen as the north-western representative of the Subtype 2 variant. The river flows over both calcareous limestone and sandstone, giving a diversity of ecological conditions, ranging from oligotrophic to mesotrophic. This river has 184 plant species recorded from it, more than any other river in the UK. The *Ranunculus* species of the river system include stream water-crowfoot *R. penicillatus* subsp. *penicillatus*

occurring here at the edge of its range, and other species, such as *R. penicillatus* subsp. *pseudofluitans* and river water-crowfoot *R. fluitans.* The *Ranunculus* communiuties have affinities with both Subtype 1 and Subtype 2 rivers.

River Itchen (18)

This site is representative of the habitat type in southern England and is chosen as a typical example of a Subtype 1 chalk river. The river is dominated throughout by *Ranunculus* spp. The headwaters contain *R. peltatus,* while two acquatic *Ranunculus* species occur further downstream, with stream water-crowfoot *R. penicillatus* subsp. *pseudofluitans,* a species especially characteristic of calcium-rich rivers, and river water-crowfoot *R. fluitans*.

River Wye/Afon Gwy (22)

The Wye is a large river representative of the Subtype 2 variant, located on the border of England and Wales. It has a geologically mixed catchment, including limestone and sandstones, and there is a clear transition between the upland reaches, with characteristic bryophyte dominated vegetation, and the lower reaches, with extensive *Ranunculus* beds. There is a varied *Ranunculus* flora; *R. penicillatus* subsp. *pseudofluitans* is abundant, with other *Ranunculus* species found locally.

Section 2.4: Temperate heath and scrub

2.4.1 Northern Atlantic wet heaths with *Erica tetralix* (31.11)

2.4.1.1 Background to selection

Northern Atlantic wet heaths are restricted to the Atlantic fringe of Europe between Norway and Normandy. However, the habitat type occurs in many parts of the UK and locally can be extensive. A high proportion of the EC resource occurs in the UK. Sites have been chosen to represent geographical range, ecological variation and the UK's special responsibilities for the conservation of this habitat type. The sites chosen are for the most part those with the largest expanses of the habitat type, with best developed structure and function, and particularly well-developed transitions to other habitats. Sites are selected to cover wet heaths in both lowland and upland parts of the UK.

The soils on which wet heaths occur are usually acidic, nutrient-poor, shallow peat or sandy soils with impeded drainage. The vegetation is typically dominated by mixtures of cross-leaved heath *Erica tetralix*, grasses, sedges and *Sphagnum* bog mosses. Four NVC communities (M14, M15, M16, H5) are included in this habitat type, but inclusion of the full range of variation also requires recognition of wet heath types rich in lichens, woolly fringe-moss *Racomitrium lanuginosum* or black bog-rush *Schoenus nigricans* found in the Hebrides and Northern Isles of Scotland, which are not described in the NVC. The M15 and M16 NVC types make up most of the national resource of wet heath and therefore account for a high proportion of the selected sites.

M15 *Scirpus cespitosus-Erica tetralix* wet heath is characteristic of the wetter areas of the west and north, where deer-grass *Trichophorum cespitosum* is abundant. In the far north-west bell heather *Erica cinerea* and woolly fringe-moss *Racomitrium lanuginosum* are characteristic, along with an abundance of Atlantic bryophytes. As this is the most extensive NVC type associated with this habitat type, a higher proportion of sites were selected for this type.

M16 *Erica tetralix-Sphagnum compactum* wet heath is characteristic of the drier south and east. The bog moss *Sphagnum compactum* is typically abundant, while in the far north on Orkney, and in the eastern Highlands at high altitude, lichens are abundant.

On the Lizard in Cornwall Cornish heath *Erica vagans* growing with black bog-rush *Schoenus nigricans* forms a distinctive and unique form of wet heath (H5 *Erica vagans-Schoenus nigricans* heath), found nowhere else in Europe. A further very local wet heath type is the M14 *Schoenus nigricans-Narthecium ossifragum* mire. which is mainly associated with transitions from heath to valley bog at a small number of lowland sites in southern Britain.

In the south, species of a mainly southern distribution in Britain, such as marsh gentian *Gentiana pneumonanthe*, brown beak-sedge *Rhynchospora fusca* and meadow thistle *Cirsium dissectum*, enrich the wet heaths. Where there is movement of mildly base-rich water through the peat, distinctive variants occur that are characterised by abundant bog-myrtle *Myrica gale*, with black bog-rush *Schoenus nigricans*, sedges *Carex* spp. and a wide range of other species favoured by the flushing.

Wet heaths occur in several types of ecological gradient and this is taken account of in the site series. In the drier areas of the south and east, wet heaths are local and often restricted to the transition zone between dry heaths and constantly wet valley mire. Most often in the uplands they occur in gradients between dry heath or other dry acid habitats and blanket mire. At high altitude in the Scottish Highlands they occur in mosaics with **Alpine and subalpine heaths**. They become increasingly extensive in the cool and wet north and west, especially in the Highlands. However, the area covered by wet heath is significantly smaller than that covered by blanket bog or dry heath.

Wet heath is an important habitat for a range of vascular plant and bryophyte species of an oceanic or Atlantic distribution in Europe, several of which have an important part of their EC and world distribution in the UK.

2.4.1.2 Site list

Cairngorms (209)

This site is selected as a representative of wet heath in north-east Scotland and has the largest extent of wet heath in this part of the UK. M16 *Erica tetralix-Sphagnum compactum* wet heath is the most extensive community. The site is notable for the occurrence, at high elevation, of this eastern vegetation type, more typically associated with southern lowland heaths. The more oceanic M15 *Scirpus cespitosus-Erica tetralix* wet heath also occurs, occupying the more strongly flushed soils. It is the presence of undisturbed lichen-rich wet heath occupying wet hollows within high altitude, windswept subalpine and alpine heath that is of particular importance. Wet heath is also developed in hollows within the upper parts of the Caledonian forest, within blanket mire and dry heath, giving a variety of ecological transitions.

Dartmoor (114)

This site is representative of upland wet heath in south-west England. M15 *Scirpus cespitosus-Erica tetralix* wet heath predominates and, together with other mire communities and small areas of drier heathland, forms a distinctive mosaic of vegetation types not fully represented by other sites. M15 *Scirpus cespitosus-Erica tetralix* wet heath and much smaller amounts of M16 *Erica tetralix-Sphagnum compactum* wet heath are closely associated with M17 *Scirpus cespitosus-Eriophorum vaginatum* blanket mire and occasional dry heathland communities including H12 *Calluna vulgaris-Vaccinium myrtillus* heath and H4 *Ulex gallii-Agrostis curtisii* heath. Additionally there are transitions to areas of the very local M21 *Narthecium ossifragum-Sphagnum papillosum* valley mire. Dartmoor supports a number of predominantly northern species on the southern edge of their national range. Plants found on the heathlands that are rare in south-west England include crowberry *Empetrum nigrum* and stag's-horn clubmoss *Lycopodium clavatum*.

Dorset Heaths (279)
Dorset Heaths (Purbeck and Wareham) and Studland Dunes (280)

These two sites, together with the New Forest (also in southern England), contain a large part of the lowland wet heath in the UK. The habitat is of the M16 *Erica tetralix-Sphagnum compactum* wet heath type and occurs as well-developed transitions between dry heath and valley bog. This habitat type is important for rare plants such as the marsh gentian *Gentiana pneumonanthe*, brown beak-sedge *Rhynchospora fusca* and great sundew *Drosera anglica*. The wet heaths and mires are also important for scarce dragonflies, such as the small red damselfly *Ceriagrion tenellum* and the southern damselfly *Coenagrion mercuriale*. The sites are an important transitional area between the more oceanic heathland of the south-west peninsula and the semi-continental heathlands of eastern England.

Gower Commons/Tiroedd Comin Gwyr (34)

This south Wales site supports several extensive tracts of lowland vegetation of the M15 *Scirpus cespitosus-Erica tetralix* wet heath type. There are well-developed transitions to stands of humid and dry heath and various forms of soligenous and topogenous mire, as well as woodland, scrub, and bracken. The site includes strong populations of a number of western species, including whorled caraway *Carum verticillatum* and the marsh fritillary butterfly *Eurodryas aurinia*.

Hoy (67)

The northern form of wet heath, which is characterised by an abundance of lichens, is very local in the UK but is extensively developed on Hoy, Orkney, Scotland. Both M15 *Scirpus cespitosus-Erica tetralix* wet heath and M16 *Erica tetralix-Sphagnum compactum* wet heath are found here and are relatively undisturbed. This lack of disturbance may have contributed to the luxuriance of the lichen cover. A range of natural transitions to subalpine and alpine heaths, blanket mire and flush mire are also found on this site.

Merrick Kells (278)

This site in south-west Scotland is representative of the typical western, upland, forms of M15 *Scirpus cespitosus-Erica tetralix* wet heath, including both forms rich in deer-grass *Trichophorum cespitosum* and those with purple moor-grass *Molinia caerulea*. This is the most extensive representation of wet heath in the UK on an upland site south of the Scottish Highlands.

North Harris (115)

North Harris represents wet heath in the Outer Hebrides, Scotland, and provides examples of the most extreme oceanic forms of wet heath in the UK and possibly Europe. The wet heath is closest in its floristics to M15 *Scirpus cespitosus-Erica tetralix* wet heath. In the most extensive development of this habitat, woolly fringe-moss *Racomitrium lanuginosum* is characteristically abundant, along with bell heather *Erica cinerea* (usually characteristic of dry heath) and Atlantic mosses and liverworts. The latter are more prominent here than on any other wet heath site. A highly acidic flushed form of wet heath is frequent, with an abundance of the rare Atlantic moss *Campylopus shawii*. Wet heath is one of the main elements in the vegetation cover, proportionally more extensive than anywhere else in the UK. Wet heath on Harris is not confined to wet hollows or gentle slopes but runs up moderately steep slopes to around 30° or more. There are also transitions to dry heath, blanket mire and grassland.

Rum (16)

Rum in the Inner Hebrides has an extensive development of the north-western, black bog-rush *Schoenus nigricans*-rich form of wet heath that is restricted to western Scotland. It is extensive on these slopes, which are underlain by ultra-basic rocks, and shows the development of *Schoenus* in response to base-rich flushing. The *Schoenus*-rich form has affinities to the strongly flushed *Carex panicea* sub-community of M15 *Scirpus cespitosus-Erica tetralix* wet heath and shows some similarities to the *Schoenus*-rich heaths of the Lizard district, which are also on ultra-basic rocks. Other more typical western forms of wet heath with abundant deer-grass *Trichophorum cespitosum* are also represented.

The Lizard (70)

The Lizard peninsula in the extreme south-west of England has a unique type of wet heath, H5 *Erica vagans-Schoenus nigricans* heath. This wet heath occurs extensively on poorly-drained soils derived from ultra-basic serpentine and gabbro. It contains unusual mixtures of species typical of acid soils growing with species typical of base-rich soils.

The New Forest (5)

The New Forest contains the most extensive stands of lowland wet heath in southern England, mainly of the M16 *Erica tetralix-Sphagnum compactum* type. M14 *Schoenus nigricans-Narthecium ossifragum* mire is also found on this site. The wet heaths are important for rare plants, such as marsh gentian *Gentiana pneumonanthe* and marsh clubmoss *Lycopodium inundatum*, and a number of dragonfly species, including the scarce blue-tailed damselfly *Ischnura pumilio* and small red damselfly *Ceriagrion tenellum*. There are a wide range of transitions between wet heath and other habitats, including dry heath, various woodland types, *Molinia* grasslands, fen and acid grassland. Wet heaths enriched by bog myrtle *Myrica gale* are a prominent feature of many areas of the Forest. Unlike much lowland heath the New Forest heaths continue to be extensively grazed by cattle and horses, favouring species with low competitive ability.

Thursley, Ash, Pirbright and Chobham (68)

This site provides representation of lowland wet heath in south-east England. The wet heath at Thursley is of the M16 *Erica tetralix-Sphagnum compactum* type and contains rare plants, such as great sundew *Drosera anglica*, bog hair-grass *Deschampsia setacea*, bog orchid *Hammarbya paludosa* and brown beak-sedge *Rhynchospora fusca*. There are transitions to valley bog and dry heath. Thursley Common is an important site for invertebrates, including the nationally rare white-faced darter *Leuccorhinia dubia.*

2.4.2 *Southern Atlantic wet heaths with *Erica ciliaris* and *Erica tetralix* (31.12)

2.4.2.1 Background to selection

This type of heath is characteristic of the western Mediterranean region and consequently in the UK is confined to warm, oceanic locations. The abundance of Dorset heath *Erica ciliaris* differentiates this priority habitat type from other UK heath types. It is a rare habitat in the UK, occurring only in Dorset and Cornwall, England. Sites have been selected that contain significant examples of the habitat type and cover its geographical range. The best examples of this habitat type in terms of representation of the habitat type and its extent and the conservation of structure and function have been selected.

Heathlands containing *Erica ciliaris* and cross-leaved heath *E. tetralix* are generally found on damp, acid soils with slightly impeded drainage. These heathlands often contain heather *Calluna vulgaris* and varying proportions of bell heather *Erica cinerea*. Other associated species are purple moor-grass *Molinia caerulea*, bristle bent *Agrostis curtisii* and dwarf gorse *Ulex minor*, with the latter being replaced by western gorse *U. gallii* in south-west England. These heathlands may grade into wetter heath and bog communities, notably valley mires with bog moss *Sphagnum* spp. and bog asphodel *Narthecium ossifragum*. Dorset heath *Erica ciliaris* may be found in the NVC communities H3 *Ulex minor-Agrostis curtisii* heath, H4 *Ulex gallii-Agrostis curtisii* heath and M21 *Narthecium ossifragum-Sphagnum papillosum* valley mire. In Cornwall this habitat type extends on to dry soils and this ecological variation is taken into account in site selection.

The single known *Erica ciliaris* site in Devon, at an altitude of 400 m on Dartmoor, has not been selected because it is atypical and it is suspected that the *E. ciliaris* is an introduction.

2.4.2.2 Site list

Carrine Common (69)

This site has been selected because it has a large area of Dorset heath *Erica ciliaris* in Cornwall and is important for the representation of the full geographical distribution of this priority habitat type. This site also takes account of the ecological variation of the habitat type, as *E. ciliaris* at Carrine Common occurs on soils that appear to be more free-draining than is usually the case in Dorset and elsewhere in Cornwall. The occurrence of this habitat type under such conditions is thought to reflect the highly oceanic climate of Cornwall.

Dorset Heaths (Purbeck and Wareham) and Studland Dunes (280)

The greatest concentration of Dorset heath *Erica ciliaris* in the UK is in Dorset on the heaths south of Poole Harbour, with outlying stands elsewhere in Dorset. The Dorset Heaths (Purbeck and Wareham) and Studland Dunes have therefore been selected for their high proportion of the total population of *E. ciliaris* in the UK.

Newlyn Downs (322)

This site has the largest area (58 ha) of heath rich in Dorset heath *Erica ciliaris* in Cornwall. A significant proportion of the *E. ciliaris* occurs in wetter situations than at Carrine Common. The selections of *E. ciliaris* heath in Cornwall, where the habitat type is rarer and more fragmented than in Dorset, are important for the representation of the full geographical distribution of this priority habitat type.

2.4.3 Dry heaths (all subtypes) (31.2)

2.4.3.1 Background to selection

Dry heaths are widespread and extensive in the UK and exhibit exceptional diversity in comparison with examples found elsewhere in the EC. A high proportion of the EC resource occurs in the UK, although this proportion is not as high as that of **Northern Atlantic wet heaths with *Erica tetralix*.** The site series accommodates the wide geographical range and ecological variation of the habitat type and takes account of the UK's special responsibilities for the habitat type.

Throughout the UK dry heaths typically occur on freely-draining acidic soils of generally low nutrient content. Ericaceous dwarf-shrubs dominate the vegetation. The most common is heather *Calluna vulgaris*, often in combination with gorse *Ulex* spp. or bilberry *Vaccinium* spp., though other dwarf-shrubs are important locally. Nearly all dry heath is semi-natural, being derived from woodland with a long history of grazing. Heath types found at high elevation and in northern latitudes around and above the presumed natural tree-line are classified as **Alpine and subalpine heaths** and are not considered here. Dry heath occurs in both the lowlands and the uplands, and both are represented in the site series, with a higher proportion of the rarer and more species-rich lowland types.

Excluding strictly **Alpine and subalpine heaths**, **Dune heaths** and **Dry coastal heaths with *Erica vagans* and *Ulex maritimus*,** which are listed elsewhere in Annex I, twelve NVC dry heath communities in Britain may be considered as meeting the definition of this habitat type. These are listed below. Examples of each of the main NVC types are represented in the site series.

H1 *Calluna vulgaris-Festuca ovina* heath
H2 *Calluna vulgaris-Ulex minor* heath
H3 *Ulex minor-Agrostis curtisii* heath
H4 *Ulex gallii-Agrostis curtisii* heath
H7 *Calluna vulgaris-Scilla verna* heath
H8 *Calluna vulgaris-Ulex gallii* heath
H9 *Calluna vulgaris-Deschampsia flexuosa* heath
H10 *Calluna vulgaris-Erica cinerea* heath
H12 *Calluna vulgaris-Vaccinium myrtillus* heath
H16 *Calluna vulgaris-Arctostaphylos uva-ursi* heath
H18 *Vaccinium myrtillus-Deschampsia flexuosa* heath
H21 *Calluna vulgaris-Vaccinium myrtillus-Sphagnum capillifolium* heath

Dry heaths vary according to climate and are also influenced by altitude, aspect, soil conditions (especially base status and drainage), maritime influence and grazing intensity. There is a gradation from southerly to northerly kinds of heath and there are both western (oceanic) and eastern (more continental) forms of dry heath. The site series takes account of these main variations.

In mild oceanic south-west England and Wales there are southern dry heaths with bristle bent *Agrostis curtisii* and western gorse *Ulex gallii*. Further east, in Dorset and the New Forest, the H3 western gorse *Ulex minor* - bristle bent *Agrostis curtisii* type occurs. The semi-continental heaths of Breckland on the western Norfolk-Suffolk border are generally dominated by *Calluna*, with, sometimes, an abundance of lichens. In oceanic parts of the north-west, bell heather *Erica cinerea* and heather *Calluna vulgaris* are abundant together, especially on more southerly-facing slopes, and bell heather becomes more dominant in the hyper-oceanic fringes of the north-west. On more shady and humid slopes there are *Sphagnum* spp. and hypnaceous moss-rich heaths, which are best developed in Scotland. In the hyper-oceanic far north-west Highlands and Islands these heaths are rich in Atlantic bryophytes, which develop as luxuriant mats under the canopy of dwarf-shrubs. The UK is one of the most important parts of the world for Atlantic bryophytes, and this is the most important habitat for many of these oceanic species of restricted world distribution.

In the less oceanic areas of north-east England and the Midlands there is an overwhelming dominance of heather *Calluna vulgaris*, with wavy hair-grass *Deschampsia flexuosa* often abundant. Further north, there are heaths with abundant bilberry *Vaccinium myrtillus*, crowberry *Empetrum nigrum* subsp. *nigrum* and bearberry *Arctostaphylos uva-ursi*, which are best developed in north-eastern Scotland. Analogous changes in floristics

occur with increase in altitude. Increasing snow-lie at high altitude favours bilberry species in particular, and in the central Highlands the rare blue heath *Phyllodoce caerulea* occurs in these snow-bed heaths.

Species-rich forms of dry heath occur in Scotland on glacial drift on moderately base-rich rocks, such as those on Rum in the Inner Hebrides. These support rare or local species, including northern bedstraw *Galium boreale*, intermediate wintergreen *Pyrola media*, stone bramble *Rubus saxatilis*, alpine bistort *Persicaria vivipara* and thyme broomrape *Orobanche alba*. A further unusual type, so-called chalk heath and limestone heath, occurs where acid surface deposits overlie calcareous materials. Such heaths contain unusual combinations of heath and calcareous grassland species and are very rare in the UK. On coastal cliffs and slopes there are maritime heaths with spring squill *Scilla verna*, including an unusual lichen-rich waved form in the far north on Orkney and Shetland.

2.4.3.2 Site list

Bollihope, Pikestone, Eggleston and Woodland Fells (298)

This north Pennine site is representative of upland dry heath in northern England. It is characterised by a more easterly, less oceanic climate and has a range of high quality dwarf-shrub heath and discontinuous blanket mire communities. This site holds 3,980 ha of heather moorland, which is almost 2% of the heather moorland of northern England. H9 *Calluna vulgaris-Deschampsia flexuosa* heath and H12 *Calluna vulgaris-Vaccinium myrtillus* heath are the main dry heath types present. H21 *Calluna vulgaris-Vaccinium myrtillus-Sphagnum capillifolium* heath, at the southernmost edge of its range, and H18 *Vaccinium myrtillus-Deschampsia flexuosa* heath add to the variation in dry heath types represented.

Breckland (287)

The dry heaths of Breckland are representative of heathlands in East Anglia, in eastern England, developed under a semi-continental climate. Breckland has an average annual precipitation of only 600 mm, relatively hot summers and cold winters. Frosts can occur in any month of the year. The dry acidic heath of Breckland provides representation of H1 *Calluna vulgaris-Festuca ovina* heath in the site series. One NVC sub-community dominated by sand sedge *Carex arenaria* is typical of areas of blown sand - a very unusual feature of this location. The highly variable soils of Breckland, with underlying chalk being largely covered with wind-blown sands, have resulted in mosaics of heather-dominated heathland, acidic grassland and calcareous grassland that are unlike those of any other site. In many places there is a linear or patterned distribution of heath and grassland, arising from fossilised soil patterns that formed under peri-glacial conditions. Breckland is important for rare plants, such as perennial knawel *Scleranthus perennis* subsp. *prostratus*, and rare invertebrates.

Cairngorms (209)

The Cairngorms has the largest extent of dry heathland in the UK and is representative of the upland heaths of the cool and less oceanic north-east Scotland. The principal NVC types present are H12 *Calluna vulgaris-Vaccinium myrtillus* heath, H18 *Vaccinium myrtillus-Deschampsia flexuosa* heath and H16 *Calluna vulgaris-Arctostaphylos uva-ursi* heath, almost all developed on acid soils. The site contains extensive examples of all the heaths characteristic of the eastern Highlands and is representative of the heathland in this area. These sub-types include the most extensive well-developed snow-bed forms of H18 *Vaccinium myrtillus-Deschampsia flexuosa* heath and species-poor forms of H16 *Calluna vulgaris-Arctostaphylos uva-ursi* heath, which are largely confined to north-east Scotland. There are widespread transitions to wet heath, woodland, juniper scrub and alpine heaths.

Dorset Heaths (279)
Dorset Heaths (Purbeck and Wareham) and Studland Dunes (280)

These sites in southern England have extensive stands of lowland dry heath vegetation. The types include H2 *Calluna vulgaris-Ulex minor* heath, H3 *Ulex minor-Agrostis curtisii* heath and some areas of H4 *Ulex gallii-Agrostis curtisii* heath. The communities are dominated by heather *Calluna vulgaris* growing in association with bell heather *Erica cinerea* and one of the dwarf gorse species - dwarf gorse *Ulex minor* or western gorse *U. gallii*. The heaths are rich in rare plants, invertebrates, birds and reptiles.

East Devon Pebblebed Heaths (19)

The East Devon Pebblebed Heaths include extensive areas of lowland dry heath in south-west England. This site is chosen primarily for its highly representative examples of H4 *Ulex gallii-Agrostis curtisii* heath community, characterised by the presence of heather *Calluna vulgaris,* bell heather *Erica cinerea,* western gorse *Ulex gallii,* bristle bent *Agrostis curtisii*, purple moor-grass *Molinia caerulea,* cross-leaved heath *Erica tetralix* and tormentil *Potentilla erecta*. The presence of plants such as cross-leaved heath illustrates the more oceanic nature of these heathlands, as this species is typical of wet heath in the more continental parts of the UK.

Eastern Mournes (221)

The Mourne Mountains contain by far the largest area of dry heath in Northern Ireland. This is mostly of the *Calluna/Erica cinerea* type (equivalent to H10 *Calluna vulgaris-Erica cinerea* heath). The dominance of bell heather *Erica cinerea* is a notable feature of the area and characteristic of dry heath in the hyper-oceanic western part of the UK. The site also contains a range of other heath vegetation, with affinities to H12 *Calluna vulgaris-Vaccinium myrtillus* heath and both montane heath on the summits and well developed H8 *Calluna vulgaris-Ulex gallii* heath on the lower slopes.

Exmoor Heaths (304)

This site is representative of upland heath in south-west England. The site is notable because it contains extensive areas of H4 *Ulex gallii-Agrostis curtisii* heath, a type most often found in the lowlands, and H12 *Calluna vulgaris-Vaccinium myrtillus* heath, a predominantly upland type. The site represents a southern outpost for northerly plant species such as crowberry *Empetrum nigrum* and cranberry *Vaccinium oxycoccos,* and the associated valley mires support the oceanic species pale butterwort *Pinguicula lusitanica* and ivy-leaved bellflower *Wahlenbergia hederacea*. The Exmoor heaths are also important as the largest stronghold for the heath fritillary butterfly *Mellicta athalia.*

Great Orme's Head/Pen y Gogarth (198)

This north Wales site is chosen as the finest example of limestone heath in the UK. The majority of this rare and unusual vegetation is characterised by a short sward in which heather *Calluna vulgaris* and bell heather *Erica cinerea* occur in an intimate mixture with a rich assemblage of calcicolous grasses and forbs such as meadow oat-grass *Helictotrichon pratense* and dropwort *Filipendula vulgaris*. Other types of dry heath present include various forms of H8 *Calluna vulgaris-Ulex gallii* heath. There are outstanding zoned sequences of limestone grassland and heath communities and these are associated with a wide range of other habitats, including limestone cliff, scree and a small area of limestone pavement.

Loch Maree Complex (173)

Beinn Eighe, Torridon Forest and Beinn Alligin have extensive and highly representative examples of hyper-oceanic heaths characteristic of the north-west Highlands, Scotland. The main NVC communities represented are H10 *Calluna vulgaris-Erica cinerea* heath and H21 *Calluna vulgaris-Vaccinium myrtillus-Sphagnum capillifolium* heath. These include the most extensive and best developed areas of moist Atlantic (oceanic) bryophyte-rich heaths in the UK, supporting bryophyte species of restricted world distribution, for example *Herbetus borealis*and *Mastigophora woodsii*. These heaths are still relatively undisturbed and in good condition, although less extensive than formerly, owing to burning in more accessible areas. There are also extensive heaths of a drier hyper-oceanic type dominated by bell heather *Erica cinerea,* representative of the development of this habitat type at higher altitude, where transitions occur with **Alpine and sub-alpine heath.**

Minsmere to Walberswick Heaths and Marshes (73)

Dry lowland heathland occupies an extensive area of this site on the east coast of England, which is at the extreme easterly range of heath development in the UK. The heathland is predominantly NVC H8 *Calluna vulgaris-Ulex gallii* heath, a type most characteristic of western parts of the UK. This type is dominated by heather *Calluna vulgaris,* western gorse *Ulex gallii* and bell heather *Erica cinerea*.

Muir of Dinnet (290)

Muir of Dinnet is a lowland heath site in north-east Scotland and represents H16 *Calluna vulgaris-Arctostaphylos uva-ursi* heath, which is largely confined to north-east Scotland. All of the sub-communities of H16 occur on the site, including the local species-rich sub-communities rich in wintergreen *Pyrola* species.

Rhinog (117)

This site is chosen as a representative example of upland heath in Wales. On shady slopes, the site contains what is considered to be the best development of H21 *Calluna vulgaris-Vaccinium myrtillus-Sphagnum capillifolium* heath outside Scotland. Other NVC types represented include H8 *Calluna vulgaris-Ulex gallii* heath, H10 *Calluna vulgaris-Erica cinerea* heath and H12 *Calluna vulgaris-Vaccinium myrtillus* heath.

Rum (16)

Rum has examples of dry heath typical of the Inner Hebrides but is particularly noted for the presence of species-rich heath on base-rich soils. A large extent of the local, species-rich form of H10 *Calluna vulgaris-Erica cinerea* heath, *Thymus praecox-Carex pulicaris* sub-community, is developed on steep, south-facing slopes on ultra-basic rocks. The associated flora includes a number of northern and arctic-alpine species, such as mountain everlasting *Antennaria dioica,* viviparous sheep's-fescue *Festuca vivipara,* alpine meadow-rue *Thalictrum alpinum,* alpine bistort *Persicaria vivipara* and alpine saw-wort *Saussurea alpina*. The associated invertebrate fauna contains several species, including large populations of rare and local burnet moths. This northern form of species-rich heath complements that on Great Orme's Head in Wales, which has a species-rich heath of a much more southern floristic character, overlying limestone. Other kinds of dry heath on Rum are typical of north-west Scotland. They include species-poor H10 *Calluna vulgaris-Erica cinerea* heath and H21 *Calluna vulgaris-Vaccinium myrtillus-Sphagnum capillifolium* heath, including some of the Atlantic bryophyte-rich forms of the latter, as well as H18 *Vaccinium myrtillus-Deschampsia flexuosa* heath.

Stromness Heaths and Coast (169)

This site in the Orkney Islands, Scotland, is selected as an example of H7 *Calluna vulgaris-Scilla verna* heath that is subject to conditions of extreme maritime exposure. It is the largest area of this distinctive northern lichen-rich maritime heath in the UK. The abundance and growth forms of the lichens in this community are better developed than in other known sites in the UK. There are seaward transitions to maritime grasslands, and inland there are transitions to non-maritime H10 *Calluna vulgaris-Erica cinerea* heath and other habitats.

The New Forest (5)

The New Forest is the largest area of lowland heathland in the UK and is particularly important for the diversity of its habitats and the range of rare and scarce species it supports. It provides a representation of heathland in southern England. The New Forest is unusual because of its long history of grazing in a traditional fashion by ponies and cattle. The dry heaths of the New Forest are of the H2 *Calluna vulgaris-Ulex minor* heath type, and H3 *Ulex minor-Agrostis curtisii* heath is found on damper areas. There are a wide range of transitions between dry heath and wet heath, *Molinia* grassland, fen, acid grassland and various types of scrub and woodland.

Both The New Forest and Dorset Heaths are in southern England. Both sites are included because together they contain a high proportion of all the lowland heath in the UK. There are, however, significant differences in the ecology of the two areas, associated with more oceanic conditions in Dorset and the continuous history of grazing in The New Forest.

The Stiperstones and The Hollies (74)

This site has been selected as an example of heathland in central Britain that contains features that are transitional between lowland heathland and upland heather moorland. The most extensive vegetation type present is H12 *Calluna vulgaris-Vaccinium myrtillis* dry heath, which is characteristic of the uplands. South-facing slopes support stands of H8 *Calluna vulgaris-Ulex gallii* heath, a predominantly lowland vegetation community of south-west Britain. The site therefore has intermediate characteristics between lowland heath and upland heath. The heathland of the Stiperstones is in excellent condition because it is managed by a programme of rotational, controlled winter burning and cutting.

Thursley, Ash, Pirbright and Chobham (68)

This south-east England site contains a series of large fragments of once continuous heathland. It is selected as a key representative of the H2 *Calluna vulgaris-Ulex minor* dry heathland community. This heath type is of marked south-eastern and southern distribution. There are transitions to wet heath and valley mire, scrub, woodland and acid grassland, including types rich in annual plants. The dry heaths support an important assemblage of animal species, including numerous rare and local invertebrate species, nightjar *Caprimulgus europaeus*, Dartford warbler *Sylvia undata*, sand lizard *Lacerta agilis* and smooth snake *Coronella austriaca*.

2.4.4 *Dry coastal heaths with *Erica vagans* and *Ulex maritimus* (31.234)

2.4.4.1 Background to selection

This priority habitat type occurs at only one site in the UK, which has been selected.

This habitat type, which in the UK corresponds to the H6 *Erica vagans-Ulex europaeus* heath community of the NVC, occurs in the extreme south-west of England, where its extent is less than 1,000 ha. In other parts of Europe it occurs very locally in Brittany and on the coast of the Basque country in both France and Spain.

2.4.4.2 Site list

The Lizard (70)

This habitat type is confined to the Lizard peninsula in south-west England. All good quality areas of the habitat type that occur in this location have been included in the site. The full range of structural and floristic variation is covered, ranging from cliff-top heaths rich in maritime species, such as spring squill *Scilla verna*, to more inland heaths containing abundant bristle bent *Agrostis curtisii.*

2.4.5 Alpine and subalpine heaths (31.4)

2.4.5.1 Background to selection

In the Atlantic Biogeographic Region, alpine and subalpine heaths are restricted to Ireland and the UK, where they are most extensive and best developed in the Scottish Highlands. Sites have been selected to take account of the UK's special responsibilities for this habitat type and to cover the ecological variation and geographical range. The sites chosen are for the most part those where alpine and subalpine heath is most extensive and structure and function are best conserved. The selection of sites reflects the importance of the Scottish Highlands for this habitat type, while the best outliers on the Northern Isles and in England are also included.

Alpine heaths are developed above the natural altitudinal tree-line. Subalpine heaths are developed below the tree-line in gaps among scrubby high-altitude woods or as a replacement for those subalpine woods lost owing to grazing and burning. On the slopes below, subalpine heaths may grade into floristically similar dry heaths. All sites selected represent both alpine and subalpine heath, with emphasis on the best combinations of the two forms together.

The dominant plants are dwarf-shrubs of heather *Calluna vulgaris* or juniper *Juniperus* spp., which are low-growing or prostrate owing to exposure to high winds or prolonged snow cover at moderately high altitudes. They occur on acid rocks on mountains, both on exposed lower summits and ridges and on sheltered slopes. The exposure or snow-lie, which suppress the growth of dwarf-shrubs, also favour the growth of characteristic lichens and bryophytes. In the north and west of Scotland this type of vegetation can occur at lower altitudes than elsewhere in the UK. Certain subtypes of alpine and subalpine heath are known only from the UK or are best developed here. These are especially those found in more exposed conditions, characterised by prostrate heather *Calluna vulgaris* and juniper *Juniperus communis* subsp. *alpina*. Some of the Atlantic mosses and liverworts that are found in these heathlands have a restricted world distribution. Heaths dominated by the prostrate dwarf-shrub mountain avens *Dryas octopetala* are considered under **Alpine calcareous grasslands**.

There is a wide range of alpine and sub-alpine heath types, with variation related to climate, local exposure and snow-lie. The habitat includes seven NVC types of alpine heath community:

H13 *Calluna vulgaris-Cladonia arbuscula* heath
H14 *Calluna vulgaris-Racomitrium lanuginosum* heath
H15 *Calluna vulgaris-Juniperus communis* subsp. *nana* heath
H17 *Calluna vulgaris-Arctostaphylos alpinus* heath
H19 *Vaccinium myrtillus-Cladonia arbuscula* heath
H20 *Vaccinium myrtillus-Racomitrium lanuginosum* heath
H22 *Vaccinium myrtillus-Rubus chamaemorus* heath

and subalpine forms of five other NVC communities:

H10 *Calluna vulgaris-Erica cinerea* heath
H12 *Calluna vulgaris-Vaccinium myrtillus* heath
H16 *Calluna vulgaris-Arctostaphylos uva-ursi* heath
H18 *Vaccinium myrtillus-Deschampsia flexuosa* heath
H21 *Calluna vulgaris-Vaccinium myrtillus-Sphagnum capillifolium* heath

Floristically there are two broad kinds of heath, dominated either by heather *Calluna vulgaris* on exposed or more sheltered ground at lower altitudes (H10, H12, H13, H14, H15, H16, H17, H21), or by bilberry *Vaccinium myrtillus* and crowberry *Empetrum nigrum* subsp. *hermaphroditum* at higher altitudes beyond the limit of heather growth or in more sheltered localities where heather growth is suppressed by prolonged snow-lie (H18, H19, H20). H22 occurs in two forms, one belonging respectively to each of the main groups.

On less exposed, more sheltered ground at the lower altitudinal range of the habitat type, heather *Calluna vulgaris* dominates, accompanied by other dwarf-shrubs, such as bilberry *Vaccinium myrtillus*, bell heather *Erica cinerea*, bearberry *Arctostaphylos uva-ursi* and crowberry *Empetrum nigrum* subsp. *nigrum* (H10, H12, H16, H21, H22). On more exposed and wind-swept ground, a range of dwarf-shrubs may dominate, forming an altitudinal progression. The first in the progression and often the most extensive are heaths dominated by heather *Calluna vulgaris* growing in a prostrate form (H13, H14) or by heather combined with dwarf juniper

Juniperus communis subsp. *alpina* (H15) or with mountain bearberry *Arctostaphylos alpinus* and trailing azalea *Loiseleuria procumbens* (H17). At higher altitudes, where conditions are too extreme for heather, prostrate bilberry *Vaccinium* spp. and crowberry *Empetrum nigrum* subsp. *hermaphroditum* dominate (H19, H20). On sheltered slopes where snow lingers, the dominant shrub is bilberry *Vaccinium myrtillus,* which is either the sole dominant (H18) or grows with crowberry *Empetrum nigrum* subsp. *hermaphroditum*, dwarf cornel *Cornus suecica* and cloudberry *Rubus chamaemorus* (H22).

Some of the heaths are restricted in distribution. H10 and H14 are most extensive in the west, H14 being developed only in the Highlands and on the Scottish islands. H15 is restricted to the north-west Highlands and Islands, while H17 occurs only in the northern Highlands and on Orkney. H13 and H19 are better developed in the eastern highlands, but H19 is the only alpine heath to occur extensively south of the Highlands. H22 is most extensively developed south of the Highlands.

Variation within NVC types may be summarised as follows:

1. In the east, favoured by a less oceanic climate, lichens may be abundant (especially those of the reindeer moss group *Cladonia* spp.), achieving the nearest in the UK to the lichen heaths of Scandinavia and the Arctic (especially H13 and H19) and including rare montane species.
2. In the north-west and north, favoured by a more extreme oceanic climate, woolly fringe-moss *Racomitrium lanuginosum,* bell heather *Erica cinerea* and Atlantic liverworts and mosses (especially the species of the northern Atlantic hepatic mat) may be abundant, characterising more oceanic forms of the NVC heaths H14, H15, H17, H20.
3. In the northern Highlands and Northern Isles, favoured by a cooler climate, mountain bearberry *Arctostaphylos alpinus* and trailing azalea *Loiseleuria procumbens* are abundant (characteristically in H17, but also in H14 and H15). The latter species is also frequent in the Cairngorms (in H19), while bearberry *Arctostaphylos uva-ursi* is abundant in the Cairngorms (H13, and characteristically in H16).
4. The action of solifluction (by creating unstable soils, which provide more plant nutrients and maintain open conditions) may favour some plants, such as mountain everlasting *Antennaria dioica,* carnation sedge *Carex panicea,* pill sedge *C. pilulifera,* sea plantain *Plantago maritima,* fir clubmoss *Huperzia selago* and viviparous sheep's-fescue *Festuca vivipara,* enriching the flora.
5. Different structural forms of heath occur, owing to differences in exposure, giving rise to closed or open heaths with crescentic waves (wave-form).

Certain types of heath are particularly susceptible to disturbance, especially by fire. This applies to all heaths rich in bryophytes (especially the fire-sensitive Atlantic mosses) or liverworts and also juniper-rich heaths. Similarly, lichen-rich heaths are susceptible to damage by fire or trampling. Rocky ground can be important in protecting heaths from fire and is included on the suite of selected sites. In general, sites have been selected where heathland is well developed and least affected by man's activities.

Sites have been selected to include all the main types of heath (represented by the range of NVC types) and variation within the types of heath and to give a wide geographical representation. Eastern, western, far northern and the best southern outliers are included. The largest stands (in the Highlands all greater than 300 ha in extent) have been selected, because these have the widest range of sub-types of the heaths with the fullest expression of characteristic species developed in relation to altitude, exposure and snow-lie. Some sites, especially those in the far north, were selected because they have an especially good development of geographically localised types. Encompassed within the range of sites are both the extremes of the more continental lichen-rich heaths and Atlantic bryophytes, and combinations of western and eastern heaths of less marked character.

All sites selected show extensive transitions to a wide range of other habitats.

2.4.5.2 Site list

Beinn Dearg (104)

Beinn Dearg has been selected because, along with the Strathglass Complex, it is representative of the heathlands found in the less extremely oceanic north-west Highlands. The heaths are extensive and well developed, and there is the full range of sub-types found in this part of Scotland. On this site, as on the Strathglass Complex, western, eastern and northern kinds of heath occur together. The main sub-types present

within the site are prostrate *Calluna* heaths (H14 *Calluna vulgaris-Racomitrium lanuginosum* heath, H13 *Calluna vulgaris-Cladonia arbuscula* heath and H17 *Calluna vulgaris-Arctostaphylos alpinus* heath). These sub-types, and H20 *Vaccinium myrtillus-Racomitrium lanuginosum* heath, are represented on finely developed solifluction terracing. On the slopes below, the alpine heaths give way to extensive subalpine heath representative of the area, including H10 *Calluna vulgaris-Erica cinerea* heath, H21 *Calluna vulgaris-Vaccinium myrtillus-Sphagnum capillifolium* heath and H12 *Calluna vulgaris-Vaccinium myrtillus* heath. H22 *Vaccinium myrtillus-Rubus chamaemorus* heath dominated by *Vaccinium* spp. is widely developed in sheltered hollows where snow lies late.

Ben Wyvis (119)

Ben Wyvis has been selected because of its extensive combination of heaths characteristic of both the eastern and northern Highlands. H13 *Calluna vulgaris-Cladonia arbuscula* heath and H19 *Vaccinium myrtillus-Cladonia arbuscula* heath are well developed, with an abundance of lichens characteristic of the eastern Highlands. The abundance of lichens in these communities on this site is greater than on any other site in the north-west Highlands, although the extent of the community is less than on Strathglass. The northern H17 *Calluna vulgaris-Arctostaphylos alpinus* heath is found on windswept lower summits and shoulders. Extensive H22 *Vaccinium myrtillus-Rubus chamaemorus* heath dominated by heather is developed on the high slopes and has an unusual mix and abundance of northern species, including cloudberry *Rubus chamaemorus*, dwarf cornel *Cornus suecica*, mountain bearberry *Arctostaphylos alpinus* and dwarf birch *Betula nana*. On the highest slopes, where snow tends to accumulate, snow-bed H18 *Vaccinium myrtillus-Deschampsia flexuosa* heath is extensive. These alpine heaths give way to subalpine H12 *Calluna vulgaris-Vaccinium myrtillus* heath on the lower slopes.

Cairngorms (209)

This site is representative of the relatively continental hills of the eastern Highlands. It has the full range of the heaths characteristic of the area and the most extensive tracts of alpine and subalpine heath in the UK. There is a superlative development of eastern lichen-rich heaths, coupled with a range of snow-bed heaths that are better developed than on any other site. H13 *Calluna vulgaris-Cladonia arbuscula* heath includes a large area in which there is a co-dominance of heather *Calluna vulgaris* and bearberry *Arctostaphylos uva-ursi*, an unusual kind of heath most extensively developed on the Cairngorms. H19 *Vaccinium myrtillus-Cladonia arbuscula* heath is dominated by mixtures of crowberry *Empetrum nigrum* subsp. *hermaphroditum*, bilberry *Vaccinium myrtillus*, cowberry *V. vitis-idaea* and, unusually, trailing azalea *Loiseleuria procumbens.* H20 *Vaccinium myrtillus-Racomitrium lanuginosum* heath is also extensive, taking the habitat type up to its highest altitude in the UK. *Calluna*-rich and *Vaccinium*-rich H22 *Vaccinium myrtillus-Rubus chamaemorus* heath is more extensive than on any other site, and snow-bed forms of H18 *Vaccinium myrtillus-Deschampsia flexuosa* heath are also well developed. There is an extensive development of heath on solifluction terracing. Alpine heath gives way below to the most extensive areas of subalpine heath in the UK, mostly H12 *Calluna vulgaris-Vaccinium myrtillus* heath and H16 *Calluna vulgaris-Arctostaphylos uva-ursi* heath; the latter is largely restricted to north-east Scotland. There are also transitions to extensive low-altitude heaths, juniper scrub, wet heath, siliceous alpine and boreal grasslands and late snow-bed vegetation. This is the single most outstanding site for high-altitude acidic habitats in the UK.

Drumochter Hills (116)

This site is representative of the heaths of the relatively continental hills of the east-central Highlands, with the full range of heath types to be expected in this part of Scotland and a wide range of high-altitude and snow-bed heaths. The alpine and subalpine heaths on this site are well developed, although the individual heathland sub-types are less extensive than on the Cairngorms. There are extensive areas of H13 *Calluna vulgaris-Cladonia arbuscula* heath and H19 *Vaccinium myrtillus-Cladonia arbuscula* heath. Lichens are especially abundant in these communities, with the lichen cover equalling, and even locally exceeding, the cover on the Cairngorms.

These heaths are the communities in Britain that are most comparable to the lichen heaths of Scandinavia. There are large areas of H20 *Vaccinium myrtillus-Racomitrium lanuginosum* heath and subalpine forms of H12 *Calluna vulgaris-Vaccinium myrtillus* heath, with a particularly fine development of wave-form prostrate H13 *Calluna vulgaris-Cladonia arbuscula* heath. In areas of H18 *Vaccinium myrtillus-Deschampsia flexuosa* heath, contrasts between wind-pruned and more sheltered heath with prolonged snow cover and dominated by bilberry *Vaccinium myrtillus* and bog bilberry *V. uliginosum* are especially well developed. Snow-bed

H22 *Vaccinium myrtillus-Rubus chamaemorus* heaths are well represented, with an abundance of the characteristic dwarf cornel *Cornus suecica.*

Foinaven (162)

Foinaven has been selected, with the Loch Maree Complex, as representative of the characteristic heaths that occur in the more highly oceanic parts of north-west of Scotland. These include extensive examples of very local heaths, which are restricted to a few sites in this area. H20 *Vaccinium myrtillus-Racomitrium lanuginosum* heath and H14 *Calluna vulgaris-Racomitrium lanuginosum* heath occur extensively within the site. H20 *Vaccinium myrtillus-Racomitrium lanuginosum* heath is especially extensive, developed over the huge areas of quartzite rock debris on the summit ridges. The site has the second largest extent of H15 *Calluna vulgaris-Juniperus communis* subsp. *nana* heath in the UK, not far short of its extent at the Loch Maree Complex. This heath has an abundant and diverse assemblage of characteristic Atlantic liverworts and mosses that is unique to the British Isles and is very rare in Ireland. In Scotland it is highly localised, being restricted to rugged ground in the north-west Highlands. This is one of only two sites with extensive development of such vegetation.

Hoy (67)

Hoy is representative of the more northerly oceanic sub-types of this habitat type, where the cool and windy climate results in the development of alpine and subalpine heaths at low altitude. The site has the most extensively developed high-quality examples of H17 *Calluna vulgaris-Arctostaphylos alpinus* heath in the UK, and the community is unusually rich in lichens. The alpine heaths are developed on a fine series of solifluction terraces. The western oceanic H14 *Calluna vulgaris-Racomitrium lanuginosum* heath, occurring here with bearberry *Arctostaphylos uva-ursi*, is also represented. At lower altitudes, covering the lower slopes, there are well developed transitions to extensive subalpine forms of the oceanic H10 *Calluna vulgaris-Erica cinerea* heath.

Invernaver (142)

Invernaver is included in the site series to represent a form of heath that is, as far as is known, floristically unique in the UK. The site is complementary to Ronas Hill in representing altitudinal descent of the habitat type to near sea-level on the exposed north coast of Scotland. The heath consists of a mix of short heather *Calluna vulgaris*, juniper *Juniperus communis*, crowberry *Empetrum nigrum*, bearberry *Arctostaphylos uva-ursi* and bell heather *Erica cinerea*, similar to heaths developed in coastal districts in Norway, but practically unknown in the UK outside Invernaver. This may be related to H16 *Calluna-vulgaris-Arctostaphylos uva-ursi* heath, but its NVC status is uncertain at present. This is the only site in the series where there are widely developed transitions to **Alpine calcareous grassland,** for which the site has also been proposed. There are also transitions to oceanic H10 *Calluna vulgaris-Erica cinerea* heath and to coastal communities.

Loch Maree Complex (173)

The Loch Maree Complex, with Foinaven, has been selected to represent a range of highly oceanic north-western types of alpine and subalpine heath, the most oceanic of the series. This site contains the most extensive and diverse assemblages in the UK of Atlantic mosses and liverworts associated with this habitat type (and with dry heaths). The complex has the largest area of H15 *Calluna vulgaris-Juniperus communis* subsp. *nana* heath in the UK. This alpine heath type is unique to the the British Isles; it is rare in Ireland and in Scotland is restricted to the north-west Highlands. There is an abundance of Atlantic bryophytes including *Herbertus borealis*, which is confined to this site in the UK and is otherwise known from only three localities in Norway, where it is less abundant. The sub-type of H20 *Vaccinium myrtillus-Racomitrium lanuginosum* heath with Atlantic bryophytes that is restricted to the north-west Highlands is well developed and extensive. There are also areas of H14 *Calluna vulgaris-Racomitrium lanuginosum* heath. At lower altitudes the alpine heaths give way to the oceanic subalpine H10 *Calluna vulgaris-Erica cinerea* heath with abundant woolly fringe-moss *Racomitrium lanuginosum* and H21 *Calluna vulgaris-Vaccinium myrtillus-Sphagnum capillifolium* heath. Structure and function of these heaths is well developed owing to lack of disturbance.

Moor House - Upper Teesdale (188)

Moor House - Upper Teesdale has the most extensive area of this habitat type south of Scotland and represents the best southern outlier. The main sub-type is H19 *Vaccinium myrtillus-Cladonia arbuscula* heath, which is a

very local alpine heath south of Scotland; here it is developed on an extensive plateau. Characteristically (as in the Highlands) there is an abundance of lichens, especially *Cladonia* species, but on this site there is also an unusual abundance of large clumps of the montane lichen *Cetraria islandica.* At the edge of the plateau H19 *Vaccinium myrtillus-Cladonia arbuscula* heath gives way below to a wind-clipped form of H12 *Calluna vulgaris-Vaccinium myrtillus* heath. which grades into taller heaths of the same community lower down the slopes. These represent alpine to subalpine transitions which, in the more severe climate of the Highlands, would be represented by prostrate heaths (typically H13 *Calluna vulgaris-Cladonia arbuscula* heath or H14 *Calluna vulgaris-Racomitrium lanuginosum* heath). Similarly, on one flat summit at an altitude of 600 m, wind-clipped heather of a short but upright growth form occurs among a profusion of lichens, especially *Cladonia* species. This constitutes an unusual alpine/subalpine form of H12 *Calluna vulgaris-Vaccinium myrtillus* heath that is very local in England.

Ronas Hill - North Roe (257)

Ronas Hill - North Roe is selected as representative of the extreme northerly development of this habitat type in the UK. The cool and windy climate on Shetland results in the development of alpine heaths at exceptionally low altitude, giving one of the best examples of the altitudinal descent of vegetation zones in the UK. The site contains the most extensive areas on any site in Britain of H14 *Calluna vulgaris-Racomitrium lanuginosum* heath, a type characteristic of the north-west and northern Highlands and Islands. Mountain bearberry *Arctostaphylos alpinus,* bearberry *A. uva-ursi* and trailing azalea *Loiseleuria procumbens* are all represented. There is also a large extent of a subalpine form of H10 *Calluna vulgaris-Erica cinerea* heath with an unusual abundance of woolly fringe-moss *Racomitrium lanuginosum* and locally frequent bearberry. Other subalpine heaths present include H21 *Calluna vulgaris-Vaccinium myrtillus-Sphagnum capillifolium* heath and small areas of H20 *Vaccinium myrtillus-Racomitrium lanuginosum* heath. H14 *Calluna vulgaris-Racomitrium lanuginosum* heath is developed on some of the finest solifluction terracing found outside the Cairngorms.

Strathglass Complex (185)

This site has been selected with Beinn Dearg as intermediate between heathland types of the east and the less extremely oceanic parts of the north-west. The Strathglass Complex has the second largest area of this habitat type in the site series, after the Cairngorms. The northern H17 *Calluna vulgaris-Arctostaphylos alpinus* heath is well represented, with the second most extensive development of this sub-type in the site series after Hoy. The site has one of the most extensive and best developments of the mainly north-western H20 *Vaccinium myrtillus-Racomitrium lanuginosum* heath, with a community structure similar in quality to that of Loch Maree Complex. Also present is the most extensive area of the characteristic eastern heathland type H13 *Calluna vulgaris-Cladonia arbuscula* heath to be found in the north-west, although lichen cover is not as high as on Ben Wyvis. In general, lichen cover is intermediate between the high cover of the east and generally low cover of the far west, while woolly fringe-moss *Racomitrium lanuginosum* is more abundant than in the east. The alpine heaths give way on the lower slopes to a representative range of subalpine types, including the oceanic H10 *Calluna vulgaris-Erica cinerea* heath, H21 *Calluna vulgaris-Vaccinium myrtillus-Sphagnum capillifolium* heath and H12 *Calluna vulgaris-Vaccinium myrtillus* heath. Overall, the site has the largest extent of the habitat type in the north-west Highlands.

2.4.6 Sub-Arctic willow scrub (31.622)

2.4.6.1 Background to selection

Sub-Arctic willow scrub is rare in the EC, being restricted to the UK, Sweden and Finland, and the site series reflects the UK's special responsibilities for this habitat type. This is one of the UK's most rare and endangered habitats, occuring only as small, discrete stands of willow *Salix* spp. or more scattered bushes. The largest stand of this very local habitat type is about 0.5 ha in size and most areas are much smaller. The sites selected hold a large proportion of the largest known patches of the scrub and have well developed community structure. They contain the largest known populations of the constituent willow species. The scrub is largely confined to the Scottish Highlands, and within this geographic range selection takes account of ecological variation.

In the UK the habitat type is confined to the higher mountains of the Scottish Highlands ,where it is found on ungrazed ledges and, more rarely, on lightly-grazed, steep, rocky slopes or boulder fields. This is the UK's highest altitude shrubby vegetation on moist, base-rich soils, and is a natural habitat maintained by the harsh climate at high altitude. The habitat type consists of a mixture of willows with arctic-alpine and arctic-sub arctic distributions in Europe, occurring in the far north of Scandinavia or on the mountains there and more rarely in the Alps. In Scotland it is a relict of post-glacial vegetation. Sub-Arctic species include downy willow *Salix lapponum,* whortle-leaved willow *S. myrsinites*, mountain willow *S. arbuscula* and woolly willow *S. lanata,* for which the sites are primarily selected. The associated arctic-alpine and northern species, such as net-leaved willow *S. reticulata,* dark-leaved willow *S. myrsinifolia* and tea-leaved willow *S. phylicifolia,* have also been represented in the site series. The willows grow among a rich mixture of grasses, rushes and broad-leaved herbs.

The NVC describes a single community (W20 *Salix lapponum-Luzula sylvatica* scrub) that belongs to this habitat type. Whortle-leaved willow *Salix myrsinites* scrub is a type not described in the NVC but it is included in the sites selected. The constituent willows occur occasionally in a range of other habitats, such as tall-herb communities, alpine calcareous grasslands, yellow saxifrage *Saxifraga aizoides* banks, *Carex-Juncus* flushes and flushed grasslands. Several species may be found within the same site, but the most abundant willow varies from patch to patch of the habitat type within a site and between sites. Some of this variation may be related to the base-richness of the underlying substrates and rocks, the altitude of the stands or, more locally, the effects of grazing. The habitat type usually occurs on soils developed on schist, which vary from strongly to weakly calcareous, and also on limestone. Different species of willow demand greater or lesser amounts of lime in the rocks. Downy willow is relatively undemanding and can grow on lime-poor schist. It is therefore the most widespread species because poorer rocks are widely distributed. Woolly willow, dark-leaved willow and net-leaved willow are more lime-demanding and are rare because the associated richer rocks are found less frequently. This range of variation is included within the site series.

Mountain willow is more resistant to grazing than other willow species and is found very locally on slopes open to grazing. The rare woolly willow forms patches where there is marked base-rich flushing. Net-leaved willow rarely forms scrub and more often is a constituent of alpine calcareous grassland. Dark-leaved willow and tea-leaved willow occur only at the lower end of the altitudinal range. A number of Annex I habitat types may occur on the same site. For example, **Sub-Arctic willow scrub** shares many of the species of the **Eutrophic tall herb** habitat type, and the two are often developed together on ledges. On slopes open to light grazing, **Sub-Arctic willow scrub** gives way to **Alpine calcareous grassland, Species-rich *Nardus* grassland** and **Alpine and subalpine heaths**.

Selection has been carried out to include the range of floristic variation and to encompass the altitudinal range and different rock types on which the habitat type is developed. It includes sites with the largest areas of scrub and populations of the willows and the best developed community structure and regeneration. The sites selected cover the main geographical range of the habitat type in the Breadalbanes, eastern and central Highlands together with outliers in the north-west Highlands. Most sites have representation of W20 *Salix lapponum-Luzula sylvatica* scrub, while Inchnadamph, Ben Alder and Ben Lawers (which has fragmentary W20 *Salix lapponum-Luzula sylvatica* scrub) have willow scrub types not fully described in the NVC. Fragmentary areas south of the Highlands were considered too small for inclusion and lacking in adequate community structure and regeneration.

This is an endangered habitat type in the UK and supports many rare plants and animals of northern latitudes and high mountains. Grazing is believed to have restricted the range of the habitat type, and at some sites its continued future on precarious rock ledges is in doubt.

2.4.6.2 Site list

Ben Alder and Aonach Beag (120)

This site in the central Highlands is selected to represent high-altitude (950 m) willow scrub on highly calcareous schist and limestone. It has the largest known population in the UK of woolly willow *Salix lanata,* the rarest of the sub-Arctic willows. Downy willow *S. lapponum* and net-leaved willow *S. reticulata* are frequent, and whortle-leaved willow *S. myrsinites* is also represented. The willows are associated with an area of alpine calcareous grassland on steep, rocky and remote ground.

Ben Heasgarnich (106)

This is one of the four sites selected in the Breadalbanes of the southern Highlands and represents sub-Arctic willow scrub up to high altitude (950 m) on highly to moderately calcareous schist. W20 *Salix lapponum-Luzula sylvatica* scrub is widely developed on the site, although it is virtually confined to crags and rock ledges, where the individual colonies of willows are small. The most abundant willow species are downy willow *Salix lapponum,* mountain willow *S. arbuscula,* whortle-leaved willow *S. myrsinites* and net-leaved willow *S. reticulata*. The scrub is associated with a rich flora of tall herbs and with alpine calcareous grassland.

Ben Lawers (103)

This is one of four sites selected in the Breadalbanes to represent sub-Arctic willow scrub with mountain willow *Salix arbuscula.* The site has the largest known population of mountain willow in the UK, developed on steep, rocky slopes that are difficult for grazing animals to reach, where it is restricted to crags and rock ledges. It also supports fragmentary W20 *Salix lapponum-Luzula sylvatica* scrub on calcareous schist, but at moderately high altitudes. Other willows are restricted to crags and rock ledges. Species include downy willow *S. lapponum,* dark-leaved willow *S. myrsinifolia* and net-leaved willow *S. reticulata,* together with scattered individual plants of woolly willow *S. lanata.* Generally they are associated with the eutrophic tall herb community or alpine calcareous grassland.

Ben Lui (105)

This site is one of four representing W20 *Salix lapponum-Luzula sylvatica* scrub in the Breadalbanes, occurring on highly calcareous schists at moderate altitude. The scrub is well developed on an extensive series of schistose crags and rock ledges. Unlike at most other sites, the dominant species is whortle-leaved willow *Salix myrsinites.* This variant also occurs at Inchnadamph (where by contrast the scrub is developed at low altitude on limestone). Net-leaved willow *S. reticulata* is frequent, mainly associated with alpine calcareous grassland. Mountain willow *S. arbuscula,* tea-leaved willow *S. phylicifolia* and downy willow *S. lapponum* are also represented. The scrub is associated with a rich flora of tall herb and alpine calcareous grassland.

Caenlochan (78)

This site has the most extensive areas of this relict habitat growing to a high altitude on highly to moderately calcareous schist. Corrie Sharroch holds the largest single patch (around 0.5 ha) of W20 *Salix lapponum-Luzula sylvatica* scrub remaining anywhere in the UK uplands. The scrub is also found spread across a larger area of crag and steep rocky slope than on any other site in the UK. The most abundant species, and generally the dominant one, is downy willow *Salix lapponum,* probably occurring in larger numbers here than on any other site in the UK. There is a relatively large patch of scrub dominated by woolly willow *S. lanata* and the site may hold the second largest population of this species in the UK. Whortle-leaved willow *S. myrsinites* and net-leaved willow *S. reticulata* are also represented. The associated habitat is mainly eutrophic tall herbs.

Creag Meagaidh (122)

Creag Meagaidh is representative of W20 *Salix lapponum-Luzula sylvatica* scrub on less strongly calcareous schist in the west-central Highlands at moderately high altitude (600-750 m). The site represents the scrub in an exceptionally wide range of different localities and associated vegetation. Clumps of the willows are widely scattered in corries on crags and rock ledges, along rocky or steep burn-sides, in boulder fields, in *Carex-Juncus* flushes and in flushed ground in association with mountain saxifrage *Saxifraga aizoides.* Downy willow *Salix lapponum* is the most common species, while mountain willow *S. arbuscula* and dark-leaved willow *S. myrsinifolia* are also represented.

Drumochter Hills (116)

This site is representative of W20 *Salix lapponum-Luzula sylvatica* scrub on less strongly calcareous schist in the east-central Highlands at moderately high altitude (750 m). The patches of sub-Arctic willow scrub on Drumochter Hills are widely developed across the site and are thought to constitute the second largest area of scattered scrub in the UK after Caenlochan. The scrub occurs in a variety of locations including rock ledges, crags, by rocky burn-sides and, unusually, in wet scree on steep slopes. Exceptionally, in one place the scrub occurs with subalpine scrub of rowan *Sorbus aucuparia* and downy birch *Betula pubescens*. The most abundant and widespread willow species is downy willow *Salix lapponum,* while whortle-leaved willow *S. myrsinites* and mountain willow *S. arbuscula* are locally abundant.

Inchnadamph (65)

This is the most northerly site selected and has a unique development of whortle-leaved willow *Salix myrsinites* scrub on limestone at low altitude. This is the largest area of scrub dominated by whortle leaved willow in the UK. The scrub occurs in and around outcrops of Durness limestone and this is the only site where the habitat type is solely developed on limestone. There are significant transitions to **Limestone pavement**, proposed as an Annex I interest in its own right.

Meall na Samhna (121)

This is one of the four sites representing sub-Arctic willow scrub (W20 *Salix lapponum-Luzula sylvatica* scrub) on highly calcareous schist in the Breadalbanes and occurs at moderately high altitude (around 750 m). The wide range of species present is characteristic of calcareous schistose rock and includes woolly willow *Salix lanata,* downy willow *S. lapponum,* whortle-leaved willow *S. myrsinites,* mountain willow *S. arbuscula* and net-leaved willow *S. reticulata,* which are mixed together. The willows are confined to rock ledges and occur in two main areas across a series of crags. They are mainly associated with eutrophic tall herb community and alpine calcareous grassland, with exceptionally rich suites of associated arctic-alpines.

Strathglass Complex (185)

This site is the only representative in the site series of W20 *Salix lapponum-Luzula sylvatica* scrub on generally base-poor schist up to high altitude in the north-west Highlands. The scrub occurs in a series of localities in two widely separated corries and scattered plants also occur in a few other places. The main occurrences are on ungrazed rock ledges, on steep rocky ground including boulder fields and on open slopes, where the willows are heavily grazed. Associated habitats are eutrophic tall herbs and herb-rich grassland. While downy willow *Salix lapponum* is the most widespread willow species, whortle-leaved willow *S. myrsinites* is also represented.

Section 2.5: Sclerophyllous scrub (Matorral)

2.5.1 Stable *Buxus sempervirens* formations on calcareous rock slopes (*Berberidion* p.) (31.82)

2.5.1.1 Background to selection

This is a rare habitat type in the UK, and only one site conforming to the habitat type definition has been identified. This site is selected.

Semi-natural and natural box *Buxus sempervirens* scrub occurs at only three sites in the UK. At only one of these sites, Box Hill in Surrey, is the scrub a stable (i.e. persistent) natural or near-natural community, as it is developed on steep, chalk slopes, where other tree species are unable to grow to mature size. At the other two sites, in Gloucestershire and Buckinghamshire, box occurs as seral scrub gradually reverting to woodland where unmanaged and so does not represent a stable formation.

2.5.1.2 Site list

Mole Gap to Reigate Escarpment (72)

This site in south-east England supports the only area of stable box scrub in the UK, on steep chalk slopes where the River Mole has cut into the North Downs Escarpment, creating the Mole Gap. Here natural erosion maintains the open conditions required for the survival of this habitat type. The site therefore supports a stable formation and has good conservation of structure and function.

2.5.2 *Juniperus communis* formations on heaths or calcareous grasslands (31.88)

2.5.2.1 Background to selection

This is a widespread but very local habitat type that is unevenly distributed in the EC and the UK. It exhibits a wide range of ecological variation. Site selection has been carried out to take account of the geographical range of the habitat type, its ecological variation and restricted occurrence. The sites with the largest expanses of juniper and the widest range of ecological variation have been favoured.

The relationship between juniper *Juniperus communis* stands and other types of vegetation is complex. In some cases the stands have no characteristics to separate them from typical examples of heath or calcareous grassland vegetation, except for the abundance of juniper. These are often relatively recent stands. However, at some sites, particularly where the juniper has been present for a longer period, a more distinctive assemblage of species occurs. Here the juniper is associated with other shrubs, shade-tolerant herbs, grazing-sensitive tall herbs, bryophytes and ferns. Sites selected include both long established and more recent stand types.

The main ecological variation occurs between stands on calcareous substrates (principally chalk and limestone but sometimes calcareous drift) and those found on acid substrates. Calcareous types are mainly found in the southern part of in the UK, while acid types are mainly found in northern areas. However, both calcareous and acid types can be found on the same sites in northern England and Scotland.

In southern England juniper scrub may develop on a range of calcareous grassland types. More closed stands with a rich scrub flora are referable to the W21 *Crataegus monogyna-Hedera helix* scrub, *Viburnum lantana* sub-community of the NVC, formerly called 'southern mixed scrub'. Where juniper is not dominant the scrub contains a rich assemblage of other shrubs, mainly of the family *Rosaceae*. Further north, at higher altitude on limestone, common juniper scrub is often associated with limestone pavement, crevice, cliff and scree. Beyond the distribution range of many rosaceous shrubs and often in heavily grazed situations, such scrub may be relatively poor in specialist scrub species. In such circumstances the vegetation has affinities to the species-poor juniper scrub more usually found on acidic substrates. Selection takes account of both the southern lowland examples and northern variants of calcareous juniper scrub.

In northern England and Scotland juniper is found on a wide range of acidic substrates. In many instances these are simply stands of heathland or acidic grassland that have become invaded by juniper. However, at sites where the juniper has been established for longer, the community is referable to the W19 *Juniperus communis* subsp. *communis-Oxalis acetosella* woodland type of the NVC. Such vegetation is typically dominated by juniper, although downy birch *Betula pubescens* and rowan *Sorbus aucuparia* are often scattered throughout. The understorey is rich in acidophilous species such as wood-sorrel *Oxalis acetosella*, heath bedstraw *Galium saxatile* and hairy wood-rush *Luzula pilosa*. There is usually a well developed layer of pleurocarpous mosses and ferns. On lower flushed slopes and on more base-rich substrates in the north the flora is enriched by species that reflect an increased base status, such as common dog-violet *Viola riviniana*, dog's mercury *Mercurialis perennis* and northern bedstraw *Galium boreale*. Stands of juniper used to occur on lowland heathland, but only scattered specimens now survive at a few sites, as a result of burning and lack of management. Both acidic and more base-rich variations of the northern scrub type have been selected.

Juniper stands occur in juxtaposition with a wide range of other vegetation types. In the north of Scotland there are stands that are transitional to Caledonian forests and birch woodlands. Southern stands occur that are transitional to beech woodlands. In upland areas, specifically the Cairngorms, stands are still found at the upper limit of tree development in an apparently natural context. Elsewhere, stands occur that are transitional to calcareous grassland, heath, acidic grassland, rock outcrop, limestone pavement, scree and cliffs. Site selection has taken account of this variation. A range of juniper scrub types may occur in individual sites, and these may include both calcareous and acidic types, altitudinal variations and transitions to a range of habitats.

This habitat type is very patchily distributed, and site selection reflects this pattern. A significant part of the resource is found in north-east Scotland, where a diverse range of stand types are also found, and therefore three of the sites selected are from this area.

2.5.2.2 Site list

Cairngorms (209)

The Cairngorms has the third largest extent of juniper *Juniperus communis* formations in the UK and is one of three sites providing representation of the habitat type in north-east Scotland. The site is exceptional for the wide range of ecological situations in which juniper occurs. Creag Fhiaclach is unique in having the only natural tree-line in the UK. At around 640 m there is a mixed tree-line woodland with stunted Scots pine *Pinus sylvestris* and juniper, giving way at higher altitude to alpine juniper scrub. The alpine juniper scrub is developed extensively and often occurs in a stunted form transitional between subsp. *communis* and subsp. *nana*. On Inchrory, juniper occurs as a seral retrogression from woodland due to grazing, and on both neutral and calcareous soils, in contrast to the juniper of the acidic granite areas elsewhere on the site. Juniper also occurs at the margins and as part of the understorey of the Caledonian forest within the site.

Chilterns Beechwoods (44)

This site and Salisbury Plain provide a representation of the habitat type on chalk in southern England. The scrub is of the southern mixed type, rich in juniper *Juniperus communis*. This area represents the habitat type in the more northerly areas in which juniper occurs on chalk and, unlike on Salisbury Plain, the scrub is juxtaposed not only with chalk grassland but also with calcareous beech woodland. This site has increased in relative importance in recent decades, owing to the decline of juniper on the southern chalk.

Ingleborough Complex (62)

This site provides an upland representation of the habitat type on a calcareous substrate in north-east England. It occurs here at its highest altitude on limestone in the UK. Amid stands of calcareous grassland it has the only large stands of juniper *Juniperus communis* on limestone pavement at high altitude in the UK and is of the relatively species-poor type found in these situations.

Moor House - Upper Teesdale (188)

This site provides representation of the habitat type on a more acidic substrate in north-east England. It has the second most extensive area of *Juniperus communis* formation in UK and the largest south of Scotland. The main area of juniper scrub grows on the igneous whin-sill, at moderately high altitude. In Upper Teesdale the juniper has developed mainly on heath and is of the W19 *Juniperus communis-Oxalis acetosella* type. There are transitions to dwarf-shrub heath, acidic grasslands and Whin cliffs. Small patches of juniper scrub also occur on calcareous soils, including the sugar limestone grassland for which this site is famous. Palaeo-environmental evidence indicates that juniper scrub has been present continuously since the last glacial period.

Morecambe Bay Pavements (191)

This site provides a representation of *Juniperus communis* formations on limestone pavement at low to intermediate altitude in north-west England. In contrast to most other areas in northern England, these are ungrazed or grazed at low intensity and have affinities to southern mixed scrub, owing to the presence of species such as wild privet *Ligustrum vulgare* and burnet rose *Rosa pimpinellifolia*. Other stands occur on calcareous grassland dominated by blue moor-grass *Sesleria caerulea*.

Morrone Birkwood (102)

Morrone Birkwood is one of three sites providing representation of the habitat type in north-east Scotland. It has the most extensive and diverse example of woodland-juniper scrub transitions in the UK. The site contains examples of *Juniperus communis* formations developed both on limestone drift soil and on contrasting acidic soils. This is the most extensive and diverse example of juniper scrub on base-rich soils in Scotland. The flora is species-rich, with an outstanding northern component. This includes rare species usually associated with Scots pine woods, such as twinflower *Linnaea borealis,* chickweed wintergreen *Trientalis europaea,* lesser twayblade *Listera cordata,* interrupted clubmoss *Lycopodium annotinum,* globe-flower *Trollius europaeus* and northern bedstraw *Galium boreale*. Juniper is actively regenerating on the open slopes above the wood. Pollen analysis indicates that the wood has not altered floristically since the post-glacial period.

Morven and Mullachdubh (289)

This is one of three sites representing this habitat type in north-east Scotland. It has the largest known area of juniper *Juniperus communis* scrub in the UK, about double the extent occurring at any other site. The juniper is developed on acidic rocks among heath and grasslands, and the flora is locally rich in ferns, including beech fern *Phegopteris connectilis*, oak fern *Gymnocarpium dryopteris* and hard-fern *Blechnum spicant.* Common woodland herbs such as wood-sorrel *Oxalis acetosella* and wood anemone *Anemone nemorosa* are widespread. Of particular interest is the extensive development of juniper up to high altitude, where there are natural transitions to lichen-rich alpine heaths and to dry heath.

Salisbury Plain (33)

This site provides a representation of the habitat type near the southern edge of its range on chalk in southern England, where it is a particularly rare habitat. This site is the best remaining example in the UK of lowland juniper scrub on chalk. The juniper is juxtaposed with extensive chalk grassland and chalk heath. In some cases the scrub has developed recently by invasion of open chalk grassland and contains few typical shrub species. However most of the scrub is of the southern mixed scrub type and is enriched by roses *Rosa* spp., wild privet *Ligustrum vulgare*, dogwood *Cornus sanguinea*, wayfaring tree *Viburnum lantana* and other species characteristic of the type.

Section 2.6: Natural and semi-natural grassland formations

2.6.1 Calaminarian grasslands (34.2)

2.6.1.1 Background to selection

Calaminarian grasslands are a locally widespread but uncommon habitat type in the UK. Such grasslands occur on soils that have levels of heavy metals, such as lead, chromium and copper, that are toxic to most plant species. The majority of the habitat type is found on artificial sites associated with past mining activities, many of them species-poor. Near-natural examples occur on outcrops of serpentine rocks. Preference has been given to the selection of the rarer, more natural types, which have distinctive structural characteristics and are important for the conservation of rare species.

The site series includes the best examples of the three main situations where this habitat type is developed, which are:

near-natural, open vegetation of serpentine rock outcrops with skeletal soils;
river gravels rich in lead and zinc and that are near-natural, although the heavy metal content may be partly an artefact of past mining activity in the river catchment;
artificial mine workings and spoil heaps, mainly on limestone; these are numerous (several thousand UK sites) and extensive, although few sites have a high species richness.

Grasslands of this type are referable to the *Violetea-Calaminareae* alliance. The vegetation is typically species-poor but contains a number of species principally found in this habitat type, most notably spring sandwort *Minuartia verna* and alpine penny-cress *Thlaspi caerulescens*, as well as a genetically adapted range of other species, such as bladder campion *Silene vulgaris* and thrift *Armeria maritima*. In northern parts of the UK there are local populations of boreal species characteristic of these habitat conditions in Scandinavia, such as Scottish sandwort *Arenaria norvegica* as well as the endemic Shetland mouse-ear *Cerastium nigrescen* (= arctic mouse-ear *Cerastium alpinum* subsp. *edmonstonii* (Dony *et al.* 1986)).

2.6.1.2 Site list

Caenlochan (78)

This site contains an example of the habitat type developed over serpentine in north-east Scotland. It is the largest extent of the habitat type in the uplands. Spring sandwort *Minuartia verna*, thrift *Armeria maritima* and scurvygrasses *Cochlearia* spp. characterise the site, but it lacks the boreal and endemic taxa of the Keen of Hamar. The grasslands occur on natural rock outcrops amidst a typical mosaic of montane and alpine heath and grassland vegetation.

Gang Mine (77)

This site is chosen as an example of the habitat type in an anthropogenic context in northern England. Natural limestone outcrops supporting species typical of calaminarian grasslands are rare and small, with a very impoverished flora. This site is included to provide an example of the habitat type on sedimentary rocks; it it has colonised the large area of mine workings and spoil heaps on limestone. These are notable for the wide variations in slope, aspect and soil toxicity. Floristically the site contains the richest anthropogenic Calaminarian grasslands in the UK, with abundant spring sandwort *Minuartia verna* and alpine penny-cress *Thlaspi caerulescens* and other species of grassland vegetation present including early-purple orchid *Orchis mascula* and dyer's greenweed *Genista tinctoria*. Many of these species are likely to be distinct genotypes adapted to soils rich in heavy metals.

Keen of Hamar (75)

This site in Shetland has the largest surviving area of Calaminarian grassland on serpentine, in a near-natural condition, in the UK. The site is rich in rare northern species such as arctic sandwort *Arenaria norvegica* subsp. *norvegica* and northern rock cross *Arabis petraea* and includes the endemic Shetland mouse-ear *Cerastium nigrescen* (= arctic mouse-ear *Cerastium alpinum* subsp. *edmonstonii* (Dony *et al.* 1986)), found only on

serpentine rocks at this site. The site has ecological features and a floristic composition that is similar to those of serpentine grasslands in Scandinavia, where the habitat type is also rare.

Tyne and Allen River Gravels (76)

This site in north-east England encompasses the most extensive, structurally varied and species-rich examples of riverine calaminarian grasslands in the UK. The river gravels contain a range of structural types, ranging from a highly toxic, sparsely vegetated area with abundant lichens through to closed willow/alder *Salix/Alnus* woodland. In addition, the site is of considerable functional interest for the series of fossilised river channel features. Spring sandwort *Minuartia verna* and thrift *Armeria maritima* are particularly abundant and there are a number of rare species, including Young's helleborine *Epipactis youngiana*, which has its main UK population at this site.

2.6.2 Siliceous alpine and boreal grassland (36.32)

2.6.2.1 Background to selection

The distribution of this habitat type is restricted in the EC. The UK and Ireland support the only examples of this vegetation within the Atlantic Biogeographic Region. In the UK extensive areas of the habitat type occur chiefly in Scotland. The sub-types dominated by woolly fringe-moss *Racomitrium lanuginosum*, which are the predominant and widespread types in the UK, are particularly significant in international terms because outside the EC they are restricted to oceanic, northern lands such as the Faroe Islands and Iceland. The habitat type is one of the few largely near-natural habitats remaining in the UK and is the most important habitat for dotterel *Charadrius morinellus*, Britain's only montane wading bird. Site selection takes account of the UK's responsibilities for conservation of this habitat type in the Atlantic Biogeographic Region. Sites have been selected to cover the wide range of ecological variation of this habitat type and to encompass its geographical range in the UK. The sites selected hold the most extensive areas for this habitat type and are those least modified by human activities. As a result they demonstrate the best structure and function of the vegetation communities.

Siliceous alpine and boreal grassland is the most extensive vegetation to be found in the high mountain zone, i.e. above an altitude of about 750 m. The grassland characteristically forms large continuous tracts and covers summit plateaux and the tops of the higher summits and ridges. Within the definition of the habitat type is a wide range of grassland types whose composition is influenced by contrasting extremes of exposure and snow-lie. There are four main sub-types of **Siliceous alpine and boreal grassland** recognised by the NVC, although these are referred to as 'heath'. These are:

U7 *Nardus stricta-Carex bigelowii* grass-heath
U8 *Carex bigelowii-Polytrichum* alpinum sedge-heath
U9 *Juncus trifidus-Racomitrium lanuginosum* rush-heath
U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath.

U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath occurs on wind-swept ground blown clear of snow during the winter. Where snow-lie builds up, such moss-heath gives way initially to U7 *Nardus stricta-Carex bigelowii* grass-heath, and both give way to U8 *Carex bigelowii-Polytrichum alpinum* sedge-heath where snow-lie is more prolonged. Alternatively U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath gives way to U9 *Juncus trifidus-Racomitrium lanuginosum* rush-heath where exposure is more severe or the substrate more unstable, and the latter represents the habitat type at its highest altitude. Collectively the flora of the grasslands is important for a wide range of montane vascular plants, mosses and liverworts.

The most common sub-type, U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath, varies in species composition depending on the base-richness and instability of the substrate. On relatively stable and acid siliceous rocks the flora is mainly species-poor, though a few cushion herbs such as moss campion *Silene acaulis*, thrift *Armeria maritima* and the montane rarity diapensia *Diapensia lapponica* occur. Localised bands of base-rich rocks support a more varied flora, and a species-rich sub-type of U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath develops, supporting a number of rare or local montane plants. The flora of this species-rich moss-heath includes dwarf willow *Salix herbacea*, alpine lady's-mantle *Alchemilla alpina*, moss campion *Silene acaulis*, thrift *Armeria maritima*, alpine bistort *Persicaria vivipara*, sibbaldia *Sibbaldia procumbens*, spiked wood-rush *Luzula spicata*, the rare cushion herb cyphel *Minuartia sedoides*, the rare mosses *Aulacomnium turgidum* and *Hypnum hamulosum* and the rare foliose lichen *Nephroma arcticum.* Open and unstable conditions can also produce an enrichment of the flora and give rise to a similar species-rich sub-type. This can develop on highly wind-swept ground but occurs most commonly on solifluction terracing in the Highlands. The terracing is formed by alternate freezing and thawing of soil water, and some plants benefit from the instability, which stirs up the soils and counteracts the effects of leaching. A special development in the UK is that strong winds at high altitude can keep the more exposed risers of the stair-like terraces open, resulting in distinctive bands of vegetation. Norwegian mugwort *Artemisia norvegica*, which is known from only two mountains in the north-west Highlands, is present in open U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath on solifluction terracing.

In the Highlands of Scotland the sub-types of this habitat type tend to form intimate mosaics with other habitats, the elements of which are ecologically interdependent. These include rare communities of late snow-lie (snow-patch communities) (NVC U11 *Polytrichum sexangulare-Kiaeria starkei* snow-bed, U12 *Salix herbacea-*

Racomitrium heterostichum snow-bed and U14 *Alchemilla alpina-Sibbaldia procumbens* dwarf-herb community), dominated by mosses and hardy herbs. Rare species found in these assemblages include hare's-foot sedge *Carex lachenalii,* starwort mouse-ear *Cerastium cerastoides,* curved wood-rush *Luzula arcuata* and the bryophytes *Conostomum tetragonum, Anthelia juratzkana* and *Moerckia blyttii*. Flushed U13 *Deschampsia cespitosa-Galium saxatile* grassland can also develop below areas of melting snow. This may include a sub-type of this grassland with an abundance of the large hypnaceous moss *Rhytidiadelphus loreus,* which occurs in the far north and west. Sites where there is a range of siliceous alpine and boreal grassland sub-types show significantly increased diversity, owing to the development of such associated communities.

There is much variation in the distribution of the different sub-types across the country. In the western Highlands of Scotland, U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath is widely distributed. The species-rich sub-type is mostly confined to this area. In the east U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath is proportionately less extensive and U8 *Carex bigelowii-Polytrichum alpinum* sedge-heath and U9 *Juncus trifidus-Racomitrium lanuginosum* rush-heath become more common, largely replacing woolly fringe-moss on the highest hills. U7 *Nardus stricta-Carex bigelowii* grass-heath grasslands are extensive throughout the Highlands of Scotland but to the south they become very local and the dominant form of the habitat is woolly fringe-moss heath. This habitat is vulnerable to grazing pressure and other forms of physical damage.

Sites have been selected to include all of the sub-types and the main geographical variants of each type. The largest sites have been selected because they include the widest range of sub-types and have the greatest diversity of vegetation mosaics and transitions to other communities.

2.6.2.2 Site list

Beinn Dearg (104)

Beinn Dearg has the third largest area of this habitat type in the UK and the second largest in the north-west Highlands. There is extensive development of U7 *Nardus stricta-Carex bigelowii* grass-heath and both the species-poor and species-rich forms of U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath. In particular the species-rich form is more extensive and better developed on this site than on any other area. Species-rich U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath is associated with base-rich schist on extensive solifluction terracing and is enriched with arctic-alpine and northern vascular plants, including moss campion *Silene acaulis,* cyphel *Minuartia sedoides,* three-leaved rush *Juncus trifidus,* spiked wood-rush *Luzula spicata,* sibbaldia *Sibbaldia procumbens,* dwarf cudweed *Gnaphalium supinum* and mountain everlasting *Antennaria dioica,* accompanied by the rare montane calcicole mosses *Hypnum hamulosum* and *Aulacomnium turgidum*. Beinn Dearg is one of only two mountains in the north-west Highlands on which the rare Norwegian mugwort *Artemisia norvegica* is known to occur.

Ben Wyvis (119)

Ben Wyvis has been selected as a representative of the species-poor U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath characteristic of the north and west of Scotland. Although the habitat type is not as extensive on Ben Wyvis as on some other hills, the site has the largest continuous single tract of this sub-type in the UK, covering almost the whole of the summit plateau. The habitat type is developed on base-poor schist. There is also a large extent of the associated *Rhytidiadelphus loreus* moss-rich grassland on the edges of the U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath, where snow tends to drift. The area is little disturbed and shows a particularly luxuriant moss-cover. U7 *Nardus stricta-Carex bigelowii* grass-heath is also well represented and U8 *Carex bigelowii-Polytrichum alpinum* sedge-heath is present locally.

Cairngorms (209)

The Cairngorms complex of sites (Cairngorms, Eastern Cairngorms, Northern Corries and Inchrory) has the largest tracts of siliceous alpine and boreal grassland in the UK, developed on granite and, more locally, base-poor schists. The total extent is more than twice that on any other site in the UK. The full range of sub-types occurs on acidic soils, and all of them are well developed and widespread. They occupy a much larger area at very high altitude (above 1,000 m) than on any other site in the UK. The U9 *Juncus trifidus-Racomitrium lanuginosum* rush-heath community is particularly well developed and its extent far exceeds that on any other site in the UK. The associated late-lie moss snow-beds (U11 *Polytrichum norvegicum-Kiaeria starkei* snow-bed

and U12 *Salix herbacea-Racomitrium heterostichum* snow-bed) are the most extensive and well developed in Britain.

Creag Meagaidh (122)

Creag Meagaidh has an extensive high plateau with schistose rocks similar to those on Drumochter Hills. The site contains a large area of siliceous alpine and boreal grassland with the full range of community types characteristic of the central Highlands. Species-poor U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath is widespread on the site and Creag Meagaidh has the third largest total extent of this sub-type in the UK. Species-rich U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath is also represented, mostly in association with solifluction terracing, but is not extensive. U7 *Nardus stricta-Carex bigelowii* grass-heath is also extensive and U8 *Carex bigelowii-Polytrichum alpinum* sedge-heath is well represented but not extensive. U9 *Juncus trifidus-Racomitrium lanuginosum* rush-heath is developed locally on exposed ridges. Despite the similarity of rock type, the proportions of the communities present on Creag Meagaidh are different from those on Drumochter Hills. The dominance of U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath is probably due to a more oceanic climate, while the smaller extent of U7 *Nardus stricta-Carex bigelowii* grass-heath and U8 *Carex bigelowii-Polytrichum alpinum* sedge-heath compared with Drumochter Hills is due to less prolonged snow cover. There are transitions to extensive late-lie moss-dominated snow-bed communities and flushed U13 *Deschampsia cespitosa-Galium saxatile* grassland.

Drumochter Hills (116)

Drumochter Hills has an extensive high plateau with the fourth largest area of siliceous alpine and boreal grassland containing the largest area in the site series of U8 *Carex bigelowii-Polytrichum alpinum* sedge-heath. Two other sub-types, U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath and U7 *Nardus stricta-Carex bigelowii* grass-heath are extensive. The site is representative of the east-central Highlands with schistose rocks, which contrast with the wholly acidic granite of the Cairngorms and support local enrichment of the flora. The comparatively large extent of U8 *Carex bigelowii-Polytrichum alpinum* sedge-heath is characteristic of the high eastern and central hills. There are especially fine transitions to alpine dwarf-shrub heaths, and unusually the grasslands border extensive high-altitude blanket mire.

Eryri/Snowdonia (118)

Eryri has the best developed and most extensive areas of this habitat type in Wales and is the largest example of the habitat type south of Scotland. The principal sub-types present are chiefly U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath, although there are fragments of U7 *Nardus stricta-Carex bigelowii* grass-heath. This site is representative of the more impoverished southern variants of the habitat type.

Merrick Kells (278)

The site is representative of siliceous alpine and boreal grassland in the southern uplands of Scotland. This is the largest area of the habitat type south of the Highlands represented in the site series. Species-poor U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath is the main sub-type and is well developed, with a high cover of woolly fringe-moss *Racomitrium lanuginosum*. Although small in area, in terms of vegetation structure and floristics, the accompanying U7 *Nardus stricta-Carex bigelowii* grass-heath is one of the best representations south of the Highlands. This representation of the habitat type is comparable with southern outliers on the hills of England and Wales.

Moor House - Upper Teesdale (188)

The summit of Cross Fell has the best developed and most extensive area of this habitat in England. The U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath that covers the summit cap has a high cover of woolly fringe-moss *Racomitrium lanuginosum*.

Strathglass Complex (185)

The Affric-Cannich Hills within this complex have the second largest extent of siliceous alpine and boreal grassland in the UK and are representative of the habitat type in the north-west Highlands. The rocks are generally acidic, with small areas of moderately base-rich rock. The dominant sub-types present are species-poor U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath and U7 *Nardus stricta-Carex bigelowii* grass-

heath. U8 *Carex bigelowii-Polytrichum alpinum* sedge-heath and U9 *Juncus trifidus-Racomitrium lanuginosum* rush-heath are also represented but the areas developed are small. There are also extensive areas of the rarer species-rich U10 *Carex bigelowii-Racomitrium lanuginosum* moss-heath chiefly associated with the disturbed ground of solifluction terracing. This is enriched with arctic-alpine vascular plants and rare montane calcicole mosses. Associated communities include late moss-dominated snow-beds and the most extensive areas of the flushed U13 *Deschampsia cespitosa-Galium saxatile* grassland in Britain.

2.6.3 Alpine calcareous grasslands (36.41 to 36.45)

2.6.3.1 Background to selection

Alpine calcareous grasslands are extremely scarce in the UK. Only about 250 ha of this habitat type are found in the SSSI and ASSI series and this is thought to be a very high proportion of the total UK resource of the habitat type. In the UK this habitat type is an outlier of a community that is otherwise restricted to the Alpine Biogeographic Region in the EC. The UK variant of the habitat type occurs close to sea-level, as well as at high altitude. This is unusual in a European context and is due to the harsh northern oceanic climate of north-west Scotland. The selection process has ensured that a high proportion of the resource is included in the site series. The sites selected are the largest and structurally and functionally most complete examples of this habitat type. Such sites have the greatest variety of sub-types and have the highest diversity of vegetation mosaics containing alpine calcareous grasslands and transitions to other communities. The sites encompass the ecological variation and geographical range of the habitat type, which occurs primarily in the Highlands of Scotland. High-altitude alpine calcareous grassland is restricted to those upland areas in the central and north-western Highlands of Scotland where base-rich rocks are found. Examples of the habitat type at low altitude are very localised, being found only on calcareous rocks in the extreme north-west of mainland Scotland and on Skye. The largest areas of the habitat type have been selected in each of these areas.

This habitat type occurs on lime-rich soils from near sea-level to an altitude of over 1000 m. It consists of short, often grazed, species-rich mixtures of mountain avens *Dryas octopetala*, arctic-alpine cushion herbs, grasses and sedges. At low altitude, colonisation of the grasslands by trees and shrubs is prevented partly by exposure and partly by grazing. At high altitude the grasslands are maintained by the harsh climate, though species composition may be altered by grazing. This is one of the most important upland habitats in the UK for rare arctic-alpine plants and other rare montane plants and animals, including the endemic Scottish primrose *Primula scotica*. Indeed, areas with this habitat type form a large proportion of the localities in the Highlands traditionally regarded as important for their arctic-alpine flora.

Arctic-alpines that occur on this habitat type include characteristic species such as moss campion *Silene acaulis*, alpine lady's-mantle *Alchemilla alpina*, sibbaldia *Sibbaldia procumbens*, spiked wood-rush *Luzula spicata*, cyphel *Minuartia sedoides*, purple saxifrage *Saxifraga oppositifolia*, dwarf willow *Salix herbacea*, alpine bistort *Persicaria vivipara*, hair sedge *Carex capillaris*, yellow saxifrage *Saxifraga aizoides*, alpine meadow-rue *Thalictrum alpinum*, net-leaved willow *Salix reticulata* and green spleenwort *Asplenium trichomanes-ramosum*. Nationally rare species present are also mainly arctic-alpines, including alpine mouse-ear *Cerastium alpinum*, rock sedge *Carex rupestris*, hoary whitlowgrass *Draba incana*, rock whitlowgrass *Draba norvegica*, dark-red helleborine *Epipactis atrorubens*, alpine forget-me-not *Myosotis alpestris*, purple oxytropis *Oxytropis halleri*, alpine meadow-grass *Poa alpina*, alpine cinquefoil *Potentilla crantzii*, alpine speedwell *Veronica alpina* and rock speedwell *V. fruticans*. There are also rare or uncommon calcicolous bryophytes such as *Aulacomnium turgidum, Amblystegium compactum, Seligeria trifaria* and *Lescuraea incurvata*. Site selection aims to represent all of the rarer species and the largest populations of the characteristic species.

There are three NVC communities, one of which is confusingly referred to as heath. They are:

CG12 *Festuca ovina-Alchemilla alpina-Silene acaulis* dwarf-herb community
CG13 D*ryas octopetala-Carex flacca* heath
CG14 *Dryas octopetala-Silene acaulis* ledge community

Variation within the habitat type is due to differences in altitude, climate and the presence of grazing. The low-altitude grasslands are dominated by the mountain avens *Dryas octopetala*. This occurs up to an altitude of 500 m in the extreme north-west of Scotland, mainly on Durness limestone and blown shell-sand. Within the CG13 *Dryas octopetala-Carex flacca* heath, mountain avens occurs mixed with lowland species and a relatively small complement of other arctic-alpine species. In some forms of the community the calcifuge (lime-hating) arctic-alpines crowberry *Empetrum nigrum* subsp. *nigrum* and hermaphrodite crowberry *E. nigrum* subsp. *hermaphroditum* and bearberry *Arctostaphylos uva-ursi* occur mixed with the calciphiles (lime-loving) species such as mountain avens. This is highly unusual and is perhaps due to surface leaching in the wet climate.

At high altitudes the habitat type occurs in two forms with a much larger complement of arctic-alpine species. Dominance of mountain avens is maintained on steep, rocky ground, on rock ledges and among boulders out of the reach of grazing animals, forming the CG14 *Dryas octopetala-Silene acaulis* ledge community. Within this

sub-type, mountain avens occurs mixed with a wide range of arctic-alpine species. On open slopes montane cushion herbs, especially moss campion *Silene acaulis,* and other small herbs replace mountain avens to form CG12 *Festuca ovina-Alchemilla alpina-Silene acaulis* dwarf-herb community. Arctic-alpines also dominate here, usually moss campion and alpine lady's-mantle, sometimes with cyphel. Site selection aims to represent all the sub-types of the habitat type.

On most upland sites, **Alpine calcareous grasslands** form intimate mosaics with other upland Annex I habitats, and there are complex transitions to a range of montane communities. They are often associated with **Sub-arctic willow scrub** and **Eutrophic tall herbs** on inaccessible rocky ground. On more siliceous soils they give way to **Species-rich *Nardus* grassland** or more species-poor forms of *Nardus* grasslands. Where snow lies late they give way to late snow-bed communities, and on the more windswept and leached summits they give way to **Siliceous alpine and boreal grassland**, **Alpine pioneer formations of *Caricion bicoloris-atrofuscae*** and the **Chasmophytic vegetation on rocky slopes - Calcareous sub-types** or **Silicicolous sub-types**.

2.6.3.2 Site list

Beinn Dearg (104)

Beinn Dearg, with Ben Nevis, is selected as representative of the high-altitude sub-types of this habitat type in north-west Scotland. It supports both CG12 *Festuca ovina-Alchemilla alpina-Silene acaulis* dwarf-herb community and CG14 *Dryas octopetala-Silene acaulis* ledge community. The habitat type is moderately extensive and well developed, supporting a rich flora of arctic-alpines, including alpine mouse-ear *Cerastium alpinum,* arctic mouse-ear *Cerastium arcticum,* alpine meadow-grass *Poa alpina,* alpine cinquefoil *Potentilla crantzii* and net-leaved willow *Salix reticulata*.

Ben Alder and Aonach Beag (120)

The site is representative of high altitude alpine calcareous grassland in the central Highlands, where the habitat is very local owing to the infrequent occurrence of calcareous rocks at high altitude. Both CG12 *Festuca ovina-Alchemilla alpina-Silene acaulis* dwarf-herb community and CG14 *Dryas octopetala-Silene acaulis* ledge community are well represented, especially the latter. The widespread arctic-alpines purple saxifrage *Saxifraga oppositifolia* and yellow saxifrage *S. aizoides* are frequent, while rarer species that are widely represented include cyphel *Minuartia sedoides*, alpine meadow-grass *Poa alpina*, hair sedge *Carex capillaris*, black alpine-sedge *C. atrata* and alpine speedwell *Veronica alpina*. Unusually, grazing levels appear to be low enough to allow the development of mountain avens heath on slopes open to grazing animals. The low grazing levels also allow the exceptional development of sufficiently large populations of montane willows, including woolly willow *Salix lanata,* defined as **Sub-Arctic willow scrub,** for the site to be proposed for it in its own right. The transition between these two habitat types is unusual.

Ben Heasgarnich (106)

This site is one of four selected to represent the variety of high-altitude alpine calcareous grassland in the Breadalbanes of Scotland. Ben Heasgarnich has moderately extensive CG12 *Festuca ovina-Alchemilla alpina-Silene acaulis* dwarf-herb community, with some well developed areas of high-altitude CG14 *Dryas octopetala-Silene acaulis* ledge community on steep, rocky slopes. The habitat type supports an outstanding arctic-alpine flora, with many of the rarer species represented, including alpine mouse-ear *Cerastium alpinum,* hoary whitlowgrass *Draba incana*, cyphel *Minuartia sedoides* and hairy sedge *Carex capillaris.* There are transitions to **Species-rich *Nardus* grassland** and other alpine communities.

Ben Lawers (103)

This site is one of four selected to represent the variety of high-altitude alpine calcareous grassland in the Breadalbanes of Scotland. Ben Lawers has the most extensive development of these sub-types in the UK. The main grassland sub-type, CG12 *Festuca ovina-Alchemilla alpina-Silene acaulis* dwarf-herb community, is found on the open hill and is dominated by moss campion *Silene acauli*. CG14 *Dryas octopetala-Silene acaulis* ledge community also occurs and is largely confined to crags because of heavy grazing pressure. The site has an exceptional arctic-alpine flora, including a wide range of characteristic species and most of the rare species including cyphel *Minuartia sedoides,* sibbaldia *Sibbaldia procumbens,* mountain pansy *Viola lutea,* alpine forget-me-not *Myosotis alpestris,* alpine fleabane *Erigeron borealis,* alpine gentian *Gentiana nivalis,* mountain sandwort *Minuartia rubella,* rock speedwell *Veronica fruticans,* blue moor-grass *Sesleria caerulea,* alpine

meadow-grass *Poa alpina,* alpine pearlwort *Sagina saginoides* and alpine saxifrage *Saxifraga nivalis.* There are well developed transitions to a wide range of other alpine plant communities, including snow-beds and alpine pioneer formations.

Ben Lui (105)

This site is one of four selected to represent the variety of high-altitude alpine calcareous grassland in the Breadalbanes of Scotland. Ben Lui has extensive areas of the open hill sub-type dominated by CG12 *Festuca ovina-Alchemilla alpina-Silene acaulis* dwarf-herb community. CG14 *Dryas octopetala-Silene acaulis* ledge community also occurs in profusion on steep, rocky ground. This supports an outstanding arctic-alpine flora including alpine bartsia *Bartsia alpina,* mossy saxifrage *Saxifraga hypnoides,* cyphel *Minuartia sedoides,* rock sedge *Carex rupestris,* and hair sedge *C. capillaris.* The quality and diversity of this community, and the range of transitions to other habitat types are similar to those on Ben Lawers, but less extensive.

Ben Nevis (123)

With Beinn Dearg, Ben Nevis has been selected to represent the high-altitude sub-types of alpine calcareous grassland in the western Highlands of Scotland. The site contains moderately extensive areas of both CG12 *Festuca ovina-Alchemilla alpina-Silene acaulis* dwarf-herb community and CG14 *Dryas octopetala-Silene acaulis* ledge community. There is a moderately rich arctic-alpine flora including alpine mouse-ear *Cerastium alpinum,* arctic mouse-ear *Cerastium arcticum,* rock sedge *Carex rupestris,* hair sedge *C. capillaris,* mossy saxifrage *Saxifraga hypnoides* and alpine meadow-rue *Thalictrum alpinum*. Ben Nevis is very unusual in that the high-altitude *Dryas* heath occurs on the open hillside, where it is potentially vulnerable to grazing. Grazing pressure normally restricts this community to inaccessible ledges. There are relatively low grazing levels on the northern slopes of Ben Nevis, and the community can survive in more open locations.

Durness (64)

This site is one of four selected as representative of the low-altitude alpine calcareous grassland that is restricted to the extreme north of mainland Scotland. Durness contains the largest stands of the low-altitude CG13 *Dryas octopetala-Carex flacca* heath in the UK. The site has an outstanding representation of characteristic species, including wild thyme *Thymus polytrichus,* ribwort plantain *Plantago lanceolata,* sea plantain *Plantago maritima,* purging flax *Linum catharticum* and common bird's-foot-trefoil *Lotus corniculatus*. The endemic Scottish primrose *Primula scotica* is present and other uncommon species include mountain everlasting *Antennaria dioica,* hair sedge *Carex capillaris,* lesser meadow-rue *Thalictrum minus,* frog orchid *Coeloglossum viride* and hart's-tongue fern *Phyllitis scolopendrium.* Locally the calcifuge species crowberry *Empetrum nigrum* occurs, giving rise to an unusual sub-type of *Dryas* heath. There are transitions to a wide range of other communities, including coastal dunes, other kinds of base-rich grasslands and a range of dwarf-shrub heaths.

Inchnadamph (65)

This site is one of four selected to represent low altitude CG13 *Dryas octopetala-Carex flacca* heath and has the second most extensive development of this variant of the habitat type in the UK. As the site is at a higher altitude than Durness there are more arctic-alpines in the flora, including purple saxifrage *Saxifraga oppositifolia,* yellow saxifrage *Saxifraga aizoides,* moss campion *Silene acaulis,* alpine meadow-rue *Thalictrum alpinum* and hair sedge *Carex capillaris,* while some low-altitude species are lacking. Therefore the site is also selected as an example of the transition from low- to high-altitude alpine calcareous grassland. As such the site occupies a key position in the range of variation shown by this habitat type in the UK.

Invernaver (142)

This is one of four sites selected to represent low altitude CG13 *Dryas octopetala-Carex flacca* heath and is the only site with extensive development of this habitat type on wind-blown calcareous shell-sand. On the other three low-altitude examples, the heath is developed chiefly on limestone outcrops. The site has an unusually extensive representation of a sub-type of *Dryas* heath with ericaceous and other woody plants mixed with the *Dryas,* including crowberry *Empetrum nigrum,* bearberry *Arctostaphylos uva-ursi,* creeping willow *Salix repens* and juniper *Juniperus communis.* This sub-type is better represented here than on any other site selected. The abundance of woody plants may be partly attributable to lower grazing pressure. The number of different arctic-alpine species is not high compared with high-altitude sites, but mountain avens, crowberry *Empetrum nigrum* subsp. *hermaphroditum* and bearberry *Arctostaphylos uva-ursi* and abundant and other species such as purple

saxifrage *Saxifraga oppositifolia*, yellow saxifrage *S. aizoides* and hair sedge *Carex capillaris* are frequent. The site is unusually exposed for a low-altitude site, and this is reflected by the frequent occurrence of dwarf juniper *Juniperus communis* subsp. *nana*. There are transitions to calcareous coastal habitats to seaward, while inland there are transitions to a unique form of mixed *Calluna-Juniperus-Arctostaphylos* heath, on more acid soils, and oceanic *Calluna-Erica cinerea* heath, calcareous grassland and base-rich mires.

Meall na Samhna (121)

This site is one of four selected to represent the variety of high-altitude alpine calcareous grassland in the Breadalbanes of Scotland. The high altitude CG12 *Festuca ovina-Alchemilla alpina-Silene acaulis* dwarf-herb community is moderately extensive and there are some well developed areas of CG14 *Dryas octopetala-Silene acaulis* ledge community on steep, rocky slopes. The habitat supports an outstanding arctic-alpine flora with many species, including alpine bartsia *Bartsia alpina*, alpine mouse-ear *Cerastium alpinum*, alpine saw-wort *Saussurea alpina*, hair sedge *Carex capillaris* and net-leaved willow *Salix reticulata*. There are transitions to species-rich *Nardus* grassland and other alpine communities.

Strath (63)

This site is one of four selected as representative of the low-altitude alpine calcareous grassland that is restricted to the extreme north-west of Scotland. Although the areas of low altitude CG13 *Dryas octopetala-Carex flacca* heath on this site are relatively small, they occur widely wherever there are outcrops of Durness limestone. This habitat type is part of a complex mosaic with the other Annex I habitat types on the site, **Limestone pavement** and **Chasmophytic vegetation on rocky slopes - calcareous sub-types**. The site contains a diverse range of characteristic species, including wild thyme *Thymus polytrichus*, ribwort plantain *Plantago lanceolata*, purging flax *Linum catharticum*, spring sedge *Carex caryophyllea* and common bird's-foot-trefoil *Lotus corniculatus*. A sub-type of the *Dryas* heath with the calcifuge dwarf-shrubs crowberry *Empetrum nigrum* and bearberry *Arctostaphylos uva-ursi* is well developed. Rarer species include dark-red helleborine *Epipactis atrorubens* and alpine bistort *Persicaria vivipara*. Unusually, there are transitions to one of the most floristically rich areas of limestone pavement in Scotland.

2.6.4 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (34.31 to 34.34)

2.6.4.1 Background to selection

Semi-natural dry grasslands, which were once widespread in Europe, are now a scarce and threatened habitat. There are no overall estimates available for the extent of this habitat type in Europe as a whole. In the UK, grasslands conforming to this type probably now occupy less than 60,000 ha. The selected sites represent a large proportion of the resource remaining in the UK.

Sites have been chosen to ensure coverage of the wide ecological variation and geographical range of this type. The sites selected are amongst the best grasslands in the UK for functional integrity as ecological units (i.e. they are judged to be large enough and physically diverse enough to maintain their current biodiversity importance under favourable management). The sites chosen are generally those with the largest expanses of a main grassland type (a community or sub-community of the NVC), although some smaller sites have been selected where they represent certain of the additional biological variations of the habitat type and have the best conservation of structure and function. The unusual *Sesleria* grasslands of Northern Ireland are also represented. The chosen sites are amongst the richest grasslands for rare plant and animal species found in the UK, although this was not a primary consideration in site selection.

The main sub-types of these grasslands correspond in the UK to the following NVC types:

CG1 *Festuca ovina-Carlina vulgaris* grassland
CG2 *Festuca ovina-Avenula pratensis* grassland
CG3 *Bromus erectus* grassland
CG4 *Brachypodium pinnatum* grassland
CG5 *Bromus erectus-Brachypodium pinnatum* grassland
CG6 *Avenula pubescens* grassland
CG7 *Festuca ovina-Hieracium pilosella-Thymus praecox/pulegioides* grassland
CG8 *Sesleria albicans-Scabiosa columbaria* grassland
CG9 *Sesleria albicans-Galium sterneri* grassland

No sites are proposed for CG4 *Brachypodium* grassland as the largest and most botanically-rich examples for this sub-type are included in the site list for the **Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (*important orchid sites)** habitat type.

This habitat type has a wide range of variation, in terms of the structure of the vegetation, the range of slope and aspect and other physical variations (e.g. presence of rock outcrops, screes, areas of shallow soils) and the presence of transitions to adjoining contrasting habitat types.

In accordance with the requirement to take account of scrubland facies, a number of sites selected have well-developed transitions between grassland and scrub (Craven Limestone Complex, Great Orme's Head, Peak District Dales, Morecambe Bay Pavements); these transitions are important habitats for a wide range of rare and local British species.

2.6.4.2 Site list

Breckland (287)

This site in East Anglia, England, has been selected as the most extensive surviving area of the CG7 *Festuca ovina-Hieracium pilosella-Thymus praecox* grassland, a rare grassland type. This sub-type is rich in rare species typical of dry, winter-cold, continental areas and approaches the features of grassland types in central Europe more than almost any other calcareous grassland found in the UK. The terrain is relatively flat, with few physical variations, but there are important mosaics of calcareous grassland and heath/acid grassland, giving rise to an important pattern of structural variation.

Craven Limestone Complex (190)

This site, in the northern half of England, is the second most extensive area of calcareous grassland in the UK and has been selected to represent CG9 *Sesleria albicans-Galium sterneri* grassland in the site list. This is the *Festuco-Brometalia* grassland type that most nearly approaches alpine grassland in floristics and ecological characteristics. The site exhibits an exceptional diversity of structural types, ranging from hard-grazed open grassland through to tall herb-rich grasslands on ungrazed cliff ledges, such as at Malham Cove, in woodland margins and around limestone pavements and screes. It is thus an important representation of grassland-scrub transition types as well as other grassland structural variation.

Great Orme's Head/Pen y Gogarth (198)

This site in north Wales has been selected as the supporting one of the largest stands in the UK of the CG1 *Festuca ovina-Carlina vulgaris* grassland community. This is the only UK grassland type referable to the *Xerobromion* of southern and central Europe and is mainly found in coastal zones of the UK, where the sea ameliorates local temperatures. The site contains a wide range of structural types, ranging from short turf on south facing rocky slopes, with abundant hoary rock-rose *Helianthemum canum*, through more closed calcareous grassland communities to tall herb-rich vegetation on scrub margins. Transitions from calcareous grassland to calcareous and acidic heath, cliff scree and limestone pavement are also well represented.

Monawilkin (223)

Monawilkin is floristically the richest example of blue moor-grass *Sesleria* grassland in Northern Ireland and has been selected to represent this variation of the habitat type. This grassland is rather different from the other *Sesleria*-dominated grasslands in the UK in that it includes species such as the eyebright *Euphrasia salisburgensis*. Although relatively small, the site contains a range of slopes and aspects and an excellent range of transitions to other habitats, including cliffs, screes, flushes, heath and scrub, and has an important invertebrate fauna.

Moor House - Upper Teesdale (188)

Extensive stands of CG9 *Sesleria albicans-Galium sterneri* grassland occur at this site in northern England. It has been selected as an important variation of the CG9 type since it contains a rich assemblage of relict arctic-alpine species, such as spring gentian *Gentiana verna* and alpine forget-me-not *Myosotis alpestris*, making it one of the most important arctic-alpine refugium sites in the UK. The grasslands are for the most part heavily grazed but show transitions to a wide range of other vegetation, including bogs, acid grassland, fens, meadow, limestone pavements, cliffs and screes.

Morecambe Bay Pavements (191)

Extensive CG9 *Sesleria albicans-Galium sterneri* grasslands occur at this site in the north-west of England. This site is included in addition to the Craven Limestone Complex and Moor House - Upper Teesdale, as the grassland habitat, which has an overall northern character, is also rich in southern lowland species, so providing important regional variation. There is a wide range of structural variation associated with intensity of grazing and the presence of cliffs, screes, and limestone pavements on the margins of the grassland stands. There are important transitions to calcareous scrub and woodland.

Peak District Dales (281)

This site is one of the most extensive surviving areas in England of the CG2 *Festuca ovina-Avenula pratensis* grasslands, the characteristic community of well-grazed and species-rich chalk and limestone grasslands. Grasslands at this site range from hard-grazed short turf through to tall herb-rich vegetation, with transitions through to calcareous scrub and woodland - a diversity of structural types unparalleled in the UK. There is also a great physical diversity due to rock outcrops, cliffs, screes and a variety of slope and aspect. Unlike examples of this type on chalk to the south, these CG2 *Festuca ovina-Avenula pratensis* grasslands are less at risk from the threat of invasion by upright brome *Bromopsis erecta* and tor-grass *Brachypodium pinnatum*, which are at the edge of their range here and have limited vigour. The relatively cold oceanic nature of the climate means that there is an enrichment with northern elements such as limestone bedstraw *Galium sterneri* and globe-flower *Trollius europaeus*.

Rodborough Common (79)

This is the most extensive area of grassland surviving in the Cotswolds of central southern England and has been selected for its representation of the CG5 *Bromus erectus-Brachypodium pinnatum* grassland type, which is more or less confined to the Cotswolds. The site contains a wide range of structural types, ranging from short turf through to scrub margins, although short turf vegetation is mainly confined to areas of shallower soils.

Salisbury Plain (33)

This site in southern England is believed to be the largest surviving calcareous grassland within the EC and has therefore been seen as the most important calcareous grassland in the UK. It provides extensive examples of the CG3 *Bromus erectus* grassland type, which is the most widespread and abundant calcareous grassland found in the UK and therefore the most typical British community. It also contains the largest example of the scarce CG6 *Avenula pubescens* grassland type.

Thrislington (86)

This is a small site but nonetheless contains the largest of the few surviving stands of CG8 *Sesleria albicans-Scabiosa columbaria* grasslands. This community type is confined to the Magnesian limestone of County Durham and Tyne and Wear, north-east England. It now covers less than 200 ha and is found mainly as small scattered stands.

2.6.5 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco - Brometalia*) (*important orchid sites) (34.31 to 34.34)

2.6.5.1 Background to selection

This is an unusual priority habitat type within the Directive in that it combines features of both species and habitat selection. The principles for the selection have been agreed by the EC Habitats Directive Committee, to incorporate one or more of the following criteria for each site:

a) the site hosts a rich suite of orchids,
b) the site hosts an important population of at least one orchid species considered to be not very common (nationally scarce) in the national territory,
c) the site hosts one or several orchid species considered to be rare, very rare or exceptional in the national territory.

In the case of this habitat type, priority status is afforded to 'important orchid sites', and there are special selection criteria related to the presence of orchid assemblages and/or rare orchids. It is not appropriate to identify other features of these sites that make them distinctive. In the UK special weight has been given to sites with one or more nationally rare orchid species. This is because in the humid climate of the UK orchids are nearly ubiquitous on calcareous grassland. This is unlike the situation in some to the drier continental zones of Europe, where orchids are less frequent in calcareous grasslands. It should be noted that these orchid sites provide important additional representation of chalk grassland in southern England, where calcareous grasslands exhibit a complex pattern of variation that has proved difficult otherwise to accommodate within the semi-natural dry grassland site series.

In the UK the criteria have been considered to apply to sites hosting populations of the following rare or scarce species:

Man orchid *Aceras anthropophorum*: nationally scarce in Great Britain, i.e. occurring in 16-100 10 km squares. It is confined to central and southern England but has a markedly eastern distribution.

Musk orchid *Herminium monorchis*: nationally scarce in Great Britain. Confined to dry calcareous grassland in southern England.

Lizard orchid *Himantoglossum hircinum*: nationally rare (i.e. occurring in 15 or fewer 10 km squares) and vulnerable in Great Britain. Vulnerable in Europe. Restricted to calcareous grasslands and dunes in southern England.

Early spider-orchid *Ophrys sphegodes*: nationally rare and lower risk - near-threatened in Great Britain. Listed on Schedule 8 of the 1981 Wildlife & Countryside Act. Restricted to calcareous grassland in southern England and north Wales.

Late spider-orchid *Ophrys fuciflora*: nationally rare and Vulnerable in Great Britain. Listed on Schedule 8 of the 1981 Wildlife & Countryside Act. Since 1990 there are only nine known populations on the North Downs of south-eastern England.

Military orchid *Orchis militaris*: nationally rare and Vulnerable in Great Britain. Listed on Schedule 8 of the 1981 Wildlife & Countryside Act. Vulnerable in Europe. Restricted to calcareous habitats in southern England and now only four known populations.

Burnt orchid *Orchis ustulata*: nationally scarce in Great Britain. It is confined to dry grassland on calcareous substrates throughout lowland England but is most widespread in the south.

Other than lizard orchid and military orchid, the species listed above are not threatened in continental Europe. They are widespread but local throughout the temperate and Mediterranean climate zones in calcareous habitats.

Sites have been selected to represent calcareous grassland holding good populations of the species listed above and have taken into account the priority nature of this habitat type. A number of the sites are of importance because they host rare species and some of the sites are of importance because they contain an important assemblage of species that are 'not common', whilst others have both rare species and an assemblage of species that are 'not common'. In most instances these sites also host a wide range of more widespread orchid species. All the sites are in the southern half of England, as orchid biodiversity declines as latitude and altitude increase in the UK.

The sites chosen provide important representation in the site series of southern calcareous grasslands, particularly the following NVC types:

CG2 *Festuca ovina-Avenula pratensis* grassland
CG3 *Bromus erectus* grassland
CG4 *Brachypodium pinnatum* grassland
CG5 *Bromus erectus-Brachypodium pinnatum* grassland.

2.6.5.2 Site list

Barnack Hills and Holes (296)

This site in Cambridgeshire consists largely of the CG5 *Bromus erectus-Brachypodium pinnatum* grassland. It has been selected because it supports what is considered to be the largest population of the nationally scarce man orchid *Aceras anthropophorum*. It also supports a rich assemblage of other orchid species, such as fragrant orchid *Gymnadenia conopsea,* pyramidal orchid *Anacamptis pyramidalis* and bee orchid *Ophrys apifera.* The site provides representation of orchid-rich grassland in the northern part of its range, on limestone rather than on chalk.

Castle Hill (85)

This chalk grassland in Sussex consists of a mosaic of calcareous grassland types; notably the CG2 *Festuca ovina-Avenula pratensis,* CG3 *Bromus erectus* and CG4 *Brachypodium pinnatum* types. This site has been selected for its important assemblage of rare and scarce species including early spider-orchid *Ophrys sphegodes* and burnt orchid *Orchis ustulata.* The colony of early spider-orchid is one of the largest in the UK.

Devils Dyke (302)

This site in Cambridgeshire consists of a mosaic of the CG3 *Bromus erectus* and CG5 *Bromus erectus-Brachypodium pinnatum* calcareous grassland types. It has been selected as the only known UK dry grassland site for the lizard orchid *Himantoglossum hircinum*.

Folkstone to Etchinghill Escarpment (84)

This site consists of extensive CG4 *Brachypodium pinnatum* and CG5 *Bromus erectus-Brachypodium pinnatum* calcareous grassland types, together with smaller areas of the short-turf CG2 *Festuca ovina-Avenula pratensis* grassland community. The site contains an important assemblage of rare and scarce species, including early spider-orchid *Ophrys sphegodes,* late spider-orchid *Ophrys fuciflora* and burnt orchid *Orchis ustulata*.

Lewes Downs (81)

This chalk grassland site in Sussex consists largely of CG2 *Festuca ovina-Avenula pratensis* and CG3 *Bromus erectus* calcareous grassland types. This site contains an important assemblage of rare and scarce orchids, including early spider-orchid *Ophrys sphegodes,* burnt orchid *Orchis ustulata* and musk orchid *Herminium monorchis*. The colony of burnt orchid is one of the largest in the UK.

Lydden and Temple Ewell Downs (83)

This site consists largely of the CG4 *Brachypodium pinnatum* and CG5 *Bromus erectus-Brachypodium pinnatum* calcareous grassland types. It contains an important assemblage of rare, scarce and uncommon species, including early spider-orchid *Ophrys sphegodes,* burnt orchid *Orchis ustulata,* musk orchid *Herminium monorchis* and autumn lady's-tresses *Spiranthes spiralis*.

Queendown Warren (82)

This site consists of the CG3 *Bromus erectus* calcareous grassland type. It contains an important assemblage of rare and scarce species, including early spider-orchid *Ophrys sphegodes,* burnt orchid *Orchis ustulata* and man orchid *Aceras anthropophorum*.

Rex Graham Reserve (288)

This is a disused chalk pit with developing dry grassland characterised by false oat-grass *Arrhenatherum elatius*. The site has been selected as it supports the largest population of military orchid *Orchis militaris* in the UK, currently comprising more than 95% of the total population.

St Albans Head to Durlston Head (285)

This site contains extensive species-rich examples of CG4 *Brachypodium pinnatum* calcareous grassland type. The site holds the largest UK population of early spider-orchid *Ophrys sphegodes*. This species has declined very dramatically in the UK, in both population size and range during the past 50 years.

Wye and Crundale Downs (80)

This site consists mostly of the CG4 *Brachypodium pinnatum* and CG5 *Bromus erectus-Brachypodium pinnatum* types, although small areas of the CG2 *Festuca ovina-Avenula pratensis* type also occur. It has an important assemblage of rare, scarce and uncommon orchids, including early spider-orchid *Ophrys sphegodes,* late spider-orchid *O. fuciflora,* burnt orchid *Orchis ustulata* and fragrant orchid *Gymnadenia conopsea.* The site contains the largest UK colony of late spider-orchid, representing about 50% of the total population.

2.6.6 *Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in continental Europe)** (35.1)

2.6.6.1 Background to selection

Species-rich *Nardus* grasslands are restricted to the cooler areas of mountains and are found mainly in the more central regions of continental Europe and the Atlantic Biogeographic Region. Although rare in the rest of Europe they are widely developed in the UK, especially in western Scotland. They are important because they support a wide range of species, including Atlantic, sub-Atlantic and arctic-alpine plants and invertebrates. The site series takes account of the UK's special responsibility for this priority habitat type. The sites selected contain the most extensive examples of this habitat type and those with the best community structure and function. Sites have also been selected to encompass the geographical range and ecological variation of this habitat type in the UK. The habitat type is best developed in western Scotland and the site series reflects this distribution.

These species-rich *Nardus* grasslands tend to develop where there is flushing through base-rich strata on siliceous bedrock. These may include moderately base-rich metamorphic and igneous rocks, but species-rich *Nardus* grasslands on limestone are excluded from the definition. The altitudinal range varies from near sea-level to moderately high at its upper limit of between 800 and 900 m.

Species present in the grassland tend to be mesophilic. Swards are closely grazed and consist of a complex mosaic of grasses, small herbs and bryophytes. Two main types of species-rich *Nardus* grasslands occur in the UK, defined by NVC community:

CG10 *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland
CG11 *Festuca ovina-Agrostis capillaris-Alchemilla alpina* grassland.

Variation within these communities is related chiefly to altitude, oceanicity, soil moisture and the extent of flushing with base-rich water. At high-altitude there is a greater representation of arctic-alpine plants. Floristically richer areas have developed where there is a concentration of base-rich or calcareous strata, giving suitable conditions for the rarer base- or calcium-loving species. Low altitude variants of the habitat type are extensive in the Western Isles or the extreme western Highlands but also occur locally in the eastern Highlands. In the west where oceanic influences predominate, communities are characterised by the presence of Atlantic or sub-Atlantic species, including both vascular plants and bryophytes. In the more maritime of these areas communities can contain maritime species, and may show transitions to sub-maritime grasslands.

Floristically the two NVC communities included in this habitat type are closely related. They are both characterised by a mix of grasses, typically sheep's fescue *Festuca ovina,* common bent *Agrostis capillaris,* sweet vernal-grass *Anthoxanthum odoratum,* mat-grass *Nardus stricta* and a wide range of small dicotyledonous herbs including heath bedstraw *Galium saxatile,* wild thyme *Thymus polytrichus,* common dog-violet *Viola riviniana,* ribwort plantain *Plantago lanceolata,* harebell *Campanula rotundifolia* and tormentil *Potentilla erecta.* The main difference between the two communities is the frequency and abundance of alpine lady's-mantle *Alchemilla alpina* and frequency of bilberry *Vaccinium myrtillus* in CG11 *Festuca ovina-Agrostis capillaris-Alchemilla alpina* grassland, and the high frequency of selfheal *Prunella vulgaris* in CG10 *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland. The latter grassland tends to occur more extensively at lower altitudes, where it supports more lowland species than the former, but both extend to the same maximum altitude. Therefore both types may be enriched with arctic-alpines at the higher end of their altitudinal range. Both types also show variation related to soil moisture, with herbs such as white clover *Trifolium repens*, field wood-rush *Luzula campestris,* heath speedwell *Veronica officinalis,* yarrow *Achillea millefolium* and spring sedge *Carex caryophyllea* characteristic of drier swards and species such as flea sedge *Carex pulicaris,* carnation sedge *C. panicea,* purging flax *Linum catharticum* and quaking grass *Briza media* in areas with high soil moisture.

At high altitudes, where the swards are more flushed, the arctic-alpines, yellow saxifrage *Saxifraga aizoides,* purple saxifrage *S. oppositifolia*, alpine meadow-rue *Thalictrum alpinum* and alpine bistort *Persicaria vivipara* may be frequent. Other arctic-alpines or northern species that are represented include the lady's-mantles *Alchemilla filicaulis* subsp. *filicaulis* and *A. wichurae,* hair sedge *Carex capillaris*, rock sedge *C. rupestris,* spring sandwort *Minuartia verna,* Scottish asphodel *Tofieldia pusilla,* alpine mouse-ear *Cerastium alpinum,* alpine clubmoss *Diphasiastrum alpinum,* northern bedstraw *Galium boreale,* spiked wood-rush *Luzula spicata*,

cyphel *Minuartia sedoides,* globe-flower *Trollius europaeus,* alpine cinquefoil *Potentilla crantzii,* sibbaldia *Sibbaldia procumbens* and mountain pansy *Viola lutea.* In the west at low altitude there may be representation of maritime species, such as sea plantain *Plantago maritima,* buck's-horn plantain *P. coronopus* and wild carrot *Daucus carota,* while species such as common rock-rose *Helianthemum nummularium* occur more generally at low altitude. Also in the west, Atlantic or oceanic bryophytes such as *Herbertus stramineus, Plagiochila spinulosa, Scapania gracilis* and *Mastigophora woodsii* occur, and more generally there are calcicole bryophytes such as *Barbilophozia lycopodioides, Aulacomnium turgidum* and *Schistidium apocarpum,* while other notable bryophytes such as *Lophozia obtusa* and *Thuidium delicatulum* are also represented.

2.6.6.2 Site list

Ardmeanach (125)

This is one of four sites representative of the range of low-altitude sub-types of this habitat type developed on the oceanic west coast of Scotland. Ardmeanach is the most westerly and most maritime of the sites selected. The species-rich *Nardus* grasslands occur extensively as short swards on a large basalt escarpment. The most extensive community represented is CG10 *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland, but on more northerly-facing slopes this is replaced by CG11 *Festuca ovina-Agrostis capillaris-Alchemilla alpina* grassland. There is a high diversity of sub-types of the communities and species represented. Sub-maritime variants of the community are developed on the lower parts of the escarpment, with the maritime species sea plantain *Plantago maritima,* buck's-horn plantain *P. coronopus* and wild carrot *Daucus carota.* Dry and wetter sub-types are both represented. Lowland species, such as common centuary *Centaurium erythraea,* fragrant agrimony *Agrimonia procera,* red clover *Trifolium pratense* and false-brome *Brachypodium sylvaticum,* as well as upland, northern species, such as globe-flower *Trollius europaeus,* the lady's-mantle *Alchemilla glabra* and northern bedstraw *Galium boreale,* occur. There are transitions to maritime grassland and species-rich dry *Calluna* heath.

Beinn a'Ghlo (124)

This is one of two sites selected to represent the species-rich *Nardus* grassland communities that are characteristic of the eastern Highlands of Scotland. Beinn a'Ghlo has a large area of species-rich *Nardus* grassland developed on schistose rocks and limestone. Both CG10 *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland and CG11 *Festuca ovina-Agrostis capillaris-Alchemilla alpina* grassland are well represented throughout the altitudinal range of the habitat type on the site (300-750 m). The moderate altitude limits the range of arctic-alpines, but there is a good representation of the more widespread species, including the lady's-mantle *Alchemilla filicaulis,* alpine bistort *Persicaria vivipara,* purple saxifrage *Saxifraga oppositifolia,* sibbaldia *Sibbaldia procumbens,* mountain pansy *Viola lutea* and hair sedge *Carex capillaris,* while some rarer species like yellow oxytropis *Oxytropis campestris* and alpine meadow-grass *Poa alpina* are also represented. There is also a good representation of low altitude species such as common rock-rose *Helianthemum nummularium,* meadow oat-grass *Helictotrichon pratense* and quaking-grass *Briza media.*

Beinn Iadain and Beinn na h'Uamha (91)

This is one of two sites selected to represent the habitat type in the western Highlands of Scotland. The species-rich *Nardus* grasslands are developed on basalt and include CG10 *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland and CG11 *Festuca ovina-Agrostis capillaris-Alchemilla alpina* grassland, both of which are well represented. The grasslands are less extensive than on other listed sites but structure and function are well maintained, owing to relatively low grazing pressures. The relatively low maximum altitude has resulted in a fairly small arctic-alpine and northern element in the flora, including alpine lady's-mantle *Alchemilla alpina,* the lady's-mantles *A. glabra* and *A. filicaulis,* northern bedstraw *Galium boreale* and viviparous sheep's-fescue *Festuca vivipara.* A sub-maritime form with sea plantain *Plantago maritima* also occurs. On shady slopes there is a mossy form with the local bryophytes *Lophozia obtusa* and *Thuidium delicatulum* and the Atlantic bryophytes *Breutelia chrysocoma, Racomitrium ellipticum, Scapania gracilis* and *Plagiochila spinulosa.*

Ben Heasgarnich (106)

This is one of two sites selected to represent the species-rich *Nardus* grassland communities that are characteristic of the base-rich schists of the Breadalbane range in the southern Highlands of Scotland. Ben Heasgarnich has the second most extensive area of species-rich *Nardus* grassland in the UK. With Meall na Samhna it contains the most species-rich and diverse examples of high-altitude grassland, and there is a rich

arctic-alpine flora, including alpine bistort *Persicaria vivipara*, sheathed sedge *Carex vaginata*, a lady's-mantle *Alchemilla filicaulis* and hair sedge *Carex capillaris*. There are transitions to floristically rich **Alpine calcareous grasslands**.

Cairngorms (209)

This site has been selected as one of two representative of the most eastern forms of the habitat type in the UK. Both CG10 *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland and CG11 *Festuca ovina-Agrostis capillaris-Alchemilla alpina* grassland are well represented throughout the altitudinal range on the site (300-750 m). There are particularly extensive examples at Inchrory on calcareous schists and limestone, but the community occurs elsewhere on schists, notably at Craig an Dail Beag and in Glen Feshie. Swards also occur on alluvial soils in the bottoms of many of the main glens. There is the best development in the site series of low-altitude species-rich *Nardus* grassland with common rock-rose *Helianthemum nummularium* abundant, spring sedge *Carex caryophyllea,* meadow oat-grass *Helictotrichon pratense* and burnet-saxifrage *Pimpinella saxifraga.* The flushed form, with an abundance of the arctic-alpines yellow saxifrage *Saxifraga aizoides* and hair sedge *Carex capillaris,* is present. Other arctic-alpines or northern species, such as mountain everlasting *Antennaria dioica*, alpine meadow-rue *Thalictrum alpinum,* alpine saw-wort *Saussurea alpina* and the rare alpine milk-vetch *Astragalus alpinus* and alpine cinquefoil *Potentilla crantzii,* are well represented.

Glen Coe (126)

Glen Coe is one of two sites selected as representative of the habitat type in the western Highlands. In this area, species-rich *Nardus* grassland has developed on base-rich igneous rocks, calcareous-schists and base-enriched alluvial soils and is found from moderately high to high altitudes. Both CG10 *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland and CG11 *Festuca ovina-Agrostis capillaris-Alchemilla alpina* grassland are well represented. Flushed grassland with an abundance of sedges such as carnation sedge *Carex panicea* and flea sedge *C. pulicaris,* purging flax *Linum catharticum*, grass-of-Parnassus *Parnassia palustris* and sea plantain *Plantago maritima,* and enriched with the arctic-alpines yellow saxifrage *Saxifraga aizoides,* purple saxifrage *Saxifraga oppositifolia,* alpine meadow-rue *Thalictrum alpinum,* and moss campion *Silene acaulis,* is especially well developed. Other northern species occurring generally are viviparous sheep's-fescue *Festuca vivipara,* northern bedstraw *Galium boreale,* a lady's-mantle *Alchemilla glabra* and mountain everlasting *Antennaria dioica.* There are transitions to western herb-rich bilberry *Vaccinium myrtillus* heath.

Lendalfoot Hills Complex (170)

This is one of four sites selected as examples of relatively low-altitude oceanic grassland. This site is selected as the most southerly site where maritime species occur inland. CG10 *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland is the only community developed. This occurs both in a dry form with yarrow *Achillea millefolium,* white clover *Trifolium repens,* spring sedge *Carex caryophyllea* and lady's-bedstraw *Galium verum,* and a flushed form with flea sedge *Carex pulicaris,* sea plantain *Plantago maritima* and purging flax *Linum catharticum,* but mixed forms are widespread. Spring sandwort *Minuartia verna*, which is very local in Scotland and characteristic of soils with heavy metals, is present locally in dry grassland. The low-altitude flora is rich and includes crested hair-grass *Koeleria macrantha,* meadow oat-grass *Helictotrichon pratense*, common rock-rose *Helianthemum nummularium* and tufted vetch *Vicia cracca,* while by contrast the northern flora is less well developed, with a lady's mantle *Alchemilla glabra,* northern bedstraw *Galium boreale* and bitter-vetch *Lathyrus montanus* present. The underlying rocks are of serpentine and other ultra-basic rocks, and the grasslands occur in unusual mosaics with black bog-rush *Schoenus nigricans*-rich wet heath and alkaline fens.

Meall na Samhna (121)

This site is one of two sites selected to represent the species-rich *Nardus* grassland communities that are characteristic of the Breadalbane range of the southern Highlands of Scotland. Species-rich *Nardus* grassland has developed widely below crags at moderately high to high altitude on calcareous-schist rocks. The CG11 *Festuca ovina-Agrostis capillaris-Alchemilla alpina* grassland is the main community developed. The site supports a rich flora of characteristic arctic-alpine species, including alpine meadow-rue *Thalictrum alpinum*, alpine bistort *Persicaria vivipara,* purple saxifrage *Saxifraga oppositifolia*, alpine mouse-ear chickweed *Cerastium alpinum*, lady's mantle *Alchemilla filicaulis,* mossy saxifrage *Saxifraga hypnoides*, sibbaldia *Sibbaldia procumbens* and dwarf cudweed *Gnaphalium supinum*. There are widely developed transitions to **Alpine calcareous grassland** and species-poor forms of *Nardus* grassland.

Rum (16)

Rum is one of four sites on the oceanic west coast of Scotland selected to represent low-altitude oceanic western sub-types of this habitat type. This site is characteristic of the communities found to the north and west of the range. Extensive herb-rich grasslands have developed below cliffs of ultra-basic rocks along the coast. The grasslands can occur from near sea-level to about 750 m. Both CG10 *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland and CG11 *Festuca ovina-Agrostis capillaris-Alchemilla alpina* grassland are well represented. The areas are more scattered and more varied ecologically than on the basalt sites elsewhere in Scotland, but overall the flora is similar. Many less common but characteristic species are present, including mountain everlasting *Antennaria dioica*, bitter-vetch *Lathyrus montanus*, milkwort *Polygala vulgaris*, field gentian *Gentianella campestris*, small-white orchid *Pseudorchis albida*, pale sedge *Carex pallescens* and lousewort *Pedicularis sylvatica*. Arctic-alpine and northern species include alpine bistort *Persicaria vivipara*, alpine meadow-rue *Thalictrum alpinum*, alpine lady's mantle *Alchemilla alpina* and viviparous sheep's-fescue *Festuca vivipara*. There is a range of transitions to maritime grassland, alpine calcareous grassland, herb-rich dwarf-shrub heath and open communities on ultra-basic rocks.

Trotternish Ridge (90)

This is one of four sites selected to represent this habitat type on the oceanic west coast of Scotland. It is the most northerly site and is more upland in character than the other sites selected. Trotternish Ridge has the most extensive tracts of species-rich *Nardus* grassland in the UK. These occur along the length of an extensive basalt escarpment. Both CG10 *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland and CG11 *Festuca ovina-Agrostis capillaris-Alchemilla alpina* grassland are well represented, mainly of the drier forms on well-drained slopes. Overall the grasslands are rich in both vascular plants and bryophytes, though heavy grazing on the slopes may be limiting the species-richness. The flora is enriched by arctic-alpine species including sibbaldia *Sibbaldia procumbens*, a lady's-mantle *Alchemilla wichurae*, mossy saxifrage *Saxifraga hypnoides* and cyphel *Minuartia sedoides*. The grasslands are notable for their bryophyte flora, which includes Atlantic species such as *Scapania gracilis, Racomitrium ellipticum, Breutelia chrysocoma* and *Plagiochila spinulosa*, occurring with calcicole mosses such as *Aulacomnium turgidum* and *Schistidium apocarpum*.

2.6.7 *Molinia* meadows on chalk and clay (*Eu-Molinion*) (37.31)

2.6.7.1 Background to selection

Molinia grasslands are found mainly on moist peats and peaty gley soils, often with fluctuating water tables. This habitat type includes the most species-rich purple moor-grass *Molinia caerulea* grasslands found in the UK. Such grasslands are widely but discontinuously distributed in Britain, with the habitat type concentrated in south-west England, western and central Wales, East Anglia and northern England. Sites have been selected to take account of the geographical range of the habitat type and the ecological variation it exhibits.

In the UK these grasslands are represented by two main NVC communities: M24 *Molinia caerulea-Cirsium dissectum* fen-meadow, which is the most widespread and diverse community, with a heathy form found mainly in south Wales and south-west England, a form with tall herbs in the fen systems of East Anglia and a more widespread 'typical' form widely but locally distributed in southern Britain. The second community is M26 *Molinia caerulea-Crepis paludosa* mire, which occurs more locally in wet grasslands and fens in uplands and upland margins of northern England and north Wales and as small scattered stands throughout Scotland as far north as Moray.

2.6.7.2 Site list

Asby Complex (192)

This is one of three sites in northern England chosen for this habitat type, which contains examples of the M26 *Molinia caerulea-Crepis paludosa* mire type. At this site the community occurs in extensive pastures in association with a range of flush, fen and calcareous grassland as well as locally in hydroseral transitions on lake margins.

Craven Limestone Complex (190)

This is one of three sites chosen to represent the habitat type in the northern England centre of distribution. This site contains what are believed to be the largest expanses of the M26 *Molinia caerulea-Crepis paludosa* mire in the UK, amidst fen and raised mire communities of the Malham Tarn area, along with smaller fragments associated with meadows, wood edges and river banks elsewhere on the site.

Culm Grasslands (29)

This is one of two sites chosen to represent the habitat type in south-west England. This site contains extremely diverse examples of the heathy type of M24 *Molinia caerulea-Cirsium dissectum* fen-meadow, ranging from short, grazed swards through to stands that are transitional to scrub. Structural diversity accounts for the conservation of a wide range of flora and fauna, particularly of species characteristic of south-western Europe, such as meadow thistle *Cirsium dissectum* and whorled caraway *Carum verticillatum*.

Cwm Cadlan (168)

This is one of the largest examples of this habitat type in Wales and is representative of the habitat type in south Wales. The typical form of M24 *Molinia caerulea-Cirsium dissectum* is extensively developed and there are transitions to a range of neutral grasslands, acid grasslands and small sedge flushes. Globe-flower *Trollius europaeus* occurs here towards the southern limit of its British distribution.

Drostre Bank (93)

This site is selected to provide a representation of the habitat type in mid Wales, where species-rich types of *Molinia* grassland are local. The site contains a well characterised example of the typical form of M24 *Molinia caerulea-Cirsium dissectum* fen-meadow close to the western limit of its main British distribution. There are transitions to a floristically related form of rush pasture.

Fenland (194)

This site contains, particularly at Chippenham Fen, one of the most extensive examples of the tall herb-rich East Anglian type of M24 *Molinia caerulea-Cirsium dissectum* fen-meadow. It is important on grounds of representativity and also for conservation of geographical range, as this type of fen-meadow is rare and ecologically distinctive in East Anglia.

Holme Moor and Clean Moor (95)

This is one of two sites chosen as a representative of species-rich *Molinia* grassland in south-west England. The grasslands are of the M24 *Molinia caerulea-Cirsium dissectum* fen-meadow type.

Moor House - Upper Teesdale (188)

This is one of three sites chosen to provide representation of this habitat type in northern England. The *Molinia* grasslands are of the M26 *Molinia caerulea-Crepis paludosa* mire type. Although less extensive and more fragmentary than at Craven Limestone Complex, stands occur in a wider range of ecological contexts, including examples in upland meadows not found in other sites, as well as examples in lightly grazed pasture, on wet margins of woodland and on stream banks.

Waveney and Little Ouse Valley Fens (94)

This site provides representation of the M24 *Molinia caerulea-Cirsium dissectum* fen-meadow type associated with spring-fed valley fen systems in East Anglia, England, where *Molinia* grassland is very rare. The habitat type is found here in conjunction with M13 *Schoenus nigricans-Juncus subnodulosus* mire and species-poor *Cladium* beds. Where it is grazed it is more species-rich, with frequent southern marsh-orchid *Dactylorhiza praetermissa*.

2.6.8 Eutrophic tall herbs (37.7 and 37.8)

2.6.8.1 Background to selection

The habitat type occurs widely across the EC but is very localised in its distribution. In the UK it is a very rare habitat, and its total extent is less than 1,000 ha. It occurs most frequently and is most widespread in the Scottish Highlands. It becomes more fragmentary on the Scottish islands and further south in the UK. It is typically found on ungrazed upland cliff ledges, occasionally extending on to open ground, and is restricted to base-rich substrates. This is one of the few near-natural communities remaining in Britain and frequently occurs in intimate mosaics with other Annex I habitat types in these ungrazed situations. This inaccessible habitat provides an important refuge for many rare montane plants. The sites selected cover the geographical range and ecological variation of the habitat type and ensure protection of a high proportion of the resource.

Eutrophic tall herbs is a species-rich plant community corresponding to NVC type U17 *Luzula sylvatica-Geum rivale* tall-herb community. It is characterised by the abundance of a species-rich mix of tall, broad-leaved herbs, most of which are otherwise rare in the uplands owing to grazing. These include great wood-rush *Luzula sylvatica,* roseroot *Sedum rosea,* wood crane's-bill *Geranium sylvaticum* and globe-flower *Trollius europaeus*.

Variation within the habitat type is related chiefly to geographical position, altitude, soil conditions and rock type. Stands in the Scottish Highlands are richer in northern species, while stands further south have species of a southerly distribution. In the Highlands stands at high-altitude are enriched by scarce arctic-alpine plants, such as holly fern *Polystichum lonchitis* and alpine cinquefoil *Potentilla crantzii*.

Selection has included the most diverse examples and those with the best developed vegetation structure and function, taking into account altitudinal range, floristic diversity and geographic variation. Larger sites with a range of rock types and a large number of ungrazed rock ledges have been favoured, as this ensures inclusion of the maximum extent of this very localised habitat type. The rarer species tend to occur on the more calcareous or base-rich ledges at high altitude. These locations also tend to be the richest in species, and sites were selected preferentially to include a wide range of these richer localities.

2.6.8.2 Site list

Beinn Dearg (104)

This site is representative of the habitat type in north-west Scotland. The habitat type is developed at high altitudes on calcareous schists. It is the best site for this habitat type in this part of Scotland, because of the extensive development of the habitat type on ledges across the site and the species diversity. Characteristic species include roseroot *Sedum rosea,* globe-flower *Trollius europaeus,* water avens *Geum rivale* and wood crane's-bill *Geranium sylvaticum,* mixed with downy willow *Salix lapponum* in places. Many of the rarer arctic-alpines associated with this habitat are present, including holly-fern *Polystichum lonchitis,* alpine saw-wort *Saussurea alpina,* black alpine-sedge *Carex atrata,* arctic mouse-ear *Cerastium arcticum* and rock whitlowgrass *Draba norvegica*.

Ben Heasgarnich (106)

This is one of three sites in the Breadalbane range in the southern Highlands of Scotland and represents the habitat type up to high altitudes on calcareous schists. Diverse and well developed examples of the habitat type occur across the site, with rarer arctic-alpines including rock whitlowgrass *Draba norvegica,* alpine mouse-ear *Cerastium alpinum* and black alpine-sedge *Carex atrata.* The site is unusual because, in places, plants characteristic of the ledge flora, such as the lady's-mantle *Alchemilla glabra,* water avens *Geum rivale,* wood crane's-bill *Geranium sylvaticum* and globe-flower *Trollius europaeus,* are found in moist grassland below the crags.

Ben Lawers (103)

This is one of three sites in the Breadalbane range in the southern Highlands of Scotland at which the habitat type occurs up to high altitude on ledges of calcareous schists. Examples of the community occur in a number of localities across the site and are relatively extensive in places. There is a diverse flora, which includes characteristic species such as roseroot *Sedum rosea,* water avens *Geum rivale,* wild angelica *Angelica sylvestris,*

wood crane's-bill *Geranium sylvaticum,* melancholy thistle *Cirsium heterophyllum* and globe-flower *Trollius europaeus*. A number of rare arctic-alpines are present in this habitat type here, including the rock whitlowgrass *Draba norvegica,* alpine cinquefoil *Potentilla crantzii,* black alpine-sedge *Carex atrata,* alpine meadow-grass *Poa alpina* and alpine forget-me-not *Myosotis alpestris.*

Ben Lui (105)

This is one of three sites representing the habitat type in the Breadalbane range in the southern Highlands of Scotland occurring on calcareous schist up to high altitude. Ben Lui has a large number of examples of this habitat type, distributed widely across the site. Structure and function are well developed and the communities are diverse, with characteristic species including roseroot *Sedum rosea,* wild angelica *Angelica sylvestris,* melancholy thistle *Cirsium heterophyllum* and globe-flower *Trollius europaeus* and a number of rare arctic-alpines, including alpine bartsia *Bartsia alpina,* alpine saw-wort *Saussurea alpina,* the lady's-mantle *Alchemilla wichurae,* black alpine-sedge *Carex atrata* and rock sedge *C. rupestris*. Together with Glen Coe the site represents the habitat type in the wetter and more oceanic west, where there is a greater frequency of species associated with wetter silts and dripping ledges, such as marsh hawk's-beard *Crepis paludosa,* grass-of-Parnassus *Parnassia palustris* and bog orchid *Hammarbya palustris,* and a great luxuriance of ferns characteristic of the west. Thes include oak fern *Gymnocarpium dryopteris,* lemon-scented fern *Oreopteris limbosperma,* beech fern *Phegopteris connectilis,* holly-fern *Polystichum lonchitis* and hard shield-fern *P. aculeatum*. In places **Eutrophic tall herbs** occurs in an intimate mosaic with **Sub-Arctic willow scrub**, and there are well developed transitions between them. Most of the species of Ben Lawers are present, although the extent of the habitat type is smaller on this site.

Caenlochan (78)

This is the most easterly site selected and is representative of the habitat type in the eastern Highlands. The habitat type is widely developed across the site and is found on ledges of calcareous and more acid schists with a wide altitudinal range, including very high altitudes (550-870 m). Caenlochan is considered to have the greatest extent of this habitat type in the UK. There is an extremely diverse and well developed montane flora containing a range of characteristic species, such as roseroot *Sedum rosea,* red campion *Silene dioica,* water avens *Geum rivale,* globe-flower *Trollius europaeus* and wood crane's-bill *Geranium sylvaticum.* Rarer species include the arctic-alpines black alpine-sedge *Carex atrata,* alpine gentian *Gentiana nivalis,* alpine fleabane *Erigeron borealis,* alpine mouse-ear *Cerastium alpinum* and alpine cinquefoil *Potentilla crantzii*. A very rare species that occurs on more acid ledges and is not represented on any other site in the series is alpine blue-sow-thistle *Cicerbita alpina*. The ledges at lower altitude have woodland species, such as wood anemone *Anemone nemorosa* and dog's mercury *Mercurialis perennis,* not often represented in the habitat type.

Eryri/Snowdonia (118)

This is the most southerly site selected and contains the most extensive and diverse examples of the habitat type in Wales. Fragmentary stands of the habitat type occur on pumice tuff and other base-enriched igneous rocks at a range of altitudes throughout the site. The vegetation is floristically somewhat impoverished compared with Scottish examples but is important as a southern outlier for arctic-alpines such as alpine saw-wort *Saussurea alpina* and black alpine-sedge *Carex atrata*. There are also some southern species, which are absent further north, for example Welsh poppy *Meconopsis cambrica*.

Foinaven (162)

Foinaven is representative of the habitat type in the north of Scotland, where the habitat type is rare. It is the best example in this area because of the extensive development of the communities and the range of unusual types of rocks on which they occur, such as calcareous serpulite grits and fucoid beds, as well as calcareous schists. Because of the low altitude the flora is not as rich as at sites further south. Characteristic species include the lady's-mantle *Alchemilla glabra,* wild angelica *Angelica sylvestris,* water avens *Geum rivale,* globe-flower *Trollius europaeus* and roseroot *Sedum rosea.* Rarer arctic-alpines on the site include alpine saw-wort *Saussurea alpina,* alpine saxifrage *Saxifraga nivalis* and holly-fern *Polystichum lonchitis.*

Glen Coe (126)

This site represents the habitat type at a range of altitudes in the western Highlands in an oceanic climate on igneous rocks, including acid rocks and calcareous andesites, which support the richest flora. This habitat type

shows well-developed structure and high species diversity. Characteristic species include roseroot *Sedum rosea*, wild angelica *Angelica sylvestris*, common valerian *Valeriana officinalis*, hogweed *Heracleum sphondylium*, mountain melick *Melica nutans*, lesser meadow-rue *Thalictrum minus* and melancholy thistle *Cirsium heterophyllum*. The habitat type is similar to that on Ben Lui, with a good representation of ferns, including brittle bladder-fern *Cystopteris fragilis*, polypody *Polypodium vulgare*, beech fern *Phegopteris connectilis* and holly-fern *Polystichum lonchitis*. Some crags have running water with an unusual abundance of common scurvygrass *Cochlearia officinalis*, and other species of wet crags are well represented, including opposite-leaved golden-saxifrage *Chrysosplenium oppositifolium*, grass-of-Parnassus *Parnassia palustris* and marsh hawk's-beard *Crepis paludosa*. On Meall Mor the vegetation communities contain a good population of whortle-leaved willow *Salix myrsinites* and show similarities to **Sub-Arctic willow scrub**.

Helvellyn and Fairfield (127)

This site is representative of the habitat type in England. Although the communities are not as rich in species as high-altitude sites in the Highlands, a representative montane flora is present. This site encloses the largest continuous area of land above 760 m in the Lake District and is one of the most important areas in England for calcareous montane flora found on extensive cliff ledges. Rocks of the Borrowdale Volcanic Series form the underlying geology of the entire area. Although these rocks are generally acidic, the eastern cliffs are particularly rich in base minerals and weather to produce pockets of fertile soil. It is these areas of moist, basic soils that support species-rich tall herb vegetation. Typical species found here include wood crane's-bill *Geranium sylvaticum*, wild angelica *Angelica sylvestris*, water avens *Geum rivale* and globe-flower *Trollius europaeus*. Often associated with these ledges but also found on the bare outcrops and ledges are many montane or northern species, such as roseroot *Sedum rosea*, mountain sorrel *Oxyria digyna*, northern bedstraw *Galium boreale*, stone bramble *Rubus saxatilis* and purple saxifrage *Saxifraga oppositifolia*. A number of rare arctic-alpine species occur, including alpine meadow-grass *Poa alpina* and black alpine-sedge *Carex atrata*. Alpine cinquefoil *Potentilla cranzii* has also been recorded here.

2.6.9 Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*) (38.2)

2.6.9.1 Background to selection

This grassland type is rare in the UK and occurs almost entirely in England. It is estimated to cover less than 1,500 ha and now survives at scattered and mostly small sites in central and southern England. There are particularly important concentrations in the flood plains of the River Thames and its tributaries, and those associated with the Vale of York rivers, especially the Derwent.

This habitat type has been interpreted as corresponding to the NVC type MG4 *Alopecurus pratensis-Sanguisorba officinalis* grassland.

The sites that have been selected are those that have the largest surviving areas and the most stable patterns of traditional low-intensity management and so show a high degree of conservation of structure and function. The sites have been selected to encompass the range of ecological variation shown by the habitat type, particularly those variations supporting important populations of rare and scarce meadow species, and also to cover the geographical distribution of the habitat type in the UK.

2.6.9.2 Site list

Lower Derwent Valley (87)

This site in the north-east of England contains a greater area of high-quality examples of this habitat type than any other UK site and provides conservation of the majority of this habitat type occurring in the Vale of York. The abundance of the rare narrow-leaved water-dropwort *Oenanthe silaifolia* is a notable feature. Traditional management has ensured that ecological variation is well developed, particularly in the transitions between this grassland type and other types of wet and dry grassland, swamp and fen vegetation.

Mottey Meadows (312)

This site in the Midlands of England has been selected as a relatively large area of the community (approximately 40 ha) in order to provide representation of the habitat type in this part of its range. The site contains grassland with limited influence of agricultural intensification and transitions to dry and wet grasslands and so demonstrates good conservation of structure and function. The site is important for a range of rare meadow species, including the fritillary *Fritillaria meleagris* at its most northerly native locality.

North Meadow and Clattinger Farm (207)

This site in the Thames Valley in southern England is one of two sites that provide representation of this grassland type in the centre of its range of distribution. As in the case of the Oxford Meadows, this site represents an exceptional survival of the traditional pattern of management and so exhibits a high degree of conservation of structure and function. This site also contains a very high proportion (>90%) of the surviving UK population of the fritillary *Fritillaria meleagris*, a species highly characteristic of damp lowland meadows in Europe and now rare throughout its range.

Oxford Meadows (88)

Together with North Meadow and Clattinger Farm, this site in southern England has been selected to provide representation of this habitat type in the Thames Valley centre of distribution. This site includes vegetation communities that are perhaps unique in the world in reflecting the influence of long-term grazing and hay cutting on lowland hay meadows. The site has benefited from the exceptionally important survival of traditional management, which has been undertaken for several centuries, and so exhibits good conservation of structure and function.

Portholme (315)

This is a large site that provides representation of the habitat type in the eastern England part of its range. It is the largest surviving traditionally managed meadow in the UK (104 ha: 7% of the total UK resource of alluvial flood meadow). There has been a long history of favourable management and very little of the site has suffered

from agricultural improvement, and so it demonstrates good conservation of structure and function. It supports a small population of the fritillary *Fritillaria meleagris*.

2.6.10 Mountain hay meadows (British types with *Geranium sylvaticum*) (38.3)

2.6.10.1 Background to selection

Mountain hay meadows now cover a very small area in the UK, considered to be less than 1,000 ha, occurring in scattered fields or small isolated groups of fields in a series of valleys in northern England and as small examples along rivers in Scotland.

Very few localities have been identified that support high quality examples of this habitat type in terms of representativity, size, structure and function, and clusters or more isolated representatives of the habitat type within these localities have therefore been selected.

This habitat type corresponds to the NVC grassland type MG3 *Anthoxanthum odoratum-Geranium sylvaticum* grassland. The floristic composition of mountain hay meadow vegetation in the UK is unlike that found in the rest of Europe and appears to be unique in the EC.

2.6.10.2 Site list

Moor House - Upper Teesdale (188)

Lying within the Upper Teesdale area, this site contains actively managed hay meadows at their highest altitude in the UK. Though representing a smaller proportion of the national resource than the North Pennine Dales Meadows, the meadows of this site have been managed at an extremely low level of agricultural intensification (i.e. there is good conservation of structure and function). There are important populations of an extensive suite of hay meadows species, including several rare species of lady's-mantle (*Alchemilla acutiloba, A. monticola* and *A. subcrenata*) and abundant globe-flower *Trollius europaeus*

North Pennine Dales Meadows (189)

This site contains a series of isolated fields within a number of north Pennine and Cumbrian valleys. The site encompasses the range of variation exhibited by this vegetation in the UK and contains the major part of the remaining UK resource of this habitat type. The grasslands included within the site exhibit very limited effects of agricultural improvement (i.e. show good conservation of structure and function). A wide range of rare and local meadow species are contained within the meadows, e.g. globe-flower *Trollius europaeus*, the lady's-mantles *Alchemilla acutiloba, A. monticola* and *A. subcrenata* and spignel *Meum athamanticum*.

Section 2.7: Raised bogs and mires and fens

2.7.1 *Active raised bogs (51.1)

2.7.1.1 Background to selection

In the Atlantic Biogeographic Region most of the relatively intact raised bogs occur in the UK and Ireland, although the total area is relatively small because a large proportion of the original area has been damaged. The habitat type also occurs widely in Fenno-Scandia. Destruction of this habitat type in north-west Europe, combined with the relatively high proportion of the resource remaining in the UK, means that the UK has a special responsibility to select and protect a substantial proportion of the sites representing the best examples of this priority habitat type.

Raised bogs are unevenly distributed in the UK, but it is possible to recognise the following broad geographic areas in which active examples occur at the present time:

Grampian Plain, Scotland
Central Belt, Scotland
Solway, England/Scotland
North-west England
North-east England
Welsh Borders
Mid Wales
Northern Ireland

Selection of sites reflects the relative abundance of raised bog within these regions and in particular a concentration in the Central Belt of Scotland. In some instances changes in land-use have resulted in fragmentation of once continuous bog. In these cases the fragments have been seen as comprising a single site.

Active raised bogs are mire (peat-forming) ecosystems that have developed during thousands of years of peat accumulation, to such an extent that the depth of peat isolates them from the influence of groundwater. Typically, lowland raised bogs form a raised dome of peat irrigated solely by rainfall. Such rainwater-fed ecosystems are very acid and poor in plant nutrients and typically support a restricted range of species that are otherwise abundant only in the cooler and wetter uplands of the UK. These species include the important peat-forming species, such as the bog mosses *Sphagnum* spp. and cottongrasses *Eriophorum* spp., together with heather *Calluna vulgaris* and other ericaceous species, leafy liverworts and carnivorous sundews *Drosera* spp. Northern sites are richer in reindeer-moss lichen *Cladonia* spp.

The ecosystem is considered to be in favourable condition when the bog mosses display a distinctive microtopography, with hummocks and hollows rich in *Sphagnum* and other peat-forming species. Classical descriptions of the ecosystem show raised bogs as having a discrete lens-shaped dome of peat with flat or imperceptibly sloping topography with a halo of fen vegetation in the zone where water draining the bog meets that from adjoining mineral soils. This is known as the lagg. A characteristic of the lagg is that normally it has more available plant nutrients, is more alkaline and hence shows greater species diversity, with a preponderance of sedge *Carex* spp. As a result of peat-digging and other activities, in Europe no example of raised bog that conforms exactly to this model is now known. Attention has been paid to ensure that sites with remnant lagg vegetation have been selected.

Site selection has concentrated on the highest quality examples of this habitat type, in terms of intact structure and function of the bog surface, within the broad geographic areas. Selection has excluded degraded sites where there is only limited evidence for regeneration. However, given the scarcity of this habitat type in Europe, sites that have been affected by peat extraction and other land-uses have been included in the series where they: i) have retained a high or significant proportion of actively growing primary bog surface, or ii) have significant areas where the peatland is regenerating on secondary or cut-over surfaces.

2.7.1.2 Site list

The list of sites for this habitat type is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

Ballynahone Bog (210)

This is one of the two largest intact active bogs in Northern Ireland with hummock and hollow pool complexes. The peatland flora includes bog-rosemary *Andromeda polifolia,* at one of its few Northern Ireland sites, and the bog mosses *Sphagnum fuscum, S imbricatum* and *S. pulchrum.* Recently constructed surface drains have been filled and the site is recovering.

Bankhead Moss, Beith (239)

Although small, this site in the Central Belt of Scotland has a largely intact structure, having suffered only marginal encroachment by domestic peat-cutting. The central dome is dominated by active bog vegetation, including occasional *Sphagnum cuspidatum*-filled hollows and *S. magellanicum* carpets. A secondary lagg fen has developed in the areas of abandoned peat-cutting.

Black Bog (215)

One of the largest active raised bog sites in Northern Ireland, this site is located in marginal upland and is somewhat intermediate in nature to blanket bog. Important features include a well developed and extensive hummock and hollow complex and largely intact lagg. The oceanic liverwort *Pleurozia purpurea* and the bog mosses *Sphagnum fuscum* and *S. imbricatum* occur.

Black Loch Moss (240)

This is one of the least disturbed raised bogs remaining in the Central Belt of Scotland and consists of a large area of undamaged bog surface that is almost continuously dominated by bog mosses, including *Sphagnum papillosum* and occasional *S. magellanicum*. The site is formed on a distinct slope and also has some characteristics of blanket bog.

Blawhorn Moss (241)

This is one of the larger, least disturbed peat bogs in the Central Belt of Scotland. The vegetation exhibits well developed hummock and hollow topography and supports many of the species representative of bog, such as *Sphagnum papillosum, S. magellanicum* and cranberry *Vaccinium oxycoccos*. It is of further interest in that on one side it grades into blanket bog.

Braehead Moss (242)

This peat bog in the Central Belt of Scotland has complex origins in that it has arisen from peat developing in two separate basins, which have now fused. In the area where peat has merged, the vegetation has affinities to blanket bog. The upper and lower bogs are dominated by hummocks largely formed of *Sphagnum* spp., including *S fuscum* and *S. imbricatum,* and are rich in heather *Calluna vulgaris* and cottongrasses *Eriophorum* spp. Soft *Sphagnum cuspidatum* hollows also occur.

Coalburn Moss (243)

This site retains an extensive primary dome, although this is now confined by two abandoned railway lines. The site contains one of the larger tracts of vigorous bog moss-dominated vegetation in the Central Belt of Scotland, with distinctive wet *Sphagnum* hollows. Typical bog mosses include *S. papillosum* and *S. magellanicum.* Hare's-tail cottongrass *Eriophorum vaginatum*, cranberry *Vaccinium oxycoccos* and reindeer-moss lichen *Cladonia* spp. are also common. The hollows, rich in *Sphagnum cuspidatum,* are occasionally fringed by the great sundew *Drosera longifolia*. Some of the margins of the site also support wetland communities.

Cockinhead Moss (244)

This small site in the Central Belt of Scotland supports a vigorous growth of typical bog mosses, including *Sphagnum papillosum* and *S. magellanicum*, as well as *S. molle*. The site is significant because part of the marginal lagg fen survives, supporting tall fen vegetation of sedges *Carex* spp. and rushes *Juncus* spp.

Cors Caron (200)

This sequence of peat domes (also known as Tregaron Bog) in the Teifi valley in mid-Wales now represents the most intact surviving example in the UK of a raised bog landscape unit. The domes are separated by the River Teifi itself and lagg streams that drain into it. The river terraces associated with these are regularly flooded and support vegetation that includes reed canary-grass *Phalaris arundinacea*, soft rush *Juncus effusus* and purple moor-grass *Molinia caerulea*. A substantial part of the raised domes themselves is also in a relatively natural condition, with a mosaic of vegetation types. These include *Sphagnum*-rich communities containing *S. papillosum, S. pulchrum* and white beak-sedge *Rhynchospora alba*. Drier areas are dominated by heather *Calluna vulgaris* and deer-grass *Trichophorum cespitosum*. The site therefore provides the best opportunity to see the type of raised bog landscape that was once an important feature of many parts of the UK.

Cors Fochno (201)

This site (also known as Borth Bog) lies on the south side of the Dyfi estuary in Wales. Although a substantial part of the former peatland body has been taken for agriculture, the remaining natural dome is one of the largest single areas of active raised bog vegetation in the UK. Extensive areas of hummock-hollow relief include occasional hummocks of *Sphagnum fuscum* and, more rarely, *S. imbricatum,* with hollows supporting *S. pulchrum*, white beak-sedge *Rhynchospora alba* and bog-rosemary *Andromeda polifolia*. An area of domestic peat-cutting on the northern edge of the dome is now actively regenerating and supports a significant area of active bog vegetation.

Cranley Moss (245)

This bog in the Central Belt of Scotland is important because it is a 'classic' raised bog, with a distinct and clearly defined active dome rising from a flat flood-plain long since converted to agricultural use. Much of the bog margin is intact, but although marshy ground surrounds parts of the site, most of the original lagg fen transition is thought to have been reclaimed. The bog has extensive *Sphagnum* carpets, which show vigorous growth throughout. *Sphagnum imbricatum* is found here.

Craven Limestone Complex (190)

This site represents the habitat type in northern England, in an area where active raised bogs are rare. Although bogs are not generally common in limestone areas because base-rich conditions are more characteristic of fen development, the Craven Limestone area supports a small number of raised bogs. These bogs have affinities with the few remaining raised bogs in the Jura mountain region of France and Switzerland and, like them, may be influenced somewhat by lime-rich material eroding from the hills around. Malham Tarn Moss displays a classic raised dome with transition from base-poor raised bog to the base-rich fen conditions of the bog margin, or lagg fen. The bog has an unusual mixture of *Sphagnum*-rich and hair-grass *Deschampsia* dominated vegetation.

Duddon Mosses (274)

This complex in north-west England is found in the plain of the Duddon Estuary. In the southern part of the complex, where there are transitions from saltmarsh to bog, the vegetation is rich in the rare *Sphagnum pulchrum*. Further north a variety of raised bog conditions can be observed, from hand-cut and vigorously regenerating cuttings, to domes of uncut bog, which display significant areas of actively-growing bog vegetation.

Dykeneuk Moss (246)

This is a large site in the Central Belt of Scotland with a typical raised bog structure. Although the site is now modified in its northern parts by afforestation and drainage, it is recovering. The remainder of the site has extensive areas of active bog vegetation with *Sphagnum papillosum, S. magellanicum* and cranberry *Vaccinium oxycoccos*.

Fairy Water Bogs (217)

This is a series of three relatively intact active raised bogs set in a drumlin landscape in Northern Ireland. They are somewhat intermediate in character to blanket bog. Two of the component bogs have pool complexes. The oceanic liverwort *Pleurozia purpurea* and the bog mosses *Sphagnum fuscum* and *S. imbricatum* occur.

Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses (109)

This is a large lowland raised bog that straddles the English/Welsh border. It is amongst the largest and most southerly raised bogs in the UK. Although part of the site has a long history of peat extraction, it retains significant areas of partially cut and uncut mire surfaces. In areas formerly subject to commercial peat cutting, recent conservation management has led to active regeneration of bog-forming vegetation. Mire vegetation includes *Sphagnum papillosum, S. magellanicum, S. pulchrum,* all three British species of sundew *Drosera* spp., cranberry *Vaccinium oxycoccos*, bog asphodel *Narthecium ossifragum*, royal fern *Osmunda regalis*, white beak-sedge *Rhynchospora alba* and bog-rosemary *Andromeda polifolia*, together with the nationally scarce moss *Dicranum affine*. Over 1,700 invertebrate species have been recorded here, including 29 nationally rare Red Data Book species.

Flanders Mosses (107)

This site consists of a cluster of individual bogs in the Central Belt of Scotland that are the remnants of one of the largest raised bog complexes in Britain. East Flanders Moss is the largest raised bog in the UK that is still in a predominantly near-natural state. Many of the typical bog mosses, including *Sphagnum papillosum* and *S. magellanicum,* are found in abundance, together with local rarities such as *S. fuscum, S. imbricatum* and *S. molle* within a rich diversity of natural microtopographical features. The development of woodland on East Flanders is a recent phenomenon, but where the conditions are sufficiently wet, tree growth is very stunted and the branches are encrusted with rich assemblages of lichen. This may approach the natural conditions of tree growth on raised bog in this part of Scotland. Collymoon Moss previously formed part of a peatland continuum with East Flanders. The ground layer is rich in *Sphagnum*, but the striking feature of this part of the site is the high proportion of lichens such as reindeer-moss *Cladonia* spp. Killorn Moss and Shirgarton Moss form small satellites to East Flanders Moss, having once almost certainly been connected to it by fen peat, which has disappeared through agricultural use. These sites have a narrow fringe of woodland giving way to open mire communities, which, in both cases, support vigorous bog moss vegetation and typical features of raised bog; they are therefore seen as an integral part of the site.

Garry Bog (216)

This is a large active bog in Northern Ireland with an exceptionally extensive and well developed pool complex and partially intact lagg. *Sphagnum fuscum* and *S. imbricatum* occur on the site and *S. pulchrum* is found in abundance in the pool system.

Reidside Moss (248)

This site in north-east Scotland is relatively intact compared with most sites in the Grampian Plain and supports typical vegetation of the north-east bogs, rich in heather *Calluna vulgaris* and cottongrasses *Eriophorum* spp. The bog moss has luxuriant cushions of *Sphagnum capillifolium,* and the great sundew *Drosera longifolia* occurs. Bog-myrtle *Myrica gale* and cross-leaved heath *Erica tetralix* are also frequent. Although peat-cuttings occur, they are regenerating, with abundant cottongrasses and typical fen communities, which thrive where the base status is higher .

Roudsea Wood and Mosses (275)

This site consists of a complex of raised bogs on the northern shore of Morecambe Bay in north-west England. Although the majority of the complex has undergone extensive drainage in the past, with domestic peat-cutting around the margins, the drainage was abandoned many years ago and much of the area has recovered to a considerable degree. Within the site there are transitions between acid bog and limestone woodland, with a number of scarce plant species including the rare large yellow-sedge *Carex flava.*

Solway Mosses (108)

This is a complex of raised bogs on the Solway Plain in north-west England. Bowness Common is one of the largest raised bogs remaining in the UK, at 759 ha. Although affected by past drainage and peat-cutting, much of the site supports typical bog vegetation, including bog rosemary *Andromeda polifolia*, cranberry *Vaccinium oxycoccos* and great sundew *Drosera longifolia*. Wedholme Flow, with its extensive *Sphagnum* carpets, contains possibly the largest area of undamaged active raised bog in England. The central part of Glasson Moss displays some of the most diverse raised bog vegetation in the UK today, with bog moss species including abundant *Sphagnum pulchrum* as well as *S. fuscum*. Lying towards the eastern limit of the Solway basin, Walton Moss represents an example of the transition from raised bog to blanket bog. It has a substantial area of active bog vegetation and is the least disturbed of the English raised bogs. As is typical in such upland conditions, the vegetation is uniform and does not display the range of surface features found at, for example, Glasson Moss.

Turclossie Moss (260)

This site in the Grampian Plain of Scotland represents the western end of a once much larger site that had many characteristics of blanket bog. The site still contains a significant area of raised bog with a continuous active surface, and *Sphagnum magellanicum* occurs frequently in the wetter areas.

Waukenwae Moss (247)

This site in the Central Belt of Scotland has extensive areas of active bog. It displays some of the best *Sphagnum*-hollow patterning to be found in bogs in this part of Scotland and also has several hummocks of *S. imbricatum*. The bulk of the site is relatively intact, having suffered little from marginal domestic peat-cutting.

2.7.2 Degraded raised bogs (still capable of natural regeneration) (51.2)

2.7.2.1 Background to selection

The degraded raised bog site series has been chosen to complement the list of active raised bogs in order to fulfil the UK's responsibility in implementing the Directive by representing the full range of raised bog habitat types. A significant part of the UK raised bog resource is included in the active raised bog series and so the significance of degraded raised bogs is much lower in the UK than in most other parts of Europe. The importance of the contribution of the UK's active raised bog series towards implementing the Directive therefore means that less emphasis is placed on representation of the degraded habitat type. However, as the Habitats Directive lists this type separately from active raised bog, two sites have been selected that are considered to be sufficiently large and valuable in terms of their potential for natural regeneration. In particular these sites have been chosen to provide representation of the habitat type from geographical areas in which the active raised bog category is now absent.

A gradation exists from fully active raised bog to those with no active vegetation, and so designation as either 'active' or 'degraded' at the site level may be difficult. Parts of many active raised bog sites have been damaged through peat extraction, drainage and other activities. In this context the damaged areas are seen as forming an integral part of the active bog, and so are not listed separately here.

Sites are considered as degraded raised bogs where there has been widespread disruption (usually by man) to the hydrology of the peat body, leading to pronounced surface desiccation or removal, resulting in species loss or change in the composition of species assemblages. Such areas occur as a component of the disturbed parts of many active raised bogs. However, degraded sites are chosen where such conditions are judged to occur over the greater proportion of the site. The vegetation usually contains several, but not all, of the species typical of active raised bog, but the relative abundance of individual raised bog species differs. Sites judged to be still capable of natural regeneration include those where the hydrology is likely to be reparable and where, with appropriate rehabilitation management, there is a reasonable expectation of establishing widespread vegetation with peat-forming capabilities within 30 years. Sites or substantial parts of sites that consist largely of areas of bare peat have been excluded.

2.7.2.2 Site list

Moine Mhor (277)

Most peat on the west coast of Scotland is classified as blanket bog. The small amount of raised bog present in this area has suffered significant human impact. Moine Mhor is the largest area of raised bog in this part of Scotland. Subjected to extensive drainage and commercial peat extraction in the past, this site shows strong evidence of regeneration and represents the hyper-oceanic zone within the raised bog site series. A transition to saltmarsh is an unusual ecological feature of this site.

Thorne Moor (110)

Thorne Moor in the east of England has been worked commercially for more than 200 years, but remains the largest single area of raised bog in the UK. It has been selected because is contains a more extensive representation of the degraded raised bog habitat type than any other area, and to provide an example in eastern England in the raised bog site series. There is evidence of regeneration over a large part of the site, with heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, hare's-tail cottongrass *Eriophorum vaginatum*, cranberry *Vaccinium oxycoccos*, bog-rosemary *Andromeda polifolia* and species of bog moss *Sphagnum* present on the secondary mire surface.

2.7.3 Blanket bog (*active only) (52.1 and 52.2)

2.7.3.1 Background to selection

In the EC this priority habitat type is found in the UK and Ireland. Because its extent is now restricted in Ireland, the UK is considered to have a special responsibility for its protection. Sites have been selected to ensure full coverage of geographic range and ecological variation, and the largest sites with the most extensive areas of active blanket bog have been favoured. A site may contain areas of non-active blanket bog, but these are seen as functional components of the system as a whole.

Blanket bog is found in the north and west of the UK and extends from Devon in the south to Shetland in the north. These extensive peatlands have formed in areas where there is a climate of high rainfall and a low level of evapo-transpiration, allowing peat to develop not only in wet hollows but over large expanses of the undulating land surface.

The blanketing of the ground with a variable depth of peat gives the habitat type its name and results in the various morphological types according to their topographical position, e.g. saddle mire, watershed mire, valleyside mire. Other morphological types are less obviously defined. Eccentric mires, of which there are possibly only three in the UK, might be thought of as extreme, fan-shaped forms of valleyside mire that abut mineral ground at their upslope margins and have dramatic surface patterning aligned at right angles to the slope. Ladder fens form an integral part of some blanket bogs and have a characteristic surface patterning, with narrow pools and intervening low, narrow ridges parallel to the contours. Associated with this structure is a more species-rich flora than that of the surrounding mire expanse. This is due to local flushing of mineral nutrients through these fen areas, in contrast to the surrounding vegetation, which receives all its nutrients through precipitation, i.e. is ombrotrophic.

Blanket bog shows a complex pattern of variation related to climatic factors, particularly illustrated by the variety of patterning of the bog surface throughout different parts of the UK. Such climatic factors also influence the pattern and distribution of bog vegetation. Many of the bogs in the Hebrides and Northern Ireland have affinities to types in western Ireland and thus exhibit the more oceanic aspect of the range of variation, while those sites towards the eastern limit of blanket bog formation show more continental affinities.

An important element in defining variation is the relative proportion of pools on the bog surface. In general, the proportion of surface patterning occupied by permanent pools increases to the north and west, although the precise shape and pattern of pools appears to depend on local topography as well as geographical location. Variety within the bog vegetation mirrors this pattern. Similarly, the number of associated habitats and communities, such as springs, flushes, fens and heath, is greater in the milder, wetter and geologically and topographically more complex north and west.

The three most abundant NVC blanket bog communities are:

M17 *Scirpus cespitosus-Eriophorum vaginatum* blanket mire
M18 *Erica tetralix-Sphagnum papillosum* raised and blanket bog
M19 *Calluna vulgaris-Eriophorum vaginatum* blanket mire

All three communities, together with some others, occur across a wide area. M17 predominates in the west, particularly at lower altitude, while M19 is particularly abundant in the east and at higher altitudes. M18 is widely but patchily distributed.

Widespread and typical throughout the entire blanket bog range are species such as heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix,* cottongrass *Eriophorum* spp., deer-grass *Trichophorum cespitosum* and bog mosses such as *Sphagnum papillosum, S. tenellum* and *S. capillifolium.* Others are more characteristic of, or more abundant in, certain areas. For example, the higher, drier eastern bogs typically support a higher proportion of hare's-tail cottongrass *Eriophorum vaginatum* and bilberry *Vaccinium myrtillus* than those further west. Similarly, purple moor-grass *Molinia caerulea* and bog-myrtle *Myrica gale* are much more widespread and typical on western bogs. The distribution of some of the rarer bog mosses, for example *Sphagnum imbricatum* and *S. fuscum,* is less readily associated with geography and may relate more to past management than to climate.

2.7.3.2 Site list

The list of sites for this habitat type is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

Achmore Bog (271)

Achmore Bog is a small southern outlier of the vast flow-ground on Lewis in the Outer Hebrides. Achmore lies at the junction between the characteristic watershed flows that dominate the northern part of Lewis and the more dissected terrain of the south of the island. This highly oceanic bog system shows reduced *Sphagnum* cover compared with other sites in the UK. The species complement is dominated by deer-grass *Trichophorum cespitosum*, purple moor-grass *Molinia caerulea* and white beak-sedge *Rhynchospora alba*, demonstrating the effect of increased sea spray. Species of note include *Sphagnum imbricatum* and bog-sedge *Carex limosa.*

Berwyn (112)

Berwyn is the most extensive tract of intact blanket bog in Wales. It supports large areas of mire dominated by heather *Calluna vulgaris* and hare's-tail cottongrass *Eriophorum vaginatum*, and within this community cloudberry *Rubus chamaemorus* is found at the southernmost limit of its British range. On deeper peat, there are smaller stands of cross-leaved heath *Erica tetralix* with *Sphagnum papillosum* that show distinct surface patterning. The mire vegetation shows transitions to heather-dominated dwarf-shrub heath.

Border Mires, Kielder - Butterburn (111)

This complex is part of what was once the largest continuous tract of blanket bog across northern England and is particularly important for the quality of the transition it represents between blanket bog and raised mire. Although much of the land has been afforested, significant areas of the original bog remain throughout the forested expanse and these have been chosen to represent this habitat type in northern England. The climate is wetter here than in some other parts of northern England, and this is reflected in the composition of the vegetation, which is dominated by species of cottongrass *Eriophorum* and a reduced cover of heather *Calluna vulgaris*. At Butterburn Flow the wetter climate is also emphasised by quite distinct surface patterning of *Sphagnum* hollows separated by *Sphagnum* ridges in the largest of the open areas. It is a very good example of the *Sphagnum*-rich cross-leaved heath *Erica tetralix* and *Sphagnum papillosum* vegetation type.

Caithness and Sutherland Peatlands (174)

The scale and diversity of the peatlands of Caithness and Sutherland in northern Scotland (widely known as The Flow Country) make them unique in Europe. They form the largest peat mass in the UK and are three times larger than any other peatland area in either Britain or Ireland. The site is important because of the considerable abundance of large (several square kilometres) continuous areas of *Sphagnum* carpets and hummocks, including *S. fuscum, S. imbricatum* and *S. pulchrum*, and for its numerous intact pool systems. Not only are these features usually rare and localised on other bog systems in the UK, but a very high proportion of this ground remains undisturbed. The vegetation is mainly cross-leaved heath *Erica tetralix* with *Sphagnum papillosum* as well as deer-grass *Trichophorum cespitosum* and hare's-tail cottongrass *Eriophorum vaginatum* blanket mire. Freshwater pools and lochans are an integral component of the mire expanse.

Carn nan Tri-Tighearnan (254)

This site lies on a plateau at more than 600 m and is thus the highest-elevation site proposed. It is an example of an upland bog in the east Highlands of Scotland. It is characterised by cool climate conditions and extreme 'wetness'. Dense sheets of lichen-rich blanket bog are dominated by species of reindeer-moss lichen *Cladonia*. Such bog is very similar in character to areas of peat formation in central and eastern Norway. Other vegetation on this site consists of a dwarf-shrub cover, beneath which can be found relatively continuous carpets of *Sphagnum*. Surface patterning resulting from combinations of high-ridges and hummocks is evident in many places.

Claish Moss and Kentra Moss (249)

Claish Moss lies along the shores of Loch Shiel, while neighbouring Kentra Moss opens into Kentra Bay. They are representative of a highly oceanic bog type found on the north-west coast of Scotland. These are two of the only three known 'eccentric' mires in Britain and are selected because of the rarity of this bog form. 'Eccentric' bogs are characterised by spectacular surface patterns and are similar in structure to types more commonly found in central Scandinavia, generally as raised bog. The development of this type is very unusual in a blanket bog landscape and is of special interest. The species composition is very rich, with fourteen *Sphagnum* species having been found on the site, including *S. imbricatum* and *S. pulchrum*. Other species, such as the liverwort *Pleurozia purpurea* and brown beak-sedge *Rhynchospora fusca*, reflect the strong oceanic influence on the site.

Coladoir Bog (250)

This site on Mull in the Inner Hebrides features a variety of patterned mire types, with small areas of poor fen lying between some of the peat domes. It is the most northerly site for bog-rosemary *Andromeda polifolia*. Some of the pools support brown beak-sedge *Rhynchospora fusca*, and the occurrence of *Sphagnum imbricatum* further indicates the undisturbed nature of much of the site.

Cuilcagh Mountain (211)

This is one of the most extensive areas of upland blanket bog in Northern Ireland. The area is situated at a relatively high altitude in a high rainfall area and has a wide range of features, including well developed pool, hummock and lawn complexes, acid flushes and bog bursts. The site contains a mixture of cross-leaved heath *Erica tetralix* with *Sphagnum papillosum* and extensive areas of deer-grass *Trichophorum cespitosum* and hare's-tail cottongrass *Eriophorum vaginatum*, with a generally low cover of dwarf-shrubs. *Sphagnum fuscum* and *S. imbricatum* are present. The site also contains transitions to montane, rock and lake habitats.

Dartmoor (114)

This site is selected as the southernmost blanket bog in Europe and is representative of blanket bogs in south-west England. As is to be expected at the edge of its range, blanket bog here is less extensive than further north and forms a mosaic with other heath types. Nevertheless good areas can be found that display small-scale surface patterning, while there are large expanses of ground that are rich in *Sphagnum* species.

Eilean na Muice Duibhe (251)

This site on Islay in the Inner Hebrides occurs at low altitude on a coastal plain and contrasts with the other Islay sites, which have different topographic features. The vegetation shows affinities to that found on many Irish bogs because species such as black bog-rush *Schoenus nigricans* and purple moor-grass *Molinia caerulea* are present, replacing species such as hare's-tail cottongrass *Eriophorum vaginatum* that are more commonly found in the UK. There is a rich variety of surface patterning, from small lochs, through continuous *Sphagnum* lawns to many hummock-forming species. Of particular note are *Sphagnum fuscum* and *S. imbricatum*, which are frequent across this largely active blanket bog site.

Elenydd (113)

This site is chosen as representative of the blanket bog habitat type in mid-Wales. Blanket bog vegetation on Elenydd is generally more modified than on Berwyn, in north Wales, and good quality mire is fragmented by species-poor grassland dominated by purple moor-grass *Molinia caerulea*. However, there are large stands of cross-leaved heath *Erica tetralix* and *Sphagnum papillosum* that contain locally abundant bog-rosemary *Andromeda polifolia*, as well as areas of mire in which heather *Calluna vulgaris* and hare's-tail cottongrass *Eriophorum vaginatum* are dominant. Areas of hummock and hollow surface patterning are found locally.

Feur Lochain (252)

This bog is at the northern end of the Rhinns of Islay in the Inner Hebrides. It is different from the other Islay sites because it lies on a broad watershed ridge. It exhibits an extensive area of hummock, hollow and pool patterning and is notable for the abundance of white beak-sedge *Rhynchospora alba*. Marginal flushes and drainage basins with poor-fen vegetation add to the diversity of interest.

Flow of Dergoals (261)

This site is one of four selected to represent the blanket bog habitat type in south-west Scotland and displays well-developed surface patterning. It has distinct hollows with *Sphagnum cuspidatum*, though these are quite small and represent a comparatively small proportion of the bog surface. It is more generally dominated by a combination of low-ridge and high-ridge, with occasional *Sphagnum* hummocks and bog-rosemary *Andromeda polifolia*. The carpet is dominated by *S. magellanicum* and *S. papillosum* rather than *S. tenellum*.

Garron Plateau (212)

This is the most extensive area of intact upland blanket bog in Northern Ireland. The peatland complex is composed of a series of raised and flushed peat bog units and a number of oligotrophic lakes. There are large areas of well-developed bog microtopography, with a mixture of cross-leaved heath *Erica tetralix*, deer-grass *Trichophorum cespitosum* and hare's-tail cottongrass *Eriophorum vaginatum*, with a generally high cover of dwarf-shrubs and *Sphagnum papillosum, S. fuscum* and *S. imbricatum*. It is the main Irish location for both the few-flowered sedge *Carex pauciflora* and tall bog-sedge *C. magellanica*. The areas of flushed peat are extremely rich floristically, with black bog-rush *Schoenus nigricans* and brown mosses. The site contains the only Northern Ireland populations of marsh saxifrage *Saxifraga hirculus* and bog orchid *Hammarbya paludosa*.

Glac na Criche (253)

This site in Islay, in the Inner Hebrides, contrasts with the other Islay sites in having a much more complex topography, giving rise to watershed, valleyside and valley mires. Areas of mineral flushing on this site are more species-rich than at neighbouring Feur Lochain, while truly ombrotrophic areas also support significant amounts of black bog-rush *Schoenus nigricans*, presumably in response to salt spray from the sea cliffs below.

Hascosay (255)

This has been chosen as one of the few remaining un-eroded pool systems in Shetland. The blanket bog on Hascosay is remarkably intact and supports a range of shallow mud-bottomed, as opposed to *Sphagnum*-filled, hollows. A particular feature of this site is the dominance of the moss *Mnium hornum*, often accompanied by *Aulacomnium palustre* around the margins of bog pools. This combination of features is unusual in the UK. *Sphagnum fuscum* adds to the diversity of the community and is indicative of the undamaged nature of the bog.

Kilhern Moss (270)

This upland site in south-west Scotland is one of four chosen to represent the blanket bog habitat type in this part of the UK. It is dominated by extensive wet flats of *Sphagnum* and is floristically very distinctive. It is dominated by the rare pool-edge bog moss *Sphagnum pulchrum* in a virtually mono-specific sward. Plants common within the moss lawn include great sundew *Drosera longifolia*, bog-rosemary *Andromeda polifolia* and cranberry *Vaccinium oxycoccos*.

Kirkcowan Flow (269)

This is the largest of the four relicts of the former flow-ground in south-west Scotland and is most representative of this geographic region. The site contains a number of features not found on the other three sites, including extensive surface patterning with *Sphagnum cuspidatum* hollows. The core of the site displays a mixture of partially-patterned watershed bog and extensive flushed slopes very similar to Feur Lochain on Islay.

Merrick Kells (278)

This blanket bog is the most southerly of the characteristic oceanic blanket mires in the west of Scotland. It has an exceptionally wet climate, reflected in the range of pool patterns, from watershed mire to valleyside flow, and in the vegetation, which is rich in the liverwort *Pleurozia purpurea* and in *Sphagnum* species, with frequent swards of the rare *S. pulchrum*.

Mochrum Lochs (272)

This lowland site in south-west Scotland has a small, vigorously-growing area of blanket bog, but unlike other sites in the geographic region, the surface features are generally flat rather than hummocks and hollows. Vegetation is dominated in places either by *Sphagnum tenellum* or, in the drier areas, by *S. capillifolium*, with a range of plants typical of healthy bog growth including *S. magellanicum, S. papillosum*, bog-rosemary *Andromeda polifolia*, white beak-sedge *Rhynchospora alba* and cranberry *Vaccinium oxycoccos.*

Moidach More (256)

Moidach More is one of two sites selected to represent blanket bog in the east Highlands of Scotland. Although it lies at almost 300 m, it is a low altitude example and complements Carn nan Tri-Tighearnan in being dominated by *Sphagnum*, with only a small component of lichens, which are restricted entirely to hummock-tops. Of major interest on this site is the surface patterning, which consists of soft, low hummocks and shallow hollows or water-filled pools and is not known to occur elsewhere in Grampian. The ridges contain both *Sphagnum fuscum* and *S. imbricatum*, while the hollows are dominated by *S. cuspidatum*. Other species include *S. papillosum*, cross-leaved heath *Erica tetralix* and round-leaved sundew *Drosera rotundifolia*.

Mointeach nan Lochain Dubha (273)

This is one of two sites on Skye in the Inner Hebrides. The bog lies at the headwaters of a number of rivers and burns and displays a range of linear and rounded pool-patterning, although it lacks the extreme flushing of lower Sligachan Glen. The vegetation includes a rich cover and variety of *Sphagnum*, including an abundance of the rare *S. pulchrum* as well as *S. fuscum* and *S. imbricatum*.

Moorhouse - Upper Teesdale (188)

This site extends the representation of blanket bog in the north of England, in the northern Pennines. The site includes the least damaged and most extensive tracts of typical M19 *Calluna vulgaris - Eriophorum vaginatum* blanket mire in England and shows this community type up to its highest altitude in England. This large expanse of peat displays the full range of features typical of the Pennines, with extensive erosion, mainly on higher areas, interspersed with large swathes of bog dominated by heather *Calluna vulgaris* or cottongrass *Eriophorum* species. A few areas display small-scale surface patterning, with distinct *Sphagnum* hollows and intervening ridges. Some parts of the site show characteristics of the western-type Scottish blanket bog, whereas the lichen-rich areas are a feature of bogs in Fenno-Scandia.

Pettigoe Plateau (213)

This is the only extensive lowland area of blanket bog in Northern Ireland. The site contains a large number of well-developed pool complexes, frequent acid flushes and basin mires. The vegetation is a mixture of generally *Sphagnum*-rich mire with cross-leaved heath *Erica tetralix* and *Sphagnum papillosum*, with extensive areas in which deer-grass *Trichophorum cespitosum* and hare's-tail cottongrass *Eriophorum vaginatum* are dominant. A notable floristic feature is the abundance of purple moor-grass *Molinia caerulea* and black bog-rush *Schoenus nigricans* on the bog plain, a characteristic feature of hyper-oceanic lowland blanket bogs. The rare bog mosses *Sphagnum fuscum, S. imbricatum* and *S. pulchrum* occur on the site. Species such as intermediate bladderwort *Utricularia intermedia* and oblong-leaved sundew *Drosera intermedia* are abundant here but are generally absent from other blanket bog areas in Northern Ireland.

Ronas Hill - North Roe (257)

This site on North Roe in Shetland, Scotland, is chosen to represent a distinctive blanket bog type found only in the far north of Scotland, where there is a sub-arctic oceanic climate. The bog type is characterised by large peat mounds, and all stages of mound development can be seen at this site, ranging from early formation, to domes of several metres high, through to collapsed examples and finally crater-pool formations.

Rannoch Moor (92)

This site lies in a high-level basin at about 300 m. Its central location in Scotland is reflected in the gradient of variation in vegetation types that occurs across it. In the west of the site the vegetation has a high proportion of purple moor-grass *Molinia caerulea*, but further east this decreases while the proportion of dwarf-shrubs rises.

Rannoch is a complex blanket bog because much of the active peat is broken up between rocky knolls and small valleys, and there are many small ladder fens, which separate the ombrotrophic units into relatively small compartments. This is the only site in Britain at which the Rannoch-rush *Scheuchzeria palustris* is found.

Slieve Beagh (226)

This is one of the most extensive areas of intact blanket bog in Northern Ireland. It contains a comparatively large area of a mixture of generally *Sphagnum*-rich mire vegetation with cross-leaved heath *Erica tetralix* and *Sphagnum papillosum*, together with deer-grass *Trichophorum cespitosum* and hare's-tail cottongrass *Eriophorum vaginatum* with high dwarf-shrub cover. It is less markedly oceanic than other Northern Ireland sites but has some limited areas of surface patterning

Sligachan Peatlands (258)

This is one of two sites on Skye, Scotland, and is chosen to represent two unusual and distinct mire types. It displays an enormous variety of blanket bog features. The southern half of the site consists of a series of valleyside flows interspersed with flushed blanket mire communities. The high base status of the water means that the blanket bog vegetation of this southern part is extremely rich, containing species such as black bog-rush *Schoenus nigricans* and broad-leaved cottongrass *Eriophorum latifolium* and brown mosses such as *Drepanocladus* spp. The northern part of the site is a broad valley forming a mire complex with extensive areas of pool patterning of a linear type. Slightly more broken ground is largely infilled with accumulated peat and has several unusual peat structures, such as dams of peat over 2 m high that hold back large pools containing pipewort *Eriocaulon aquaticum*, small examples of ladder fens and oddly-shaped pool patterns.

Teal Lough (214)

The site is comparatively small but contains an exceptionally well developed microtopography with the most extensive pool system found in Northern Ireland. The area is similar to the Hebrides bogs with abundant lesser bladderwort *Utricularia minor* and oblong-leaved sundew *Drosera intermedia*. The rare hummock-forming bog mosses *Sphagnum fuscum* and *S. imbricatum* also occur on the site.

Tingon (259)

This site in Shetland is chosen for the diversity of its surface patterning, erosion and other mire features, which cover a substantial tract of ground on the Tingon Peninsula. The vegetation is dominated by cottongrass *Eriophorum* spp., heather *Calluna vulgaris*, deer-grass *Trichophorum cespitosum*, cross-leaved heath *Erica tetralix* and mosses *Sphagnum* spp.

2.7.4 Transition mires and quaking bogs (54.5)

2.7.4.1 Background to selection

This is a widespread but local habitat type in the UK that is ecologically variable and occurs in a wide range of geomorphological contexts. Sites have been chosen to reflect this range and variability. Larger examples have been favoured and these generally have the best conservation of structure and function, particularly of hydrological features.

The term 'transition mire' relates to vegetation that in floristic composition and general ecological characteristics is transitional between acid bog and alkaline fen. The vegetation normally has intimate mixtures of species considered to be acidophile and others thought of as calciphile or basophile. In some cases the mire occupies a physically transitional location between bog and fen vegetation, as for example on the marginal lagg of raised bog or associated with certain valley and basin mires. In other cases these intermediate properties may reflect the actual process of change, as peat accumulates in groundwater-fed fen to produce rainwater-fed bog isolated from groundwater influence. Many of these systems are very unstable underfoot and can therefore also be described as 'quaking bogs'. There is a special type of quaking bog, known as Schwingmoor, in which rafts of vegetation float over semi-liquid substrates, that has also been taken into account in the selection process. Schwingmoors typically have vegetation composed almost entirely of acidophilous species and have been seen as distinct from transition mires, rather than as a subclass of this type.

Transition mires can occur in a variety of situations, related to different geomorphological processes: in floodplain mires, valley bogs, basin mires and the lagg zone of raised bogs, and as regeneration surfaces within mires that have been cut-over for peat or areas of mineral soil influence within blanket bog. Site selection has taken account of this variation by selecting examples from a range of different hydrological and geomorphological situations.

The following NVC types form the core of transition mire vegetation in the UK, but this list is not exhaustive:

M4 *Carex rostrata-Sphagnum recurvum* mire
M5 *Carex rostrata-Sphagnum squarrosum* mire
M9 *Carex rostrata-Calliergon cuspidatum/giganteum* mire
S27 *Carex rostrata-Potentilla palustris* fen

Particular NVC categories are not associated with a given mire type, and at most sites selected a range of these types occurs. Emphasis has been placed upon the selection of sites to cover the range of mire types, although extensive examples of the above NVC communities have been favoured.

2.7.4.2 Site list

Derryleckagh (224)

This site is a large example of an inter-drumlin wetland in Northern Ireland with well-developed transition mire vegetation of the basin mire type. Although a large part of the site is dominated by tall reedswamp, it still contains extensive areas of M9 *Carex rostrata-Calliergon cuspidatum/giganteum* mire dominated by lesser tussock-sedge *Carex diandra*, *Sphagnum contortum* and brown mosses. Within this fen vegetation are well-developed pools and soakaways with marsh St John's-wort *Hypericum elodes* prominent. The site contains several rare or localised invertebrate species.

Insh Marshes (268)

This site in north-east Scotland has been selected as the largest transition mire in the UK. This site is representative of the floodplain mire type. The vegetation is a relatively uniform area of S27 *Carex rostrata-Potentilla palustris* tall-herb fen in which *Sphagnum* is found locally. String sedge *Carex chordorrhiza* is a rare sedge that occurs at this site and only one other, Scottish, site in the UK. It is more frequently found in this mire type in continental Europe.

Rannoch Moor (92)

This site in west Scotland has been selected as an unusual ecological variant of transition mire developing in the midst of blanket bog and containing Rannoch-rush *Scheuchzeria palustris*, at its only known location in the UK. Such vegetation, clearly belonging to the *Scheuchzerietalia palustris* order, is developed in regeneration surfaces within raised and blanket bogs elsewhere in Europe, but in this site Rannoch-rush is also found in situations where the blanket bog is locally influenced by mineral-rich groundwater. The community containing Rannoch-rush has some affinities to the M1 *Sphagnum auriculatum* bog pool community and is a distinctive and unusual type.

Rhos-goch (202)

This site in the Welsh Borders is chosen to give representation of transition mire within the lagg zone of raised bog, demonstrating the transitional nature of this vegetation type, between raised bog and fen. S27 *Carex rostrata-Potentilla palustris* fen and M5 *Carex rostrata-Sphagnum squarrosum* mire are the main components of a series of swamp and mire communities present on the site.

The Broads (166)

This site provides examples of transition mire in a floodplain in the south-eastern part of the UK, where the habitat is rare. The areas of transition mire, mainly of M9 *Carex rostrata-Calliergon cuspidatum/giganteum* mire and S27 *Carex rostrata-Potentilla palustris* fen, are relatively small, having developed in re-vegetated peat-cuttings as part of a complex habitat mosaic of fen, carr and open water.

West Midlands Mosses (172)

This site is chosen to provide representation of Schwingmoor vegetation in the site series. Here floating rafts of *Sphagnum*-dominated vegetation have developed over semi-liquid substrates within basins. In the UK this type of *Sphagnum*-dominated vegetation with a scatter of sedges *Carex* species and cranberry *Vaccinium oxycoccos* is confined to this part of England and mid-Wales.

Whitlaw and Branxholme (171)

Within this site in south-east Scotland transition mires occur as a part of valley mires and basin mires, in complexes of vegetation containing bog and fen vegetation. The vegetation, which is mainly of the M9 *Carex rostrata-Calliergon cuspidatum/giganteum* mire type, is therefore not only floristically intermediate between fen and bog, but occupies transitional positions within vegetation zonations. The site provides an excellent representation of transition mire, being transitional both in vegetation types (especially the occurrence of *Sphagnum* with other, more fen-type, species such as *Carex diandra*) and in hydrological characteristics..

2.7.5 Depressions on peat substrates (*Rhynchosporion*) (54.6)

2.7.5.1 Background to selection

This is a rare habitat type in the UK that exhibits a narrow range of ecological variation and has a restricted geographical distribution. The site list includes the small number of sites supporting extensive habitat mosaics in which this habitat type can be found. This habitat type has a very discontinuous distribution, being found in largest quantity on heaths in southern England, with an outlying example in East Anglia. Site selection has taken this into account.

The *Rhynchosporion* communities of humid, bare or recently exposed peat found on lowland heaths, although rare, occur in three distinct situations, which have been covered in site selection:

in and around the edges of seasonal bog pools, particularly on patterned areas of valley mire,
in flushes on the edges of valley mires in heathlands, and
in areas that are artificially disturbed, such as along footpaths and trackways and in old peat-cuttings and abandoned ditches.

The vegetation is typically very open, often with well developed algal mats, with white beak-sedge *Rhynchospora alba*, the bog moss *Sphagnum auriculatum*, marsh clubmoss *Lycopodiella inundata*, round-leaved sundew *Drosera rotundifolia* and, in relatively base-rich sites, brown mosses such as *Drepanocladus revolvens* and *Scorpidium scorpioides*. The habitat type often occurs in complex mosaics with wet heath and valley mire vegetation, with species that may include great sundew *Drosera longifolia* and bog orchid *Hammarbya paludosa*.

Small, fragmentary stands occur in a range of disturbed contexts in sites not listed below, often covering less than 10 m² and lacking the more notable species such as bog orchid and great sundew, but these have not been considered for selection, on account of their poor quality. *Rhynchosporion* type vegetation can be found on the margins of bog pools in both raised bogs and blanket bogs, but these have been considered to form an integral part of the raised bog and blanket bog habitat types.

2.7.5.2 Site list

Dorset Heaths (279)
Dorset Heaths (Purbeck and Wareham) and Studland Dunes (280)

These sites form one of two locations in southern England chosen because they host a large proportion of the UK resource of this habitat type. It is widespread on the Dorset Heaths, both in bog pools of valley mires and in flushes. There are numerous valley mires within the Dorset Heaths, and the habitat type is most extensively represented here as part of a habitat mosaic. This location shows extensive representation of brown-beak sedge *Rhynchospora fusca* and is also important for great sundew *Drosera longifolia* and bog orchid *Hammarbya paludosa.*

Roydon Common and Dersingham Bog (71)

This site is of importance as an example of this habitat type in eastern England. There are examples of this habitat type present in natural bog pools of patterned valley mire, in flushes on the margins of valley mire and locally in disturbed areas associated with trackways and paths in mire and wet heath. Mosaics containing this habitat type are important for bog orchid *Hammarbya paludosa.*

The New Forest (5)

This site, one of two selected in southern England (where a large part of the UK resource occurs), is considered to hold the largest area of this habitat type, in complex habitat mosaics associated primarily with the extensive valley bogs of this site. The habitat type is developed in all three situations: in natural bog pools of patterned bog surfaces, in flushes on the margins of valley mires and in areas disturbed by peat-digging, footpaths, tracks, ditches etc. In places the habitat type is rich in brown mosses *Cratoneuron* spp. and *Scorpidium scorpioides,* suggesting flushing by mineral-rich waters. The mosaics in which this habitat type occurs are an important location for the bog orchid *Hammarbya paludosa*.

Thursley, Ash, Pirbright and Chobham (68)

This site contains examples of this habitat type in south-east England, where it occurs as part of a mosaic associated with valley bog and wet heath. The vegetation is found in natural bog pools of patterned valley mire and in disturbed peat of trackways and former peat-cuttings.

2.7.6 *Calcareous fens with *Cladium mariscus* and *Carex davalliana* (53.3)

This title is that which appears in the published version of the Directive. The revised name "Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*" is given in DGXI (1996), to take account of the fact that *Carex davalliana* is extinct in the UK.

2.7.6.1 Background to selection

This habitat type occurs throughout the EC, except Denmark and Greece, but it is rare and is identified as a priority habitat type. Site selection for this habitat type takes account of the fact that it is a priority habitat that is rare in the UK and has a limited and discontinuous geographical range. The sites selected include a very high proportion of all examples of the habitat type in the UK.

This priority habitat type comprises the more species-rich examples of great fen-sedge *Cladium mariscus* fen, particularly those stands enriched with elements of the *Caricion davallianae* (i.e. small sedge fen - fen with open, low-growing sedge vegetation). Such stands occur in the following situations, which have been taken into account in site selection:

sites with a mixture of closed, species-poor *Cladium* beds, which at their margins have transitions to species-rich small sedge mire vegetation;
Sites where *Cladium* beds retain their species-richness owing to management.
Situations where *Cladium* fen is inherently species-rich, possibly owing to the fact that conditions do not allow the *Cladium* to grow vigorously and dominate the vegetation.

At most sites several of these types are found as complex mosaics with other fen types, and in most cases the species-rich stands are less extensive than species-poor *Cladium* vegetation. Site selection has favoured those sites where the *Cladium* stands are most extensive and show the widest range of habitat conditions in which species-rich *Cladium* vegetation occurs (see above), and also takes account of the range in hydrological situations (from floodplain mires and isolated spring-fed systems through to valley fens) and the geographical range of the vegetation in the UK. In this context it should be noted that this habitat type has two main centres of distribution, the Broads of East Anglia and, to a lesser extent, the fen systems of Anglesey. This vegetation is very scattered and local elsewhere. The other sites selected cover the range of distribution of this type and represent the range of hydrological situations in which this fen is found.

The site list includes the largest surviving examples of the habitat type. Other sites where *Cladium* is found are mainly small, isolated, species-poor habitat fragments, as for example in drainage ditches of various grassland sites and in heathlands, where stands are more extensive than at grassland sites but are more species-poor. These sites have therefore not been selected.

2.7.6.2 Site list

Corsydd Môn/Anglesey Fens (96)

The individual sites comprising this complex hold the second largest area of this habitat type in the UK. In some parts the low vigour of *Cladium* accounts for the species-richness of the vegetation, but elsewhere management maintains species-richness. There are stands of species-poor *Cladium* fens present adjoining areas of species-rich fen with species-rich contact zones between the communities. In places, a *Cladium-Molinia* community has developed through partial lowering of the water table.

Crymlyn Bog/Cors Crymlyn (97)

This site embraces the more acid range of variation of this habitat type and is relatively species-poor. It is one of the largest sites for *Cladium* in south Wales. There are large stands of *Cladium*, with transitions to a highly distinctive suite of tall-herb fen communities, often dominated to varying degrees by common reed *Phragmites australis*. The area is also important for the occurrence of a substantial population of the rare slender cottongrass *Eriophorum gracile*.

Holme Moor and Clean Moor (95)

This is a small site, compared to others listed, but it is important as an outlier of the habitat type in south-west England, where *Cladium* is a local and rare species. The site occupies an unusual ecological situation on the spring line at the foot of a scarp slope. Although not currently managed, management continued until comparatively recently and in part explains the high species-richness of this site. There are important species-rich transitions to mire, with black bog-rush *Schoenus nigricans* and blunt-flowered rush *Juncus subnodulosus* as well as fen-meadow vegetation with purple moor-grass *Molinia caerulea* and meadow thistle *Cirsium dissectum.*

The Broads (166)

This floodplain mire site in East Anglia, in eastern England, has the largest example of this habitat type in the UK and possibly the largest occurrence in the EC outside Sweden. The *Cladium* habitat occurs in a diverse set of conditions that maintain its species richness, including managed *Cladium* fen, contacts between *Cladium* beds and small sedge mires, and situations where *Cladium* occurs at the limits of ecological vigour. The habitat type forms large-scale mosaics with other fen types, open water and woodland, and important associated plant species are the fen orchid *Liparis loeselii* (found at Upton Fen), marsh helleborine *Epipactis palustris*, lesser tussock-sedge *Carex diandra*, slender sedge *Carex lasiocarpa* and fibrous tussock-sedge *Carex appropinquata.*

Waveney and Little Ouse Valley Fens (94)

This site occurs in the East Anglia centre of distribution of this habitat type in eastern England and contains very extensive *Cladium* beds, including managed examples, as well as stands in contact zones between small sedge mire and species-poor *Cladium.* The habitat type here occurs in a different hydrological situation to the Broads - spring-fed valley fen rather than floodplain mire.

2.7.7 *Petrifying springs with tufa formation (*Cratoneurion*)** (54.12)

2.7.7.1 Background to selection

This priority habitat type is associated with hard water springs and is found in a number of EC Member States, in diverse environments from forests to open countryside. In the UK it occurs as small scattered flushes, and the total area of the habitat type is small. Sites have been selected to encompass the geographical range and ecological variation of this habitat type and to take account of its priority status. The sites selected contain the most important concentrations of these flushes in the UK and encompass a high proportion of the total UK resource.

Tufa formation is a relatively rare phenomenon in the UK. It is associated with areas where groundwater rich in calcium bicarbonate comes to the surface. On contact with the air, carbon dioxide is lost from the water and a hard deposit of calcium carbonate (tufa) is formed. These conditions occur most often in areas underlain by limestone or other calcareous rock types, and particularly in the uplands of northern England and the Highlands of Scotland. The site list reflects this pattern of distribution, and there is a concentration of selected sites in the Carboniferous limestones of northern England, where a high proportion of the habitat type is found.

Tufa-forming spring-heads are characterised by the swelling yellow-orange mats of the mosses *Cratoneuron commutatum* and *C. filicinum*. Many rare, lime-loving (calcicole) species live in the moss carpet, particularly arctic-alpine species. The sites chosen are those containing a rich flora and include sites that support a wide range of rare and local calciphile species, such as bird's-eye primrose *Primula farinosa,* Scottish asphodel *Tofieldia pusilla,* alpine bartsia *Bartsia alpina* and false sedge *Kobresia simpliciuscula*.

There are two main NVC communities associated with tufa formation, and both communities occur at most of the selected sites:

M37 *Cratoneuron commutatum-Festuca rubra* spring
M38 *Cratoneuron commutatum-Carex nigra* spring

The former is widely distributed, while the latter is found only at moderate to high altitudes and has a flora especially rich in rare arctic-alpine species, best developed in Upper Teesdale and Scotland.

Tufa-forming springs are often associated with alkaline fens, where they may form prominent up-welling masses of short open vegetation around the spring-heads that feed the fen system. There are also transitions between petrifying springs and a wide range of communities, particularly calcareous grassland, acid grassland, heath and calcareous limestone pavement, cliff and scree. This range of variation in ecological context is covered by the site series.

Tufa also forms in some highly calcareous lowland alkaline fens in the south of Britain, but these fens are not considered to fall within the *Cratoneurion* in terms of their detailed floristic composition.

2.7.7.2 Site list

Asby Complex (192)

This is one of three sites selected on Carboniferous limestone in northern England. Sunbiggin Tarn and Moors is considered to be the most important site in Britain for springs with tufa formation, owing to the extent of the habitat type and the degree of conservation of spring-head structures. Nearby, Crosby Gill has areas of tufa with transitions to **Alkaline fen** and holds good populations of alpine bartsia *Bartsia alpina.* Large tufa mounds formed around spring-heads are frequent. There are transitions to a range of alkaline fens, calcareous grasslands and acid heath.

Cairngorms (209)

This is one of two sites selected for tufa-forming springs in north-east Scotland and it is representative of the habitat type in the uplands of this part of the UK. The springs occur particularly at Inchrory, where there is an extensive series of springs associated with metamorphosed limestones and calc-schists. There are transitions to alkaline fens, species-rich mat-grass *Nardus stricta* grassland and more acidic grassland and heath communities.

Craven Limestone Complex (190)

This is one of three Carboniferous limestone sites in northern England selected for this habitat type. The site contains extensive complexes of tufa-forming springs associated with a wide range of other habitats, including alkaline fens, calcareous grasslands, limestone pavements, cliffs and screes. Locally calcareous springs emerge within areas of acid drift supporting heath and acid grassland. The flora of these habitat mosaics is outstandingly species-rich and includes many rare northern species, such as alpine bartsia *Bartsia alpina* and bird's-eye primrose *Primula farinosa.*

Creag nan Gamhainn (167)

Creag nan Gamhain is one of two sites in north-east Scotland and is selected as an example of petrifying springs with tufa formation occurring in woodland. Although this situation is unusual in the UK, the habitat type is found in similar woodland situations in Fenno-Scandia.

Hoy (67)

This site is chosen to represent tufa-forming springs at the northern edge of the habitat type's range in the UK. A series of *Cratoneurion* springs occurs on a slope fed by calcareous water derived from calcium carbonate bands within Old Red Sandstone. Tufa formation also takes place within alkaline fens, owing to flushing by strongly calcareous waters. There are floristically unusual communities with black bog-rush *Schoenus nigricans* and yellow saxifrage *Saxifraga aizoides*.

Inchnadamph (65)

The tufa-forming springs on Durness limestone at Inchnadamph are considered to be the best examples in the north-west Highlands on account of their overall extent and the intact nature of the springs. They are formed on the slopes below massive outcrops of Durness dolomite. Petrifying springs occur at relatively low altitude at this site.

Moor House - Upper Teesdale (188)

This is one of three sites in northern England that have extensive series of petrifying springs. At this site the Carboniferous limestones are thinly bedded amidst shales, sandstones and slates. Tufa springs often occur at the junction between limestone and these other, less permeable, rocks at a range of altitudes. Tufa springs are associated with calcareous glacial drift and can be found in calcareous grasslands, in fen systems of grazed pastures, associated with limestone scar cliffs and screes and amidst acid heathland and grassland. The flora is exceptionally rich and includes rare northern species such as bird's-eye primrose *Primula farinosa* and Scottish asphodel *Tofieldia pusilla*.

Strath (63)

This is one of two sites in north-west Scotland where this habitat type occurs at low altitude. The habitat type is associated with Durness dolomite and the springs are scattered within a complex of alkaline fen, calcareous grassland, limestone pavement, birch-hazel woodland and calcareous open water. This site is representative of the habitat type at its extreme western geographical limit in the UK.

2.7.8 Alkaline fens (54.2)

2.7.8.1 Background to selection

A significant proportion of the **Alkaline fen** surviving in the EC is believed to occur in the UK and Sweden. In the UK it is a widely scattered but local habitat, encompassing a wide range of ecological variation. Fen vegetation has declined dramatically in the past century in the UK, as in other parts of Europe, and in many parts of the country only small, fragmentary examples occur. Site selection has taken account of geographical range and ecological variation and has given consideration to the limited area now covered by alkaline fen as well as the UK's responsibility for protection of this habitat type.

Alkaline fen consists of a complex assemblage of vegetation types characteristic of sites where there is tufa or peat formation with a high water table and a calcareous base-rich water supply. The core vegetation is short sedge mire (mire with low-growing sedge vegetation) of the following NVC types, and selection has favoured sites where these types are well represented:

M9 *Carex rostrata-Calliergon cuspidatum/giganteum* mire
M10 *Carex dioica-Pinguicula vulgaris* mire
M13 *Schoenus nigricans-Juncus subnodulosus* mire

At most sites there are well-marked transitions to a range of other fen vegetation, predominantly, but not exclusively, the NVC communities M14 *Schoenus nigricans-Narthecium ossifragum* mire and S24 *Phragmites australis-Peucedanum palustre* tall-herb fen. These may occur with various types of reed swamp (such as species-poor stands of great fen-sedge *Cladium mariscus*), wet grasslands (particularly various types of purple moor-grass *Molinia caerulea* grassland) and areas rich in rush *Juncus* species, fen carr and, in some cases, transitions to wet heath and acid bogs.

There is also considerable variation between sites in the types of associated communities and the transitions that may occur. Such variation can be broadly classified by the geomorphological situation in which the fen occurs, namely: floodplain mire, valley mire, basin mire, hydroseral fen (i.e. as zones around open water bodies) and spring fen. The site list includes examples of each of these geomorphological types.

Fens occur over a relativley wide geographical range in the UK, but the resource is unevenly distributed, with important concentrations of the habitat type in East Anglia, in northern England and on Anglesey in north Wales. This distribution is reflected in the site list.

Another important source of ecological variation is altitude, with significant differences between lowland fens, which are rich in southern and continental species, and upland fens, which are rich in northern species. The site series takes account of this variation related to altitude. The site list encompasses the larger sites, where the hydrology tends to be least modified by human activity and which show the most intact structure and function.

2.7.8.2 Site list

Asby Complex (192)

This is one of two upland sites in northern England where there are extensive flushes of M10 *Carex dioica-Pinguicula vulgaris* mire amidst moorland and grassland. An important example in the fen site series of hydroseral fen community occurs on the lake margins in the vicinity of Sunbiggin Tarn. There are also lake-side transitions to reedswamp vegetation. Away from the lake the site has an exceptionally rich flora and contains a number of rare and local northern plant species, such as bird's-eye primrose *Primula farinosa*.

Corsydd Môn/Anglesey Fens (96)

This series of lowland fens in north Wales contains a large and diverse range of short sedge mire, including extensive stands of M13 *Schoenus nigricans-Juncus subnodulosus* mire community. These are considered to be of pre-eminent importance in the UK, owing to their extent and species-richness, which encompasses an exceptionally rich assemblage of orchid species. The fens are mainly of the valley mire type, although very locally there are hydroseral fens and isolated flushes. There are complex zonations of vegetation, with a series of communities including *Cladium* swamp, fen, *Molinia* grasslands and fen carr. The fens contain a number of

rare and local plant species that have a mainly southern distribution, such as fly-orchid *Ophrys insectifera* and columbine *Aquilegia vulgaris*.

Cothill Fen (98)

This lowland valley mire contains one of the largest surviving examples of fen vegetation in central England, a region where fen vegetation is rare. The M13 *Schoenus nigricans-Juncus subnodulosus* vegetation found here occurs under a wide range of hydrological conditions, with frequent bottle sedge *Carex rostrata,* grass-of-Parnassus *Parnassia palustris,* common butterwort *Pinguicula vulgaris* and marsh helleborine *Epipactis palustris*. The alkaline fen vegetation forms transitions to other vegetation types that are similar to M24 *Molinia caerulea-Cirsium dissectum* fen-meadow and S25 *Phragmites australis-Eupatorium cannabinum* tall-herb fen and wet alder *Alnus* spp. wood.

Moor House - Upper Teesdale (188)

This is one of two upland sites in northern England to have been selected. Spring-fed flush fens of the M10 *Carex dioica-Pinguicula vulgaris* community are widespread on the moors amidst calcareous grassland, limestone scars, heath and bog, in enclosed pastures amidst a range of acid and calcareous grasslands and in meadows, often as part of complex vegetation mosaics. The site has an exceptionally important rare plant flora associated with flush vegetation, including species such as bird's-eye primrose *Primula farinosa* and Scottish asphodel *Tofieldia pusilla*. On the highest and coldest parts of the site fen grades into the **Alpine pioneer formations of *Caricion bicoloris-atrofuscae*** habitat type, and intermediate examples occur.

Newham Fen (99)

This site is important as a lowland short sedge fen in north-east England, a part of the UK in which this habitat type is rare. The site is an example of basin fen, developed from the hydroseral succession of a small lake. The main fen community is M13 *Schoenus nigricans-Juncus subnodulosus* and M9 *Carex rostrata-Calliergon cuspidatum/giganteum* type, and there are transitions to S25 *Phragmites australis-Eupatorium cannabinum* fen, MG1 *Arrhenatherum elatius* grassland and W26 *Salix cinerea-Betula pubescens-Phragmites australis* fen carr woodland. A number of rare species occur at this site, including narrow-leaved marsh-orchid *Dactylorhiza traunsteineri,* coralroot orchid *Corallorhiza trifida,* dark-leaved willow *Salix myrsinifolia* and round-leaved wintergreen *Pyrola rotundifolia.*

Norfolk Valley Fens (101)

This site is one of two sites selected in East Anglia, in eastern England, where the main concentration of lowland fen occurs. This site comprises a series of valley-head spring-fed fens. Such spring-fed flush fens are very rare in the lowlands. Most of the vegetation at this site is of the small sedge fen type, mainly referable to the M13 *Schoenus nigricans-Juncus subnodulosus* community, but there are transitions to reedswamp and other fen and wet grassland types. The individual fens vary in their structure according to intensity of management and provide a wide range of variation. There is a rich flora associated with these fens, including species such as grass-of-Parnassus *Parnassia palustris,* common butterwort *Pinguicula vulgaris,* marsh helleborine *Epipactis palustris* and narrow-leaved marsh-orchid *Dactylorhiza traunsteineri.*

The Broads (166)

This is one of two alkaline fen sites in East Anglia, in eastern England, where a main concentration of lowland fen occurs. There are areas of short sedge fen (mainly M9 *Carex rostrata-Calliergon cuspidatum/giganteum* mire), which in places form a mosaic with S24 *Phragmites australis-Peucedanum palustris* fen. There are complex zonations present and many differences exist between the individual fens that comprise the site. The fens are principally of the floodplain mire type. The site contains a range of rare and local plant species, including fen orchid *Liparis loeselii,* lesser tussock-sedge *Carex diandra* and slender sedge *Carex lasiocarpa.*

Tulach Hill and Glen Fender Meadows (100)

This site in the southern Highlands of Scotland is the most northerly fen within the site series and has extensive spring-fed alkaline fens associated with limestone-rich drift. This is the most extensive and species-rich alkaline fen system in Scotland. The main community present is M10 *Carex dioica - Pinguicula vulgaris* type, with some M9 *Carex rostrata - Calliergon cuspidatum/giganteum* mire developed as basin mire in hollows. The

predominant *Carex* - *Pinguicula* mires occur in mosaics with local open flushes of the M11 *Carex demissa* - *Saxifraga aizoides* type. The fens occur in a complex topography, with drier and wetter habitats and well developed zonations to dry and flushed calcareous, acid and neutral grasslands, acidic species-poor fen, ericaceous sub-shrub heath and species-rich fen meadow. It is representative of the northerly variants of the habitat type and supports a rich assemblage of rare northern fen species, such as Scottish asphodel *Tofieldia pusilla* and false-sedge *Kobresia simpliciuscula*, with other arctic-alpine and northern species, including hair sedge *Carex capillaris*, alpine meadow rue *Thalictrum alpinum* and marsh hawk's beard *Crepis paludosa*.

2.7.9 *Alpine pioneer formations of *Caricion bicoloris-atrofuscae* (54.3)

2.7.9.1 Background to selection

In the UK this priority habitat type is rare and is largely restricted to the Scottish Highlands, where it is relatively widespread, although there is a southern outlier in Moor House - Upper Teesdale. Selection has covered the range of ecological and geographical variation of the habitat type. The habitat type is rarely extensive but is important as a habitat for some of the rarest plant species in the UK. The largest and most diverse examples of the habitat type and those with best developed structure and function have been selected. Large upland sites are most likely to have a variety of different flush types within them and this is reflected in the site list.

Alpine pioneer formations of *Caricion bicoloris-atrofuscae* is a type of flush mire that occurs only at high altitude. The plant communities colonise open substrates that are constantly flushed by surface seepage of cold, base-rich water. They are one of the few natural plant communities in the UK and are maintained by harsh climatic and soil conditions.

The vegetation consists of mixtures of small sedges, rushes, small herbs and bryophytes and includes many arctic-alpine species. High altitude stands of three NVC communities, enriched by arctic-alpine elements, fall within the definition of this habitat type:

M10 *Carex dioica-Pinguicula vulgaris* mire
M11 *Carex demissa-Saxifraga aizoides* mire
M12 *Carex saxatilis* mire.

There is variation in this habitat type because of differences in altitude, geographic location, length of snow-lie, nature of the substrate and the amount of water flushing the communities. The habitat type is characterised by the presence of a number of rare species. These include scorched alpine-sedge *Carex atrofusca,* bristle sedge *C microglochin,* alpine rush *Juncus alpinoarticulatus,* chestnut rush *J. castaneus,* two-flowered rush *J. biglumis,* three-flowered rush *J. triglumis,* false sedge *Kobresia simpliciuscula* and Scottish asphodel *Tofieldia pusilla*. Other uncommon species may occur, such as hair sedge *Carex capillaris,* sheathed sedge *C. vaginata* and variegated horsetail *Equisetum variegatum.* There is a range of calcicolous mosses, some of which are rare. A number of commoner species are also characteristic of the habitat type. These include yellow sedge *Carex viridula,* carnation grass *C. panicea,* flea sedge *C. pulicaris,* russet sedge *C. saxatilis,* jointed rush *Juncus articulatus,* common butterwort *Pinguicula vulgaris,* yellow saxifrage *Saxifraga aizoides,* alpine bistort *Persicaria vivipara,* alpine meadow-rue *Thalictrum alpinum* and the moss *Blindia acuta.* The sites have been selected to include the most important sites for the rare species that characterise this habitat type in the UK. Larger examples of the habitat type have been selected in order to include the most extensive populations of the commoner species.

This habitat type usually forms mosaics and shows complex transitions to other upland Annex I habitat types.

2.7.9.2 Site list

Beinn a'Ghlo (124)

This site is representative of flushes at moderate altitude in the eastern Highlands. Open flushes of M11 *Carex demissa - Saxifraga aizoides* mire are frequent, and species include yellow saxifrage *Saxifraga aizoides*, Scottish asphodel *Tofieldia pusilla,* three-flowered rush *Juncus triglumis* and alpine rush *J. alpinoarticulatus*. The site is of particular interest because of the transitions between alpine pioneer flushes and alkaline fens at moderate altitudes.

Beinn Dearg (104)

This site is representative of the flush communities found at high altitude in the north-west Highlands. Although the extent of the communities present is restricted, they are the most diverse and best developed in this part of Scotland. M12 *Carex saxatilis* mire is frequent, with Scottish asphodel *Tofieldia pusilla*, two-flowered rush *Juncus biglumis*, three-flowered rush *J. triglumis* and chestnut rush *J. castaneus*. Open, stony flushes of the M11 *Carex demissa - Saxifraga aizoides* mire are also well represented.

Ben Alder and Aonach Beag (120)

This site is representative of high altitude flushes in the central Highlands. Both open flushes of M11 *Carex demissa - Saxifraga azoides* mire and more closed flushes of M12 *Carex saxatilis* mire are well represented. Although this is a relatively small site, the flushes are well developed and are notable for the occurrence of the rare scorched alpine-sedge *Carex atrofusca*, which is known to occur in only two other locations in the site series. Other characteristic species include three-flowered rush *Juncus triglumis*, Scottish asphodel *Tofieldia pusilla*, sheathed sedge *Carex vaginata*, alpine bistort *Persicaria vivipara* and the moss *Blindia acuta*. Other uncommon species include hair sedge *Carex capillaris* and alpine cat's-tail *Phleum alpinum*.

Ben Heasgarnich (106)

This is one of three sites representing the range of variation up to high altitude in the Breadalbane range in the southern Highlands of Scotland. High-altitude mires are frequent on the site and include both open types of M11 *Carex demissa - Saxifraga aizoides* mire and more closed types of M12 *Carex saxatilis* mire. Rarer species present include scorched alpine-sedge *C. atrofusca*, false sedge *Kobresia simpliciuscula*, variegated horsetail *Equisetum variegatum*, chestnut rush *Juncus castaneus* and two-flowered rush *J. biglumis*.

Ben Lawers (103)

This is one of three sites representing the range of variation at high altitude in the Breadalbane range in the southern Highlands of Scotland. Ben Lawers is considered to be the most important site for this habitat type in the UK because the extent and diversity of high altitude mires present here is greater than on any other site in the UK. M12 *Carex saxatilis* mires are especially frequent, with more open, stony M11 *Carex demissa - Saxifraga aizoides* mires also common. The site supports the most abundant populations in Scotland of the rarer but characteristic species of the habitat type. These include two-flowered rush *Juncus biglumis*, bristle sedge *Carex microglochin* and scorched alpine-sedge *C. atrofusca*. Chestnut rush *Juncus castaneus* and hair sedge *Carex capillaris* are also frequent.

Ben Lui (105)

This site is one of three representing the range of variation at high altitude in the Breadalbane range in the southern Highlands of Scotland. High-altitude mires are frequent on the site and include both open types with M11 *Carex demissa - Saxifraga aizoides* mire and more closed types with M12 *Carex saxatilis* mire. The rare false sedge *Kobresia simpliciuscula*, Scottish asphodel *Tofieldia pusilla* and two-flowered rush *Juncus biglumis* are present. The rarer flush bryophytes *Catascopium nigritum, Meesia uliginosa, Timmia norvegica, Harpanthus flotovianus* and *Tritomaria polita* are well represented.

Caenlochan (78)

Caenlochan is one of two sites representing base-rich mires at moderately high to high altitude in the eastern Highlands. Mires are frequent within the site and have a high species diversity. There is a well developed community structure and the rarer species occur frequently. Open flushes of M11 *Carex demissa - Saxifraga azoides* mire and the closed M10 *Carex dioica - Pinguicula vularis* mire are both widely developed. Characteristic species include three-flowered rush *Juncus triglumis*, chestnut rush *J. castaneus*, alpine rush *J. alpinoarticulatus*, Scottish asphodel *Tofieldia pusilla*, sheathed sedge *Carex vaginata*, hair sedge *C. capillaris*, alpine bistort *Persicaria vivipara* and alpine meadow-rue *Thalictrum alpinum.* An additional interest is the presence of an eastern outlier of the mainly western M12 *Carex saxatilis* mire.

Cairngorms (209)

This is one of two sites representing the communities found on base-rich mires at moderately high altitude in the eastern Highlands of Scotland. Within the Cairngorms complex these flushes are restricted in extent, occurring mainly in the Inchrory area, with a small representation in Glen Feshie. Despite this restricted distribution, the flushes are well developed. They contain a range of characteristic species, including yellow saxifrage *Saxifraga aizoides*, Scottish asphodel *Tofieldia pusilla*, three-flowered rush *Juncus triglumis* and alpine rush *J. alpinoarticulatus*. The main community type present is M11 *Carex demissa - Saxifraga azoides* mire.

Moor House - Upper Teesdale (188)

This site in northern England is the largest and most diverse example of the habitat type south of the Highlands. It is included as a southern outlier with an extensive area of the habitat type. The site is a southern outpost for many of the rarer arctic-alpine plants characteristic of this habitat type and has a unique relict mountain flora. Teesdale sandwort *Minuartia stricta* is restricted to Upper Teesdale, and other rare species found in this habitat type include false sedge *Kobresia simpliciuscula*, hair sedge *Carex capillaris* and Scottish asphodel *Tofieldia pusilla*. The community types represented are M10 *Carex dioica - Pinguicula vulgaris* mire and M11 *Carex demissa - Saxifraga aizoides* mire.

Morrone Birkwood (102)

Morrone Birkwood is representative of low-altitude flushes in the eastern Highlands of Scotland, which, unusually, support this upland vegetation type. The mires have developed at relatively low altitude on northerly slopes. Although they are not extensive they are undisturbed and have good structure and function. Open flushes of M11 *Carex demissa - Saxifraga aizoides* mire are frequent, and species include yellow saxifrage *Saxifraga aizoides*, Scottish asphodel *Tofieldia pusilla* and alpine rush *Juncus alpinoarticulatus*.

Section 2.8: Rocky habitats and caves

2.8.1 Siliceous scree (61.1)

2.8.1.1 Background to selection

Scree habitats consist of rock fragments covering the frost-shattered summits of mountains or accumulating on slopes below cliffs. Siliceous screes are made up of siliceous rocks such as quartzite, granite and sandstone. They may occur from low to high altitude. The scree is colonised by a range of pioneer species, such as brittle bladder-fern *Cystopteris fragilis*. It also provides shelter for many species sensitive to frost, such as Wilson's filmy fern *Hymenophyllum wilsonii*, or to grazing, such as stone bramble *Rubus saxatilis*. Screes in the UK provide a habitat for plant communities with affinities to the *Thlaspietalia rotundifolia*, as described from continental Europe. Both eutric scree and siliceous scree are important for their rich fern flora and act as refugia for a number of rare species.

Sites have been selected to encompass the range of geographical, geological and ecological variation of the habitat type in the UK. Generally the largest and most diverse examples with the best developed structure are selected. Low-altitude, oceanic and upland scree and high-altitude, snow-influenced scree have been included.

Floristically the habitat type is characterised by two NVC types in which both parsley fern *Cryptogramma crispa* and other ferns are prominent:

U18 *Cryptogramma crispa-Athyrium distentifolium* snow-bed community occurs principally above 600 m in the Scottish Highlands, where prolonged snow-cover provides suitable conditions for alpine lady-fern *Athyrium distentifolium*, the rare Newman's lady-fern *Athyrium flexile* and other montane vascular plants, bryophytes and lichens.

U21 *Cryptogramma crispa-Deschampsia flexuosa* community extends to lower altitudes in mild oceanic climates in western Scotland, north-west England and north Wales and has a less well developed montane flora.

Other forms of siliceous scree are dominated by bryophytes and lichens and are not covered by the NVC. In the west and, more locally at high altitude, in the eastern Highlands of Scotland, such screes provide an important habitat for Atlantic bryophytes, such as *Anastrophyllum donnianum*, *Bazzania pearsonnii*, *Herbertus aduncus*, *Scapania nimbosa* and *Scapania ornithopodiodes*, many of which have a restricted world distribution. These variants have been taken into account in site selection.

Stabilised block screes may support vegetation proposed for selection as Annex I habitat types in their own right, such as **Chasmophytic vegetation**, and often support a diverse range of micro-habitats.

2.8.1.2 Site list

Ben Nevis (123)

Ben Nevis is representative of high altitude siliceous scree occurring in the north-west Highlands of Scotland. The site contains extensive screes of quartzite and granite, with the most extensive known development in the UK of snow-bed screes with parsley fern *Cryptogramma crispa*, alpine lady-fern *Athyrium distentifolium* and other ferns. The screes found in the site are diverse, with a range of characteristic species. There is an abundance of acid rock-loving species in high-altitude glacial troughs, corries and on summit ridges. These include a number of montane bryophytes and arctic-alpine vascular plants, such as curved wood-rush *Luzula arcuata*, wavy meadow-grass *Poa flexuosa*, hare's-foot sedge *Carex lachenalii*, alpine tufted hair-grass *Deschampsia alpina*, starwort mouse-ear *Cerastium cerastoides*, alpine speedwell *Veronica alpina* and highland saxifrage *Saxifraga rivularis*.

Cairngorms (209)

The Cairngorms complex contains representative examples of the high altitude siliceous scree communities characteristic of the eastern Highlands of Scotland. Extensive areas of scree occur on granite at a range of altitudes in the Cairngorms. The scree communities in this site are very diverse. Of particular interest is the flora of high-altitude screes in the snowy corries, with parsley fern *Cryptogramma crispa*, alpine lady-fern

Athyrium distentifolium and rare wavy meadow-grass *Poa flexuosa*. The flora is rich in rare moss species, including *Kiaeria starkei* and *Dicranum glaciale*, and rare liverworts, such as *Tetralophozia setiformis* and *Marsupella adusta.* These occur on rocks in and about the snow-beds. There are also several northern Atlantic bryophytes such as *Scapania nimbosa, S. ornithithpodiodes* and *Anastrophylum donnianum,* which are restricted to areas of late snow-lie where they are protected from winter frosts.

Eryri/Snowdonia (118)

Eryri/Snowdonia is representative of the habitat type in Wales and is the most southerly site to have been selected. The site has extensive screes of igneous rocks with large stands of U21 *Cryptogramma crispa-Deschampsia flexuosa* vegetation; associated species include fir clubmoss *Huperzia selago*. Bryophyte and lichen-dominated screes are also well represented and include important populations of rare and local montane and oceanic species, such as *Marsupella adusta*, *M. stableri* and *Cornicularia narmoerica.*

Glen Coe (126)

Glen Coe is representative of communities on the siliceous screes developed on igneous rocks at a range of altitudes in the western Highlands of Scotland. The characteristic species parsley fern *Cryptogramma crispa* occurs throughout the site, although it tends to be found with alpine lady-fern *Athyrium distentifolium* in snowy corries at high altitude. There is an abundance of ferns on the boulder screes within the site. These include lemon-scented fern *Oreopteris limbosperma*, while a number of oceanic species including Wilson's filmy-fern *Hymenophyllum wilsonii* are also present. Atlantic mosses and liverworts such as *Anastrophylum donianum* and *Scapania nimbosa* are also abundant in screes on steep, shady, humid slopes. The rare Highland saxifrage *Saxifraga rivularis* occurs in scree at high altitude.

Helvellyn and Fairfield (127)

This complex is representative of the siliceous scree communities found at high altitude in north-west England. The site has the most extensive development of screes with parsley fern *Cryptogramma crispa* in the UK. The rock, Borrowdale volcanics, varies much in base status, but the screes are chiefly base-poor. The communities are well developed and diverse, with a range of characteristic species, including an abundance of alpine lady's-mantle *Alchemilla alpina.* Stone bramble *Rubus saxatilis* is present, and the screes provide a suitable micro-climate for many oceanic moss and liverwort species such as *Scapania ornithopodiodes* and *Kiaeria starkei.*

Loch Maree Complex (173)

Loch Maree is representative of communities on siliceous scree, mainly of quartzite and sandstone, in north-west Scotland. Screes are extensive and the communities they support are well developed and diverse, with a range of characteristic species. Parsley fern *Cryptogramma crispa* is locally abundant, northern rock-cress *Arabis petraea* is frequently found and alpine lady-fern *Athyrium distentifolium* occurs in high-altitude areas where snow lingers. Other ferns occur frequently on the screes, where they include mountain male-fern *Dryopteris oreades*, beech fern *Phegopteris connectilis*, lemon-scented fern *Oreopteris limbosperma* and the oceanic Wilson's filmy-fern *Hymenophyllum wilsonii*. The most outstanding feature of the vegetation on these sites is the abundance of northern Atlantic mosses and liverworts, which include *Plagiochila spinulosa, Anastrophyllum donnianum* and *Scapania nimbosa,* which are chiefly developed on steep, shady and humid slopes. The screes form a significant part of the habitat complex on this site, and it is the most important single area in the UK for communities of these lower plants.

Moor House - Upper Teesdale (188)

Moor House - Upper Teesdale is representative of the communities developed on both low and high altitude siliceous screes in northern England. Screes are extensive, with diverse plant communities. Cross Fell is a southern outlier of high-altitude gritstone scree, with a flora including rare lichens and some widespread montane vascular plants. Ferns including parsley fern *Cryptogramma crispa* and holly fern *Polystichum lonchitis* occur on extensive whin-sill screes at lower altitudes.

2.8.2 Eutric scree (61.2)

2.8.2.1 Background to selection

Scree habitats consist of rock fragments covering the frost-shattered summits of mountains or accumulating on slopes below cliffs. Eutric screes consist of calcareous or base-rich rocks and include limestone, calcareous-schists and the more basic igneous rocks, such as serpentine and basalt. The scree is colonised by a range of pioneer species and provides shelter for many species sensitive to frost or grazing. Similar species may be found in the habitat known as fell field. Screes in the UK provide a habitat for various plant communities with affinities to the *Thlaspietalia rotundifolia* described from continental Europe.

Such areas are widely distributed in uplands in the UK, but are local in their occurrence. Sites have been selected to take account of the importance of the habitat type as a refugium for rare plant species and to cover the ecological and geological variation of the habitat type and its geographical range. Sites with the largest and most diverse examples of scree vegetation have been selected, and consideration has been given to the range of variation from low to high altitude. Large upland sites generally contain more varied and extensive examples of the habitat type, and this is reflected in the site series. Sites that host important populations of arctic-alpine species have been favoured in the selection process.

The vegetation consists of assemblages of calcicole and basophile species, the composition of which is heavily influenced by altitude. Characteristic species at high altitude include purple saxifrage *Saxifraga oppositifolia*, holly-fern *Polystichum lonchitis* and alpine meadow-grass *Poa alpina*, while at lower altitudes limestone fern *Gymnocarpium robertianum*, herb-Robert *Geranium robertianum* and wall lettuce *Mycelis muralis* are more usual. A large number of calcicolous mosses occur in the habitat type. Some low-lying examples are referable to the NVC community OV38 *Gymnocarpium robertianum-Arrhenatherum elatius*, but other forms of eutric scree vegetation have no NVC equivalents. The selected sites encompass this range of ecological variation.

2.8.2.2 Site list

Caenlochan (78)

This site is representative of the communities developing on eutric screes at high altitude in the eastern Highlands of Scotland. Although the habitat type is localised within the site, Caenlochan has a variety of different screes with an unusual flora. Fern-rich screes on calcareous-schist rocks support holly-fern *Polystichum lonchitis*, buckler-fern *Dryopteris* spp., roseroot *Sedum rosea* and mountain sorrel *Oxyria digyna*, while porphyritic screes have alpine penny-cress *Thlaspi caerulescens* and alpine speedwell *Veronica alpina*. On Meikle Kilrannoch, serpentine screes are associated with one of only two populations in the UK of alpine catchfly *Lychnis alpina*.

Helvellyn and Fairfield (127)

The Borrowdale volcanic screes have representative examples of eutric scree communities at high altitude in north-west England. Although the screes in this area are mainly acidic, there is a complex mosaic of scree types, and small areas of eutric scree are found where more base-rich rocks occur. While the plant communities here are less diverse than those further north, species characteristic of eutric screes are present. Some rare relict montane species occur in these screes, including alpine cinquefoil *Potentilla crantzii*, hoary whitlowgrass *Draba incana*, holly-fern *Polystichum lonchitis* and alpine pennycress *Thlaspi caerulescens*.

Inchnadamph (65)

This site is representative of eutric screes at low altitude in the north of Scotland. Screes of Durness limestone are extensive and support a diverse calcicolous flora. Species present include the limestone fern *Gymnocarpium robertianum*, holly-fern *Polystichum lonchitis*, hard shield fern *Polystichum aculeatum*, herb-Robert *Geranium robertianum*, the lady's-mantle *Alchemilla glabra*, alpine lady's mantle *A. alpina* and, unusually in this habitat type context, primrose *Primula vulgaris.* Many calcicolous bryophytes are also found.

Keen of Hamar (75)

This site, in the north of Shetland, is the most northerly site selected to represent the habitat type in Scotland. It is highly unusual in that the communities have developed on serpentine rock debris, which occurs extensively throughout the site and forms a mosaic with **calaminarian grasslands** at low altitude. The scree supports a flora that is unique in the number of endemic races and subspecies it contains. These include moss campion *Silene acaulis,* northern rock-cress *Arabis petraea,* arctic sandwort *Arenaria norvegica* subsp. *norvegica* and Shetland mouse-ear *Cerastium nigrescens*.

Moor House - Upper Teesdale (188)

This site is representative of the communities of eutric scree in the north of England up to an altitude of 760 m. This site has the most extensive areas of eutric scree in the UK, consisting of Carboniferous limestone. Communities are diverse and there is a mix of northern and southern elements of flora, including holly-fern *Polystichum lonchitis,* rigid buckler-fern *Dryopteris submontana,* limestone fern *Gymnocarpium robertianum,* musk thistle *Carduus nutans* and mossy saxifrage *Saxifraga hypnoides.* Hairy stonecrop *Sedum villosum* occurs where scree is flushed by springs.

Rum (16)

This site is representative of mildly eutric scree occurring to moderately high altitude in oceanic western Scotland. Rum has screes of various types, some of which are relatively small areas composed of ultra-basic rocks. The communities present are unusual and include an association of the rare arctic sandwort *Arenaria norvegica* subsp. *norvegica* and northern rock-cress *Arabis petraea,* which is confined to the very few other sites in the north with serpentine rocks. The screes have a rich flora and may support the alpine penny-cress *Thlaspi caerulescens,* sea plantain *Plantago maritima* and purple saxifrage *Saxifraga oppositifolia,* ferns such as hay-scented buckler-fern *Dryopteris aemula,* northern buckler-fern *D. expansa* and male-fern *D. filix-mas,* together with a rich community of lower plants.

Trotternish Ridge (90)

This site is representative of mildly eutric screes occurring at moderately high altitude in the oceanic west of Scotland. Although there is a mixture of scree types on the site, the eutric screes are relatively restricted in extent. However, the mildly eutric screes that are present have rich floras, including northern rock-cress *Arabis petraea,* mountain sorrel *Oxyria digyna,* moss campion *Silene acaulis,* alpine lady's-mantle *Alchemilla alpina,* stone bramble *Rubus saxatilis,* lesser clubmoss *Selaginella selaginoides,* the oceanic mosses *Campylopus setifolius, Ulota phyllantha* and *Racomitrium ellipticum,* and liverworts *Plagiochila carringtonii* and *Lepidozia pearsonii*. There is a rich fern flora, including green spleenwort *Asplenium trichomanes-ramosum,* scaly male-fern *Dryopteris affinis* and holly-fern *Polystichum lonchitis.* Flushed scree and the similar stony fell-field are habitats for the rare Iceland-purslane *Koenigia islandica,* growing with spiked wood-rush *Luzula spicata* and the montane liverwort *Anthelia juratzkana*.

2.8.3 Chasmophytic vegetation on rocky slopes - Calcareous sub-types (62.1 and 62.1A)

2.8.3.1 Background to selection

Chasmophytic vegetation consists of plant communities that colonise the cracks and fissures of rock faces. The type of plant community that develops is largely determined by the base status of the rock face. Calcareous sub-types develop on lime-rich rocks such as limestone and calcareous schist, whereas silicicolous (or siliceous) communities develop on acid rocks. The presence of calcareous bands within otherwise mainly siliceous rocks often brings the two types together on the same rock outcrop, and some sites may be listed for both types. Although both calcareous and silicicolous types are widely distributed in the uplands of the UK, siliceous rocks predominate and calcareous chasmophytic vegetation is of more limited overall extent. Both plant communities in the UK broadly belong to the rock fissure communities described from Europe (*Asplenietea trichomanis*).

This habitat type is widespread in upland areas of the UK but is localised in its occurrence. Depending on the nature of the rock face, individual stands are usually fragmentary. Sites have been selected to encompass the full range of geological and altitudinal variations of the habitat type, its geographical range and its floristic diversity. Large upland sites which, in general, contain more varied and extensive examples of this habitat type comprise the majority of the selected sites. Sites that host important populations of arctic-alpine species have been particularly favoured in the selection process.

The vegetation is characterised by bryophytes such as *Tortella tortuosa*, *Anoectangium aestivum* and *Ctenidium molluscum.* Associated vascular plants include brittle bladder-fern *Cystopteris fragilis*, green spleenwort *Asplenium trichomanes-ramosum* and glaucous meadow-grass *Poa glauca*. Some forms of this vegetation are included within the NVC types OV39 *Asplenium trichomanes-Asplenium ruta-muraria* community and OV40 *Asplenium viride-Cystopteris fragilis* community, but other forms are not covered by the NVC. Floristic variation within the habitat type is influenced by geographical location, altitude and rock type. High-altitude examples on mica schist in the Scottish Highlands have a particularly rich montane flora, including alpine woodsia *Woodsia alpina,* tufted saxifrage *Saxifraga cespitosa* and many rare bryophytes. In contrast, base-rich crevice vegetation on limestone in northern England includes some species with a predominantly southern distribution, such as bird's-foot sedge *Carex ornithopoda*.

2.8.3.2 Site list

Beinn Iadain and Beinn na h'Uamha (91)

This is representative of the habitat type at moderately high altitudes in the oceanic north-west Highlands of Scotland. The communities develop on extensive crags of calcareous basalt, which provides a refugium for a rich calcicolous flora. Characteristic chasmophytic vascular plants include alpine saxifrage *Saxifraga nivalis*, northern rock-cress *Arabis petraea*, glaucous meadow-grass *Poa glauca* and holly-fern *Polystichum lonchitis*. There is a rich associated flora of calcicolous bryophytes, such as *Orthothecium rufescen*s and *Rhytidium rugosum*.

Ben Heasgarnich (106)

This is one of two sites representing high-altitude calcareous rock face habitat in the central Breadalbanes in the southern Highlands of Scotland. There are extensive calcareous schist outcrops with a wide range of characteristic chasmophytic plant species. Of particular interest is the very rare high-altitude crevice flora, which includes species such as mountain bladder-fern *Cystopteris montana*, oblong woodsia *Woodsia ilvensis* and rock whitlowgrass *Draba norvegica*. This is one of the most important sites in the UK for arctic-alpine flora because of the number of rare species present.

Ben Lawers (103)

Ben Lawers is one of two sites representing high-altitude calcareous chasmophytic vegetation in the central Highlands of Scotland. The rock faces are formed on calcareous schists and limestones outcropping extensively at very high altitude. The site supports extensive areas of chasmophytic vegetation with some of the most diverse examples of these communities in the UK. They contain a large number of nationally rare species, such as drooping saxifrage *Saxifraga cernua*, rock whitlowgrass *Draba norvegica*, alpine fleabane *Erigeron borealis*,

alpine forget-me-not *Myosotis alpestris*, rock sedge *Carex rupestris*, alpine gentian *Gentiana nivalis*, mountain bladder-fern *Cystopteris montana* and alpine woodsia *Woodsia alpina*. The montane calcicole bryophyte flora of this site is outstanding.

Caenlochan (78)

Caenlochan represents high-altitude examples of this habitat type in the eastern Highlands, on extensive outcrops of calcareous schists. The site has one of the most extensive and diverse high-altitude crevice habitats in the UK, with an abundance of characteristic high montane plant species. These include a number of rare arctic-alpine species, such as mountain bladder-fern *Cystopteris montana,* alpine woodsia *Woodsia alpina,* rock sedge *Carex rupestris,* glaucous meadow-grass *Poa glauca* and hoary whitlowgrass *Draba incana*. The montane calcicole bryophyte flora is also outstanding and includes a number of species not present on any other selected sites.

Eryri/Snowdonia (118)

This site is representative of calcicolous chasmophytic vegetation found at its most southerly outpost and contains the most extensive and diverse examples of these communities in Wales. Crevices in base-rich igneous rocks support a characteristic assemblage of plants, with a large number of arctic-alpine species. These include a number of nationally rare species, such as alpine saxifrage *Saxifraga nivalis,* tufted saxifrage *Saxifraga cespitosa,* alpine meadow-grass *Poa alpina* and alpine woodsia *Woodsia alpina*. A species of particular interest is the Snowdon lily *Lloydia serotina*, which in the UK occurs only in Snowdonia, in rock crevices and ledges.

Inchnadamph (65)

Inchnadamph is one of two sites selected to represent the calcareous chasmophytic habitat found in the north of Scotland. This habitat type occurs extensively on northerly crags of Durness dolomitic limestone at low altitude. It has a diverse flora, rich in characteristic northern species including abundant holly-fern *Polystichum lonchitis*, dark-red helleborine *Epipactis atrorubens*, bearded couch *Elymus caninus* and rock sedge *Carex rupestris*. There are rare submontane calcicole bryophytes associated with the crevice flora, such as *Tortula princeps, Amblystegium compactum* and *Seligeria trifaria*.

Ingleborough Complex (62)

This is one of three sites representing the crevice communities found in the north of England. These communities are developed on extensive limestone scars and are characteristic of the area. The flora has a mix of northern and southern species, including purple saxifrage *Saxifraga oppositifolia,* yellow saxifrage *Saxifraga aizoides*, alpine meadow-grass *Poa alpina*, hoary whitlowgrass *Draba incana*, lesser meadow-rue *Thalictrum minus*, wall lettuce *Mycelis muralis* and baneberry *Actaea spicata*.

Moor House - Upper Teesdale (188)

This is one of three sites representing crevice communities in the north of England. The communities have developed on extensive limestone scars, especially along the Pennine escarpment and around the summits of hills. Cliff crevice vegetation occurs extensively and to an altitude of 760 m. The most extensive community present is characterised by green spleenwort *Asplenium trichomanes-ramosum* and brittle bladder-fern *Cystopteris fragilis.* Less common species found in this community include hoary whitlowgrass *Draba incana,* alpine cinquefoil *Potentilla crantzii* and holly-fern *Polystichum lonchitis*. The site is also of interest for its combination of southern and northern flora. Rarer southern species include bird's-foot sedge *Carex ornithopoda* and horseshoe vetch *Hippocrepis comosa.* The whitebeam *Sorbus rupicola*, which is widely distributed but found at only a few sites, is also present.

Strath (63)

This is one of two sites selected to represent low-altitude crevice habitat in northern Scotland. This is one of the few sites in this area with a markedly calcareous chasmophytic flora, associated with outcrops of Durness limestone. The crevice flora is moderately well developed but is less extensive and diverse than those at higher altitudes. There are only a few rare arctic-alpine species, and these include rock sedge *Carex rupestris* and alpine cinquefoil *Potentilla crantzii*. However, the communities contain an unusual assemblage of northern and more southerly characteristic species. Northern species include dark-red helleborine *Epipactis atrorubens*, green

spleenwort *Asplenium trichomanes-ramosum* and holly-fern *Polystichum lonchitis*, while southern species include hart's-tongue fern *Phyllitis scolopendrium*.

Trotternish Ridge (90)

The Trotternish Ridge is one of two sites selected to represent the calcareous chasmophytic habitat type in north-west Scotland. There are extensive basalt cliffs, on which calcareous outcrops occur locally at moderately high altitude, higher than on the comparable site, Strath. These outcrops support characteristic crevice-dwelling plants. Of particular interest are the ferns green spleenwort *Asplenium trichomanes-ramosum*, brittle bladder-fern *Cystopteris fragilis* and holly-fern *Polystichum lonchitis*, and various calcicolous mosses. There is a moderately rich flora of arctic-alpine calcicoles, including glaucous meadow-grass *Poa glauca*, alpine meadow-grass *Poa alpina*, hoary whitlowgrass *Draba incana* and alpine saxifrage *Saxifraga nivalis.* The oceanic bryophyte flora associated with this habitat type is thought to be the richest in the site series and includes the liverworts *Colura calyptrifolia, Harpalejeunea ovata, Herbertus stramineus* and *Plagiochila spinulosa.*

Wasdale Screes (89)

This is one of three sites selected to represent calcareous chasmophytic communities in northern England. The crevice communities develop on a long line of cliffs formed largely of acidic rocks of the Borrowdale Volcanic Series, with considerable amounts of calcite in the eroding gullies. These gullies are widespread and occur frequently. The rich calcareous flora that they support descends to as low as 100 m and represents the lowest recorded altitude in England for alpine lady's-mantle *Alchemilla alpina*, alpine clubmoss *Diphasiastrum alpinum* and yellow saxifrage *Saxifraga aizoides.* There are good populations of montane species, including purple saxifrage *S. oppositifolia*, mossy saxifrage *S. hypnoides* and roseroot *Sedum rosea*, and less common species, such as mountain everlasting *Antennaria dioica*, northern bedstraw *Galium boreale*, mountain avens *Dryas octopetala* and shrubby cinquefoil *Potentilla fruticosa*.

2.8.4 Chasmophytic vegetation on rocky slopes - Silicicolous sub-types (62.2)

2.8.4.1 Background to selection

Chasmophytic vegetation consists of plant communities that colonise the cracks and fissures of rock faces. The type of plant community that develops is largely determined by the base status of the rock face. Silicicolous (or siliceous) communities develop on acid rocks such as basalt, quartzite, granite and sandstone, and calcareous sub-types develop on lime-rich rocks. The presence of calcareous bands within otherwise mainly siliceous rocks often brings the two types together on the same rock outcrop, and some sites are therefore listed for both types. While both silicicolous and calcareous types are widely distributed in the uplands of Britain and other parts of Europe, silicolous types predominate and calcareous chasmophytic vegetation has a much more limited distribution. Both plant communities in the UK have affinities to the rock fissure communities described from Europe (Asplenietea trichomanis).

This habitat type is widespread in upland areas of the UK. Sites have been selected to take account of the range of floristic assemblages characteristic of acidic rock crevices in the UK. Preference has been given to the largest areas with the most diverse populations of characteristic montane plants. Sites that host important populations of arctic-alpine species have been favoured in the selection process.

Silicicolous rock crevice vegetation is poorly covered by the NVC, although some forms can be referred to U21 *Cryptogramma crispa-Deschampsia flexuosa* community. The habitat type typically comprises mixtures of bryophytes, such as *Amphidium mougeotii* and *Racomitrium* spp., and vascular plants, such as wavy hair-grass *Deschampsia flexuosa* and fir clubmoss *Huperzia selago*.

Altitude and geographical location account for a large part of the ecological variation exhibited by this habitat type. High altitude examples in northern Scotland are particularly important for a range of rare species, such as alpine speedwell *Veronica alpina* and Highland cudweed *Gnapthalium norvegicum,* that have an arctic-alpine or boreal distribution. Such sites in Scotland have been favoured in site selection.

In western localities, especially close to the coast, the habitat type is enriched by oceanic species, such as Wilson's filmy fern *Hymenophylum wilsonii* and sea spleen wort *Asplenium marinum,* as well as rich assemblages of Atlantic bryophytes. In the southern uplands of Wales and England, northern floristic elements are reduced. Although some species, such as dwarf willow *Salix herbacea,* have their most southerly occurrence in this habitat type, southern species, such as forked spleenwort *Asplenium septentrionale,* tutsan *Hypericum androsemum* and wood bitter vetch *Vicia orobus,* also occur. The site series takes account of this range of floristic variation.

2.8.4.2 Site list

Beinn Dearg (104)

This is one of three sites selected to represent high-altitude examples of this habitat type in north-west Scotland. On Beinn Dearg the habitat type is developed on large crags of siliceous metamorphosed sandstones. There is a rich flora of characteristic montane acid-loving and base-indifferent arctic-alpines, such as three-leaved rush *Juncus trifidus*, spiked wood-rush *Luzula spicata*, dwarf willow *Salix herbacea*, mountain sorrel *Oxyria digyna,* northern rockcress *Arabis petraea,* stone bramble *Rubus saxatilis* and the rare Highland cudweed *Gnaphalium norvegicum*. The associated montane bryophyte flora contains a rich assemblage of species characteristic of the north-west Highlands.

Ben Nevis (123)

Ben Nevis is one of three sites selected to represent high-altitude crevice vegetation in north-west Scotland. The communities develop extensively on acidic crags up to a very high altitude and have a diverse flora, with characteristic examples of the commoner arctic-alpine species. The site also supports a number of rare species, including hare's-foot sedge *Carex lachenalii*, spiked wood-rush *Luzula spicata* and alpine speedwell *Veronica alpina*.

Cairngorms (209)

The Cairngorms has been chosen as a representative of high-altitude crevice habitat in the eastern Highlands of Scotland. The habitat type is developed on acidic granite rocks, occurs widely within the site and supports an abundance of characteristic species. Rare species include Highland cudweed *Gnaphalium norvegicum,* common scurvygrass *Cochlearia officinalis,* alpine speedwell *Veronica alpina,* spiked wood-rush *Luzula spicata* and hare's-foot sedge *Carex lachenalii.*

Eryri/Snowdonia (118)

Snowdonia, north Wales, is the most southerly site selected and is representative of communities found at the southern edge of the range of the habitat type. Acidic crevice communities occur throughout the site on igneous outcrops and include populations of stiff sedge *Carex bigelowii,* fir clubmoss *Huperzia selago* and forked spleenwort *Asplenium septentrionale.* Atlantic species, including Wilson's filmy-fern *Hymenophyllum wilsonii* and a wide range of bryophytes, are also well represented.

Foinaven (162)

This site in Scotland is the most northerly selected. The site has a cool oceanic climate and the crevice communities are developed widely on extensive outcrops of quartzite, Lewisian gneiss and schist, which occur from low to moderately high altitude. Characteristic species that occur are black spleenwort *Asplenium adiantum-nigrum,* fir clubmoss *Huperzia selago* and starry saxifrage *Saxifraga stellaris,* while rarer species, such as rock whitlowgrass *Draba norvegica,* and oceanic ferns, such as Wilson's filmy-fern *Hymenophyllum wilsonii,* with associated oceanic bryophytes, may occur.

Glen Coe (126)

Glen Coe is representative of high-altitude chasmophytic habitat in the west of Scotland. The habitat type is developed on massive outcrops of siliceous igneous rocks with crags up to very high altitude. The rock type varies across the site, leading to variation in the plant species. The crags support many of the commoner arctic-alpine species of acidic rocks, which are widespread across the site. The very rare drooping saxifrage *Saxifraga cernua* occurs in small pockets of calcareous material within predominantly acidic rocks, together with such species as brittle bladder-fern *Cystopteris fragilis,* roseroot *Sedum rosea* and mountain sorrel *Oxyria digyna*. The fern flora of this site is extremely diverse and the westerly influences on the site are shown by the extensive development of oceanic bryophytes associated with the crags.

Helvellyn and Fairfield (127)

This is one of two sites selected to represent high-altitude communities in the north-west of England. Rock face communities are diverse and widespread on the site, with abundant populations of characteristic species such as dwarf willow *Salix herbacea,* alpine lady's mantle *Alchemilla alpina,* starry saxifrage *Saxifraga stellaris* and stiff sedge *Carex bigelowii.* Some more local species are also represented, such as common scurvygrass *Cochlearia officinalis*. The rare oblong woodsia *Woodsia ilvensis* has been recorded on this site in the past.

Loch Maree Complex (173)

This is one of three sites selected as representative of the acid chasmophytic habitat in north-west Scotland. The habitat type is developed widely on extensive crags of Torridonian sandstone and quartzite at low to moderately high altitudes. The site contains a characteristic north-western flora, with many of the commoner montane vascular plants, including Wilson's filmy-fern *Hymenophyllum wilsonii,* sea spleenwort *Asplenium marinum,* three-leaved rush *Juncus trifidus,* dwarf willow *Salix herbacea* and spiked wood-rush *Luzula spicata.* Rarer species include rock whitlowgrass *Draba norvegica* and the characteristic black spleenwort *Asplenium adiantum-nigrum*. Oceanic influence is shown by the widespread development of oceanic ferns. Of particular importance is the outstanding flora of Atlantic mosses and liverworts, in the crevices of the more shady crags.

Wasdale Screes (89)

This site is one of two sites representative of the communities occurring in north-west England. It is complementory to Helvellyn, as the screes are at low altitude and contain a number of southern lowland species. The communities develop on a long line of cliffs formed largely of acidic rocks of the Borrowdale Volcanic

Series, with considerable amounts of calcite in the eroding gullies. On the predominantly acid crags, there are extensive communities of silicicolous vegetation. These are characteristic of the north of England and include forked spleenwort *Asplenium septentrionale* and bearberry *Arctostaphylos uva-ursi*. More typical lowland species found here are royal fern *Osmunda regalis*, tutsan *Hypericum androsaemum* and wood bitter-vetch *Vicia orobus.*

2.8.5 *Limestone pavements (62.4)

2.8.5.1 Background to selection

Within the EC, **limestone pavements** occur in the UK, Ireland and Sweden. Elsewhere in Europe there are only fragmentary occurrences in high alpine limestone areas. In the UK limestone pavement is uncommon, covering only 2,000 ha. Nevertheless it is widespread, being found from south Wales to northern Scotland on three different limestone formations - the Carboniferous in England, Wales and Northern Ireland, and the Dalradian and Durness in Scotland. Sites have been selected to reflect the UK's special responsibility for this priority habitat type. Larger sites have been selected because they contain the widest range of communities. However, the most extensive limestone pavements occur on the Carboniferous limestone of northern England, from Morecambe Bay to the Pennines, and site selection reflects this distribution. Elsewhere, the exposures in Wales and Northern Ireland and the Dalradian of Scotland are of limited extent. However, those on the Durness limestone of north-west Scotland are valuable because they represent an extremely unusual geological and floristic variant. Selection takes account of this geographic variation. Altitudinal variation is also significant, as there are significant differences between pavements close to sea level and those in montane areas. Another factor in ecological variation is the level of grazing, and the site series contains a range of land use types, from woodland to sheep pastures.

Limestone pavements are outcrops of rock, typically horizontal or gently inclined, although a few are steeply inclined. The surface has been dissolved by water over millions of years into 'paving blocks', known as clints, with a complex reticulate pattern of crevices, known as grikes, between them. The vegetation of limestone pavements is unusal because of the combinations of floristic elements, including woodland and woodland edge species, such as hart's-tongue fern *Phyllitis scolopendrium* and dog's mercury *Mercurialis perennis*. On the clint surfaces or the upper walls of the grikes there are plants of rocky habitats, such as wall-rue *Asplenium ruta-muraria* and maidenhair spleenwort *A. trichomanes*. The grikes provide a shady, humid environment favouring woodland plants. The selected sites have a well developed clint and grike structure, with associated vegetation pattern.

Grazing pressure is a key factor in determining ecological variation in limestone pavements. Where grazing pressure is low, woodland may cover the pavement and woodland vegetation may mask the limestone surface. Here only the massive areas of pavement may be exposed as clearings. Where there is sufficient grazing pressure, vegetation mau be found only in the grikes, but, where grazing is light, dwarf trees, herbs and ferns may protrude from the grikes. Where grazing pressure is intense, these same plants survive only within the grikes. Grikes that are about 60 cm deep provide shelter without unduly limiting light and are usually the best floristically.

One rarer species, the rigid buckler-fern *Dryopteris submontana*, has its main centre of population in limestone pavement and, in common with two other rare species, dark-red helleborine *Epipactis atrorubens* and angular Solomon's-seal *Polygonatum odoratum*, flourishes in the low- to mid-altitude pavements. Other rare species, such as baneberry *Actaea spicata* and green spleenwort *Asplenium trichomanes-ramosum*, occur in the more montane pavements. The selected sites provide representation of these rare floristic elements.

2.8.5.2 Site list

Asby Complex (192)

This is one of four sites selected in the north of England to represent limestone pavements. It has been selected because of its size and its well developed flora of species typical of more montane pavements and sheep grazed pastures. Most of the pavements contain dog's mercury *Mercurialis perennis* and wall lettuce *Mycelis muralis*, but in the main the herb flora is restricted, perhaps reflecting exposure to grazing sheep over many decades. The grikes provide a niche for a varied assemblage of ferns. Green spleenwort *Asplenium trichomanes-ramosum*, wall-rue *A. ruta-muraria*, maidenhair spleenwort *A. trichomanes*, brittle bladder-fern *Cystopteris fragilis*, male-fern *Dryopteris filix-mas*, hard shield-fern *Polystichum aculeatum* and hart's-tongue *Phyllitis scolopendrium* occur in most pavements, with limestone fern *Gymnocarpium robertianum* and rigid buckler-fern *Dryopteris submontana* in some pavements. Where grazing is less intensive, the flora is more diverse and trees and shrubs grow beyond the confines of the grikes.

Craven Limestone Complex (190)

This is one of four limestone pavement sites in the north of England selected to represent this habitat type. It is selected on the basis of its size and as an example of mid-altitude pavement. There is a wide range of transitions to other habitats, including grasslands, flushes and woodlands. Despite being accessible to grazing sheep, these pavements provide a refuge for downy currant *Ribes spicatum* and, occasionally, alpine cinquefoil *Potentilla crantzii* and baneberry *Actaea spicata*.

Durness (64)

This site on Durness limestone is the most northerly occurrence of limestone pavement in the UK. It is one of three sites representing the northern variant of this habitat type occurring on the Dalradian limestone. Because of its location it supports a diverse flora rich in northern and alpine species. The site supports communities with a maritime element, similar to those on Strath, with burnet rose *Rosa pimpinellifolia*, stone bramble *Rubus saxatilis*, mountain avens *Dryas octopetala*, dark-red helleborine *Epipactis atrorubens* and black spleenwort *Asplenium adiantum-nigrum*. Both lesser meadow-rue *Thalictrum minus* and alpine meadow-rue *T. alpinum* occur here. Further inland, brittle bladder-fern *Cystopteris fragilis* and hard shield-fern *Polystichum aculeatum* flourish.

Inchnadamph (65)

This is one of three sites representing limestone pavement on the Durness limestone in north-west Scotland. It is one of the most floristically rich limestone pavement sites in Scotland. The communities have some species in common with the more maritime communities on Strath, including burnet rose *Rosa pimpinellifolia* and stone bramble *Rubus saxatilis*, but are montane in character. For example, holly-fern *Polystichum lonchitis* is abundant and whortle-leaved willow *Salix myrsinites* is unique here as it occurs on limestone pavement. When the species is abundant, it is defined as **Sub-Arctic willow scrub**, an Annex I interest for which the site is poposed in its own right.

Ingleborough Complex (62)

This is one of four sites selected to represent limestone pavement on Carboniferous limestone in northern England. It has the most extensive series of limestone pavements in the UK, varying from moderate altitude to montane in character (300-640 m). The pavements range from those where grazing is completely excluded (Colt Park Wood National Nature Reserve), to some where grazing is restricted (pavements amidst cattle-grazed pastures) and others within common land intensively grazed by sheep. Characteristic species include baneberry *Actaea spicata* (more abundant here than elsewhere), great bellflower *Campanula latifolia*, found only here as a limestone pavement species, lily-of-the-valley *Convallaria majalis*, marsh hawk's-beard *Crepis paludosa*, wall lettuce *Mycelis muralis*, lesser meadow-rue *Thalictrum minus* and mountain melick *Melica nutans*. Among the ferns, green spleenwort *Asplenium trichomanes-ramosum*, brittle bladder-fern *Cystopteris fragilis* and hard shield-fern *Polystichum aculeatum* occur on most pavements. Rigid buckler-fern *Dryopteris submontana* and limestone fern *Gymnocarpium robertianum* are widespread but much less abundant than on Morecambe Bay Pavements. Dog's mercury *Mercurialis perennis* and wood sorrel *Oxalis acetosella* occur on most pavements.

Morecambe Bay Pavements (191)

This is one of four sites chosen as representative of limestone pavements on Carboniferous limestone in Northern England. This site provides an example of lowland pavements that range from low to moderate altitudes (up to 274 m). Some of the pavements form woodland clearings that are sheltered and warm-up quickly in spring. The pavement flora is here at its most diverse and, where grazing is absent, can be seen at its best because plant growth is not confined to the grikes. Trees and shrubs, including yew *Taxus baccata*, juniper *Juniperus communis*, buckthorn *Rhamnus catharticus*, hazel *Corylus avellana*, small-leaved lime *Tilia cordata* and ash *Fraxinus excelsior*, grow above the pavement surface. Some pavements lie within sheep pasture but are for the most part lightly grazed. Rustyback *Ceterach officinarum* is restricted to pavements that form sheltered woodland clearings. Other ferns occurring on the site include the nationally scarce rigid buckler-fern *Dryopteris submontana*, which is abundant on Hutton Roof Crags, and limestone fern *Gymnocarpium robertianum*. These pavements tend to be rich in herbs, with lily-of-the-valley *Convallaria majalis*, dark-red helleborine *Epipactis atrorubens*, pale St John's-wort *Hypericum montanum*, ploughman's-spikenard *Inula conyzae*, angular Solomon's-seal *Polygonatum odoratum*, wood-sage *Teucrium scorodonia*, lesser meadow-rue *Thalictrum minus* and hairy violet *Viola hirta* achieving their best representation in limestone pavement here.

Strath (63)

This is one of three sites representing limestone pavement on Durness limestone in north-west Scotland. It is the most extensive and floristically the richest limestone pavement in Scotland and represents a more maritime variant of the habitat type. The pavements are found at a range of altitudes from close to sea level up to 280 m. There is a maritime influence across the whole site. Some of the species on this site, including tutsan *Hypericum androsaemum*, dark-red helleborine *Epipactis atrorubens*, herb-Paris *Paris quadrifolia*, burnet rose *Rosa pimpinellifolia*, stone bramble *Rubus saxatilis*, wood-sage *Teucrium scorodonia* and black spleenwort *Asplenium adiantum-nigrum*, are more southern species, characteristic of Morecambe Bay Pavements near the coast. Indeed, one pavement supports the characteristic southern scrub woodland of hazel *Corylus avellana*. Other characteristic species, such as melancholy thistle *Cirsium heterophyllum*, globe-flower *Trollius europaeus* and mountain avens *Dryas octopetala*, are distinctly northern. Perhaps as a result of their more northerly latitude, vernal species are more common here than in southern coastal pavements. These include ramsons *Allium ursinum*, wood anemone *Anemone nemorosa*, primrose *Primula vulgaris* and common dog-violet *Viola riviniana*.

2.8.6 Submerged or partly submerged sea caves

2.8.6.1 Background to selection

The UK has the most varied and extensive sea caves on the Atlantic coast of Europe. Sites were selected to encompass the range of structural and ecological variation of sea caves and cover their geographic range in the UK. Selection was confined to well developed cave systems, with extensive areas of vertical and overhanging rock, and those that extend deeply into the rock, which are likely to support a wider range and higher diversity of plants and animals.

Cave communities vary considerably depending on the structure and extent of the cave system, their degree of submergence and of exposure to scour and surge, and the nature of their geology. Caves can vary in size, from only a few metres to more extensive systems, which may extend hundreds of metres into the rock. There may be tunnels or caverns with one or more entrance, in which vertical and overhanging rock faces provide the principal marine habitat. Caves are typically colonised by encrusting animal species but may also support shade-tolerant algae near their entrances.

Physical conditions, such as inclination, wave surge, scour and shade, change rapidly from cave entrance to the inner parts of a cave and this often leads to a marked zonation in the communities present. Sites in which these zonations are well developed have been favoured in selection.

A high proportion of caves are in the intertidal or in shallow water. Caves on the shore and in the shallow sublittoral zone are frequently subject to conditions of strong wave surge and tend to have floors of coarse sediment, cobbles and boulders. These materials are often highly mobile and scour the cave walls. Caves that are subject to strong wave surge are characterised by communities of mussels *Mytilus edulis*, barnacles *Balanus crenatus*, cushion sponges, encrusting bryozoans and colonial sea-squirts, depending on the degree of water movement and scour at particular points in the cave system.

Caves that occur in deeper water are subject to less water movement from the surrounding sea, and silt may accumulate on the cave floor. The sponges *Dercitus bucklandi* and *Thymosia guernei*, the soft coral *Parerythropodium corallioides*, solitary sea-squirts, bryozoans and sessile larvae of jellyfish are characteristic of deeper cave systems. These caves, particularly where they are small, provide shelter for crabs, lobsters *Homarus gammarus*, crawfish *Palinurus elephas* and fish, such as the leopard-spotted goby *Thorogobius ephippiatus.*

The type of rock in which the cave is formed has an important influence on its shape and qualities as a substrate for plans and animals, and this variation is taken account of in site selection. In chalk caves in south-east England bands of microscopic algae occur, including *Chrysophyceae* and *Pilinia maritima*, that are highly specific to this habitat type. The UK holds a high proportion of the total area of coastal chalk, a comparatively rare habitat in Europe. Emphasis has been given to this habitat in site selection.

2.8.6.2 Site list

Berwickshire and North Northumberland Coast (230)

This is an extensive and diverse stretch of coastline in north-east England and south-east Scotland. There is variation in the distribution of features of interest along the coast. Caves occur throughout the site in both the intertidal and the subtidal zones in a range of different hard rock exposures. There are examples of partly submerged caves in the cliffs north of Berwick and in the limestone at Howick (south of Craster), and there are submerged sea caves, tunnels and arches in the volcanic rock of the Farne Islands and around St Abbs Head. Caves occur in association with reefs, in both the intertidal and the subtidal zones. Depending on the depth of the cave and its morphology, the site supports a range of distinct biological communities.

Flamborough Head (140)

There are larger numbers and a wider range of cave habitats here than at any other chalk site in Britain. This site,on the east coast of England, represents caves of the North Sea coast cut into soft rock exposures and is important for its specialised cave algal communities, which contain abundant *Hildebrandia rubra, Pseudoendoclonium submarinum, Sphacelaria nana* and *Waerniellina lucifuga*. There are more than 200 caves within the site, particularly around the Headland and on the north facing cliffs. Some of these caves are partly submerged at all stages of the tide, others dry out during low water and some lie above the high water mark but are heavily influenced by wave splash and salt spray from the sea. The largest caves are known to extend for more than 50 m from their entrance on the coast.

Papa Stour (228)

Papa Stour in Shetland has excellent examples of caves, tunnels and arches occurring in cold northerly waters. In very exposed sea conditions the caves support rich communities that illustrate the effects of surge, scour and changes in light conditions. The cave walls have extensive faunal turfs, and among the more unusual species present is the northern anemone species *Phellia gausapata*. The rare, surge-tolerant alga *Schmitzia hiscockiana* is found on boulders in cave entrances. Further diversity is due to the presence of sheltered gullies and tunnels where the community zonation is influenced by tidal flows.

Rathlin Island (316)

This site, situated off the north coast of Northern Ireland, includes well developed examples of both partly submerged and submerged caves and overhangs in limestone and basalt in a strong tidal stream. Submerged caves occur mainly at depths ranging from 20 to over 100 m. The site has a rich assemblage of sponges and hydroids. Species found include sponges such as *Syrphnus ponderosus* and *Dericitus bucklandi* and the anemones *Sagartia elegans, Parazoanthus axinellae* and *P. anguicomus,* which are frequent. The site is used by cave-breeding grey seals *Halichoerus grypus.*

St Kilda (180)

The St Kilda archipelago lies west of the Outer Hebrides and supports one of the most extensive sea cave systems in the UK. Throughout the island group basalt and dolerite dykes have eroded to form caves and tunnels above and below the water. The communities these support are diverse and reflect the degree of surge to which they are exposed. In shallow water in the extremes of surge the cave walls are blanketed only by the sponge *Myxilla incrustans*. With a reduction in surge, species such as the northern anemone *Phellia gausapata* are common and thin encrusting sponges, bryozoans and the anemones *Corynactis viridis* and *Sagartia elegans* are abundant. Microhabitats in the deeper caves show a wave exposure gradient, with species usually found in more sheltered conditions, such as the fan worm *Sabella pavonina* and the burrowing anemone *Cerianthus lloydii,* present in the inner regions. Rarely recorded nocturnal species have also been found in the inner caves, most notably the crab *Bathynectes longipes* and the anemone *Arachnanthus sarsi.*

Thanet Coast (156)

The Thanet Coast provides the second most extensive representation of chalk caves in the UK on the extreme south-east coast of England. The site is bordered by about 23 km of chalk cliffs with many caves and stack and arch formations. Partly submerged caves around Thanet range considerably in depth, height and aspect and hence in the algal communities present. Some caves extend for up to 30 m into the cliffs and reach 6-10 m in height, although many are much smaller. They support very specialised algal and lichen communities containing species such as *Pseudoendoclonium submarinum* and *Lyngbya* spp., some of which were first described from Thanet and have never been recorded elsewhere.

Section 2.9: Forests

2.9.1 Beech forests with *Ilex* and *Taxus,* rich in epiphytes (*Ilici-Fagion*) (41.12)

2.9.1.1 Background to selection

Beech woodland of this type is a habitat type largely restricted to the western seaboard of Europe. In the UK it is restricted to southern areas, and extensive stands on acid sites are rare outside south-east England. 'Old growth' characteristics (which often include epiphytic richness) have been stressed in the selection, because of the importance of deadwood habitats in the overall structure and function of woodland systems and the scarcity of very old trees in Europe generally. Often sites of this type are, or were, managed as wood-pasture systems, in which beech *Fagus sylvatica* and oak *Quercus* spp. pollarding was common. This is known to prolong the life of these trees. Sites have been selected to cover the geographical range of the habitat type in the UK, within which preference has been given to large sites or those particularly rich in lichens or deadwood invertebrates, which are indications of the conservation of structure and function.

This type occurs on acid soils and falls within two NVC communities: W14 *Fagus sylvatica-Rubus fruticosus* woodland and W15 *Fagus sylvatica-Deschampsia flexuosa* woodland. Although the Habitats Directive name emphasises stands rich in epiphytes, the fuller description included in the *Interpretation manual of European Union habitats* (DGXI 1996a) accommodates some stands less rich in epiphytes.

2.9.1.2 Site list

Burnham Beeches (299)

Selected to provide representation in central southern England, this is an extensive area of former beech wood-pasture with many old pollards and associated beech *Fagus sylvatica* and oak *Quercus* spp. high forest. Recent surveys have shown that it is one of the richest sites for saproxylic invertebrates in the UK, including fourteen Red Data Book species. It also retains nationally important epiphytic communities, including the moss *Zygodon forsteri*.

Ebernoe Common (40)

Selected to represent the habitat type in the south-eastern part of its UK range, this site has an extensive block of beech *Fagus sylvatica* high forest and former wood-pasture over dense holly *Ilex aquifolium* and has a very rich epiphytic lichen flora, including *Agonimia octospora* and *Catillaria atropurpurea*. Other woodland types, open glades and pools occur, contributing to a high overall diversity.

Epping Forest (42)

This site has been selected to represent the habitat type in the north-eastern part of its UK range. Although the epiphytes of this site have declined, largely as a result of air pollution, this site remains important for a range of rare epiphyte species, including the moss *Zygodon forsteri*. The long history of pollarding, and resultant large number of veteran trees, ensures that the site is also rich in fungi and deadwood invertebrates.

The Mens (41)

This is an extensive area of mature beech *Fagus sylvatica* woodland rich in lichens, bryophytes, fungi and saproxylic invertebrates and is one of the largest tracts of this habitat type in the south-eastern part of its UK range.

The New Forest (5)

This is the largest area of mature, semi-natural acidic beech *Fagus sylvatica* woodland in Britain and is selected to represent the habitat type in the most southerly part of its UK range. The mosaic with other types of woodland and heath has allowed unique and varied assemblages of epiphytic lichens and saproxylic invertebrates to be sustained, particularly in situations where the woodlands are open and the tree trunks receive plenty of light.

2.9.2 *Asperulo-Fagetum* beech forests (41.13)

2.9.2.1 Background to selection

Asperulo-Fagetum forest is relatively widespread in Europe and is relatively abundant within its range in southern England and Wales along the slopes of the major hill systems of the chalk and southern limestones.

Sites were selected to include extensive stands across the geographical range of the habitat type, in order to encompass its ecological variation within the UK, including variations in the underlying geology (chalk and limestone) and in its occurrence with other woodland types. Sites where the stands of beech *Fagus sylvatica* occur in combination with other woodland types, grassland and scrub were selected to increase the variety of structure and to allow for the dynamics of beech woodland, because the dominance of beech at any one time may be greatly affected by disturbance and past management. Sites that have rare or specialised ground flora were also priorities for selection.

This type falls within two NVC communities that often occur together on a site: W12 *Fagus sylvatica-Mercurialis perennis* woodland and W14 *Fagus sylvatica-Rubus fruticosus* woodland. Each has a different associated suite of species and woodland types, which change according to slope and soil type.

2.9.2.2 Site list

Chilterns Beechwoods (44)

These beechwoods were selected because they represent a very extensive tract of the habitat type in the centre of its range. The woodland is an important part of a grassland-scrub-woodland mosaic. A distinctive feature in the woodland flora is the occurrence of the rare coralroot *Cardamine bulbifera*.

Cotswold Beechwoods (177)

This site was selected as representative of the most westerly of the continuous blocks of this beech woodland type in the UK. The woods are floristically richer than the Chilterns example, and rare plants include the red helleborine *Cephalanthera rubra*.

East Hampshire Hangers (43)

This site represents the type in south-east England and is extremely rich in terms of vascular plants, including white helleborine *Cephalanthera damasonium*, violet helleborine *Epipactis purpurata* and Italian lords-and-ladies *Arum italicum*.

Wye Valley Woodlands/Coetiroedd Dyffryn Gwy (45)

The beech stands in the Wye Valley, where it occurs as part of a mosaic with a wide range of other woodland types, represent the western range of this habitat type. The ecological variety associated with this mosaic of woodland types is rare within the UK.

2.9.3 *Stellario-Carpinetum* oak-hornbeam forests (41.24)

2.9.3.1 Background to selection

This is predominantly a central European habitat type and is a rare habitat type in the UK. Only two sites have been identified that are considered to be good examples having close affinities to the central European type. Both sites have been selected.

In south-east England there are woodland stands of oak *Quercus* spp. with some hornbeam *Carpinus betulus* that are considered closer to the central European habitat type than its Atlantic counterpart (mainly mixed Atlantic bluebell-oak forests). The bluebell *Hyacinthoides non-scripta*, which is most abundant in Atlantic parts of Europe including the UK, is unusually rare in this habitat type, which is characterised by the occurrence of great wood-rush *Luzula sylvatica*, hairy wood-rush *L. pilosa* and, locally, southern wood-rush *L. forsteri*, with greater stitchwort *Stellaria holostea* in the more open patches.

2.9.3.2 Site list

Blean Complex (182)

At this site in the south-east of England, hornbeam *Carpinus betulus* coppice occurs interspersed with pedunculate oak *Quercus robur* stands and introduced sweet chestnut *Castanea sativa*. Great wood-rush *Luzula sylvatica* is locally dominant in the woodland, and the characteristic greater stitchwort *Stellaria holostea* is found in more open patches.

Wormley Hoddesdonpark Woods (181)

This wood in the south-east of England has large stands of almost pure hornbeam *Carpinus betulus* (former coppice), with sessile oak *Quercus petraea* standards. Areas dominated by bluebell *Hyacinthoides non-scripta* do occur, but elsewhere there are stands of great wood-rush *Luzula sylvatica* with carpets of the mosses *Dicranum majus* and *Leucobryum glaucum*. Locally, a bryophyte community more typical of the continent occurs, including the mosses *Dicranum montanum, D. flagellare* and *D. tauricum*.

2.9.4 **Tilio-Acerion* ravine forests** (41.4)

2.9.4.1 Background to selection

This is a priority habitat type that is uncommon in the UK. It is found largely in the intermediate area between upland and lowland zones. Sites have been selected to reflect the scarcity and priority status of this habitat type and to cover the main elements of the geographical range and ecological variation found in the *Tilio-Acerion* in the UK. The sites chosen are amongst the most extensive examples in the UK, with good conservation of structure and function. This habitat occurs in small scattered stands in many other woods in the UK, but such examples have not been selected. Site selection has taken size into account, with the largest sites containing this habitat type being favoured.

Tilio-Acerion ravine forests are woods of ash *Fraxinus excelsior*, wych elm *Ulmus glabra*, lime (mainly small-leaved lime *Tilia cordata* but more rarely large-leaved lime *Tilia platyphyllos*). Introduced sycamore *Acer pseudoplatanus* is often present and is a common part of the community on the continent. The habitat type typically occurs on coarse scree, steep rocky slopes and in ravines, particularly on calcareous substrates on cliffs, screes and gorges, where inaccessibility has reduced human impact. This means that, even at the most extensive sites, the habitat type occurs as a series of scattered patches grading into other types of woodland on slopes above and on flat valley floors below. Transitions to scrub and grassland and the presence of a mosaic of other woodland habitats are important features of several selected sites.

This habitat type is ecologically variable. As the *Tilio-Acerion* has its centre of distribution on the continent, some of the species that are abundant on the continent are much more scattered in UK sites. This applies to both of the tree species noted in the name. From site to site the dominant tree species in the canopy vary. To the north and west ash and wych elm assume increasing importance in the canopy of this woodland type. Ecological variation due to variations in slope, aspect and nature of the substrate adds to the diversity of conditions within the sites. This variation has been accommodated in the selection of sites.

The type corresponds in the UK largely to stands on the upland-lowland boundary, predominantly in England and on the Welsh border, although related stands do occur to the north and west. Within these geographic and topographic limits the main NVC types are the 'western' sub-communities d - g of the W8 *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland (and the north-western equivalent W9 *Fraxinus excelsior-Sorbus aucuparia-Mercurialis perennis* woodland). Ferns such as hart's-tongue *Phyllitis scolopendrium* and soft shield-fern *Polystichum setiferum* are usually abundant, along with basophilous species such as dog's mercury *Mercurialis perennis*. North of the Central Belt in Scotland, and in upland areas generally, the distinctiveness of the type tends to break down. Base-rich conditions become very restricted in extent; birch *Betula* spp. and oak *Quercus* spp. assume greater abundance in the canopy, and species typical of more acidic communities are often found in a close mosaic with more basophilous indicators.

The associated ground flora can be very varied, but the following elements are usually present: fern banks (particularly hart's-tongue, soft shield-fern and buckler-ferns *Dryopteris* spp.); stands of ramsons *Allium ursinum* in the moister zones; dog's mercury and enchanter's-nightshade *Circaea* spp. on drier but still base-rich soils; wood avens *Geum urbanum*, and natural 'disturbance communities' comprising common nettle *Urtica dioica*, herb-Robert *Geranium robertianum* and cleavers *Galium aparine* associated with scree and cliff bases. A wide range of other basophilous herbs and grasses may occur within these stands.

2.9.4.2 Site list

Avon Gorge Woodlands (46)

This site is representative of the habitat type in south-west England on the limestone cliffs and screes of a large river gorge. It is important because of the high concentration of small-leaved lime *Tilia cordata*, compared with other sites in the region, and the presence of rare whitebeams *Sorbus* spp., including two unique to the Avon Gorge (*Sorbus bristoliensis* and *S. wilmottiana)*, uncommon plants such as green hellebore *Helleborus viridis* and other characteristic species, such as soft shield-fern *Polystichum setiferum* and hart's-tongue *Phyllitis scolopendrium*. It has associated species-rich transitions to scrub and grasslands. Small groves of yew *Taxus baccata* also occur on some of the stonier situations.

Clyde Valley Woods (153)

This site in southern Scotland represents the habitat type near the northern edge of its occurrence, beyond the distribution limit of lime *Tilia* spp. but otherwise with characteristic features of the *Tilio-Acerion*. Clyde Valley Woods contain the most extensive areas of such ash-elm *Fraxinus-Ulmus* woodland in river valleys in Scotland. Ground flora typical of the *Tilio-Acerion* is found in these woods, with some southern species such as herb-Paris *Paris quadrifolia* and pendulous sedge *Carex pendula* also present.

Downton Gorge (47)

This site in south-west England has been selected to provide an example of the type in the western part of its range, in this case within a narrow ravine with a distinctive micro-climate and a variety of slope and aspect. Both small-leaved lime *Tilia cordata* and large-leaved lime *T. platyphyllos* occur with ash *Fraxinus excelsior* and elm *Ulmus* spp. The ground flora includes wood fescue *Festuca altissima* and violet helleborine *Epipactis purpurata*. The gorge cliffs are rich in ferns, reflecting the humidity of the site, with a wide range of species recorded.

East Hampshire Hangers (43)

This site, with Rook Clift, represents an unusual occurrence of the type in the south of England and has areas of small-leaved lime *Tilia cordata* on the steepest parts of the Upper Greensand scarp, associated with low sandstone cliffs and scree slopes, which are locally calcareous. The bryophyte flora is richer than on the chalk examples and includes several species that are rare in the lowlands, such as *Campylostelium saxicola,* which has its strongest population in England here. The site is ecologically similar to sites selected in the Welsh Borders, despite its geographic location.

Mendip Woodlands (310)

This site is chosen as a relatively extensive example in south-west England of this habitat type on limestone substrates. It is a cluster of three ash-dominated woods on Carboniferous limestone. A rich variety of other trees and shrubs are present, including elm *Ulmus* spp. and, locally, small-leaved lime *Tilia cordata*. At Ebbor Gorge elm rather than lime is mixed with the ash *Fraxinus excelsior* in a steep-sided gorge; at both Rodney Stoke and Cheddar Wood lime and ash are found on rocky slopes with patches of deeper soil between the outcrops. Ferns characteristic of this type, such as hart's-tongue *Phyllitis scolopendrium* and shield-ferns *Polytrichum* spp., are common. The site is in the centre of the range for the dormouse *Muscardinus avellanarius* and holds a large population of this species.

Morecambe Bay Pavements (191)

The woodland on this site in north-west England is considered part of the same complex as Roudsea Wood and Mosses and is described below. The habitat type occurs here both on limestone pavement and in other areas on loose scree and steep slopes.

Peak District Dales Woodlands (282)

Representing the north-central part of its range, this site in the Midlands of England contains a large area of *Tilio-Acerion*, dominated by ash *Fraxinus excelsior*. Locally, sycamore *Acer pseudoplatanus* is abundant (although not native to this community in the UK). The Dales provide good examples of woodland-scrub-grassland transitions, with associated rich invertebrate populations and plant communities. Among the uncommon plants present in the woods are mezereon *Daphne mezereum* and green hellebore *Helleborus viridis*, as well as whitebeams *Sorbus* spp. on the crags.

Rook Clift (318)

This is the largest known remnant stand of *Tilio-Acerion* dominated by large-leaved lime *Tilia platyphyllos* in the south of England. It lies on the deeper soils towards the base of the slope and valley bottom of a small wooded combe, which gives the site its humid micro-climate. The soils are rather deeper and there is less exposed rock at this site because the chalk is more readily weathered than the limestones on which many of the other sites lie. Despite this, the vegetation is otherwise typical of the habitat type, with an abundance of ferns

such as hart's-tongue *Phyllitis scolopendrium* and shield-fern *Polystichum* spp. In addition to species more common in the west of Britain, continental species such as Italian lords-and-ladies *Arum italicum* also occur.

Roudsea Wood and Mosses (275)

Woodland at this site, with others within the Morecambe Bay Pavements, provides a representation of the habitat type on Carboniferous limestone in north-west England. Although close to the northern limit of lime distribution, the ash-dominated woodland around Morecambe Bay contains many patches of small-leaved lime *Tilia cordata*, which survive sometimes with elm *Ulmus* spp., often along outcrop edges. There is a rich assemblage of rare species, including fingered sedge *Carex digitata*, wood fescue *Festuca altissima* and mezereon *Daphne mezereum*. A notable feature of this wood is the sudden vegetation change across the boundaries between the limestone, where the *Tilio-Acerion* occurs, and acid peats or Silurian slates.

Wye Valley Woodlands/Coetiroedd Dyffryn Gwy (45)

The woods of the lower Wye Valley on the border of south Wales and England form one of the most important areas for woodland conservation in the UK and provide the most extensive examples of *Tilio-Acerion* in the west of its range. A wide range of ecological variation is associated with slope, aspect and land form. The woodland occurs here as a mosaic with other types, including beech *Fagus sylvatica* and pedunculate oak *Quercus robur* stands. Uncommon trees, such as large-leaved lime *Tilia platyphyllos* and rare whitebeams such as *Sorbus porrigentiformis* and *S. rupicola*, are found here, as well as locally uncommon plants, including wood barley *Hordelymus europaeus*, stinking hellebore *Helleborus foetidus*, narrow-leaved bitter-cress *Cardamine impatiens* and wood fescue *Festuca altissima*.

2.9.5 Old acidophilous oak woods with *Quercus robur* on sandy plains (41.51)

2.9.5.1 Background to selection

Oak woodland is abundant in the UK on certain soil types, but many examples are secondary, having developed on, for example, former heathland. Such secondary woodlands tend to be poor in vascular plants. Therefore selection is centred on large ancient woodlands, particularly those with ancient trees important for their lichen, fungi or invertebrate assemblages. Veteran oaks are much more abundant in the UK than in most other European countries.

Sites have been selected to encompass the range of geographic and ecological variation of this habitat type in the UK. All the sites are in England. Two sites, the New Forest and Windsor Forest and Great Park, have been previously identified as 'important' in the Council of Europe review of European saproxylic invertebrate sites.

Oak woodland on acid, sandy or gravelly sites in lowland areas is considered to be broadly equivalent to NVC type W16 *Quercus* spp.-*Betula* spp.-*Deschampsia flexuosa* woodland and some stands of W10 *Quercus robur*-*Pteridium aquilinum*-*Rubus fruticosus* woodland. This old growth/veteran stage is an aspect of the structure and function of forest ecosystems that is particularly poorly represented in European woodland and hence was stressed in the site selection, as compared to ground flora representativity.

2.9.5.2 Site list

Birklands and Bilhaugh (48)

This site is the most northerly of those selected and is notable for its rich invertebrate fauna, particularly its spiders, and for a diverse fungal population. Both oak *Quercus* species are present, with a mixture of age classes, so there is good potential for maintaining the structure and function of the woodland system and a continuity of deadwood habitats.

Staverton Park and the Thicks, Wantisden (49)

This site is representative of the habitat type in the eastern part of its range, and its ancient oaks *Quercus* spp. have rich invertebrate and epiphytic lichen assemblages. Despite being in the most 'continental' part of southern Britain, the epiphytic lichen flora of this site includes rare and Atlantic species, such as *Haemotomma elatinum, Lecidea cinnabarina, Thelotrema lepadinum, Graphis elegans* and *Stenocybe septata*. Part of the site includes an area of old holly *Ilex aquifolium* trees that are probably the largest in Britain. The site has a very well documented history and good conservation of structure and function.

The New Forest (5)

This site is representative of the habitat type in the southern part of its UK range. It is the most extensive area of active wood-pasture with old oak *Quercus* spp. and beech *Fagus sylvatica* in north-west Europe and has outstanding invertebrate and lichen populations. This site is preferred over other sites that lack a succession of age classes because, although scattered over a wide area, the oak stands are found within a predominantly semi-natural landscape with a more balanced age structure of trees.

Windsor Forest and Great Park (14)

This site represents the habitat tyhpe in the south-eastern part of its UK range. It has the largest number of veteran oaks *Quercus* spp. in Britain (and probably in Europe) and is of importance for its range and diversity of saproxylic invertebrates.

2.9.6 Old oak woods with *Ilex* and *Blechnum* in the British Isles (41.53)

2.9.6.1 Background to selection

Within the EC this habitat type is confined to the UK and Ireland, where it is relatively widespread in the west. A key feature of European importance are the rich Atlantic bryophyte communities. Fourteen different bryophyte zones have been identified in Britain; there are distinct differences in the bryophyte assemblages within them. The richest zones are in the west Highlands of Scotland, and the site selection reflects the importance of this zone. Sites have been selected in the western part of the UK to give the best representation of Atlantic characteristic,s which are less well represented elsewhere in Europe. Additional emphasis has been given in site selection to the richest bryophyte zone.

In addition to the bryophyte zones, there are distinct differences in higher plant and animal assemblages in the south compared with the north. Selected sites reflect this ecological variation and geographical range, and the largest examples or complexes have been favoured. Sites are selected to (a) reflect the overall variation in the type, (b) give particular weight to the exceptional bryophyte communities that reach their finest development in West Scotland and (c) take account of the fact that nearly all the habitat type in the EC occurs in the UK.

This habitat type corresponds broadly to the 'western oakwoods' in previous accounts of UK woodlands (particularly NVC types W17 *Quercus petraea-Betula pubescens-Dicranum majus* woodland, W11 *Quercus petraea-Betula pubescens-Oxalis acetosella* woodland and W10e *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland *Acer pseudoplatanus-Oxalis acetosella* sub-community). This habitat type is widespread throughout western areas and shows considerable variation across its range, in terms of associated ground flora and the richness of its bryophyte communities. Rare and local butterfly species are also important. Local variations reflect the position of the woodland on the slope, soil depth, aspect and past woodland history. Adjacent woodlands have been grouped into clusters in the process of site selection to take account of the former more extensive and more continuous cover of this habitat type. The bryophyte-rich oakwood stands that dominate these woods do not exist in isolation but frequently occur as part of a mosaic of woodland types that varies with position on the slope, occurrence of streams or other water bodies and local soil enrichment. These transitions are important in understanding and maintaining the structure and function of the habitat type and differ across the country.

2.9.6.2 Site list

Borrowdale Woodland Complex (50)

This site in the north-west England bryophyte zone has the most extensive block of western oak woodland in northern England and has a diverse range of stand types, which contributes to conservation of structure and function. Northern species, such as the moss *Ptilium crista-castrensis,* occur, and the woods still hold populations of red squirrel *Sciurus vulgaris,* which is in decline throughout most of England and Wales. Rare plants such as touch-me-not balsam *Impatiens noli-tangere* and alpine enchanter's-nightshade *Circaea alpina* also have important British occurrences here.

Coedydd a Cheunant Rheidol/Rheidol Woods (51)

These woods provide an example of the habitat type in the south Wales bryophyte zone. The bryophyte communities are less well developed than in the northern examples, owing to the drier micro-climates. There are some lowland characteristics in the woods, including the occurrence of small-leaved lime *Tilia cordata* in places, suggesting a fragmentary occurrence of the *Tilio-Acerion* woodland type.

Coedydd Derw Meirion/Meirionnydd Oakwoods (199)

This is an example of western hill woodland with a rich Atlantic flora of lichens and bryophytes in the north Wales bryophyte zone. Notable bryophyte species include the endangered *Sematophyllum demissum* and the nationally scarce *Campylopus setifolius* and *Leptoscyphus cuneifolius.* The woods in the complex occur on a variety of slopes and aspects and in narrow ravines and gorges, which leads to variation in species composition. Despite past coppice management of the woods, inaccessibility of the ravines and gorges has allowed the survival of mature trees on which the more rare and sensitive bryophyte species depend.

Largalinny (307)

This site has been selected to represent bryophyte-rich oakwoods in Northern Ireland. The site contains mixed deciduous woodland in which western oakwood predominates, but there is also good representation of flush, calcicolous woodland, and there is a transition to open heath. A number of rare species, such as the serrated wintergreen *Orthilia secunda* and the oceanic Tunbridge filmy-fern *Hymenophyllum tunbrigense,* are found here, as well as a rich bryophyte and lichen flora.

Loch Etive Woods (53)

This example in western Scotland is one of three sites selected to represent the habitat type in the most bryophyte-rich zone, the south-west Highlands zone. The oakwood occurs in combination with both wet alder *Alnus glutinosa* and base-rich ash-elm-hazel *Fraxinus-Ulmus-Corylus avellana* stands, giving additional patterns of structural variation and transitions. The diversity of soils and physical conditions leads to transitions to wet alder and base-rich ash-elm. The woods support important populations of chequered skipper butterfly *Carterocephalus palaemon*.

Loch Lomond Woods (163)

This is one of three sites representing the south-west Highlands bryophyte zone. This extensive block of woodland in western Scotland includes a mosaic of woodland types, including ash *Fraxinus excelsior*, elm *Ulmus* spp. and alder *Alnus glutinosa* woodland, which adds to the ecological variation of the site. Pedunculate oak *Quercus robur,* rather than sessile oak *Q. petraea,* is locally abundant, and the oak stands intergrade in places with ash-elm stands and alder at flush sites by the loch. The stands on the islands include areas that have been less subject to grazing than many other examples of this type of woodland.

Loch Maree Complex (173)

This site in western Scotland is the most northerly example of the western oakwood type and is representative of the north-west Highlands bryophyte zone. The ground flora communities range from base-rich areas through to those dominated by dwarf-shrubs. A distinct feature of this site is the juxtaposition of the oakwood and the **Caledonian pine forest,** an Annex I habitat type for which this site is also selected. Oak-dominated woodland on the lower slopes grades through a series of transition communities to Scots pine *Pinus sylvestris* and birch *Betula* spp. communities at higher altitudes.

Loch Sunart Woodlands (263)

This site on the west coast of Scotland contains the richest complex of Atlantic bryophyte-rich woodland in the UK and is a representative of the Mid-west Highlands bryophyte zone. The woods support a rich fern flora and a diverse range of lichens, including well-developed lung-wort *Lobarion* communities and many rarities. The woodland canopy is diverse, with areas of ash *Fraxinus excelsior* and hazel *Corylus avellana*, and alder *Alnus glutinosa* on wet ground. Uninterrupted transitions to marine habitats are found along the shore, a rare situation in British woodlands. The rare chequered skipper butterfly *Carterocephalus palaemon* has a strong population within these woods.

South Dartmoor Woods (52)

This complex is the most southerly of the sites selected and is representative of the south-west England bryophyte zone, where the lichen and bryophyte communities are less rich than in western Scotland. This is partly as a consequence of the differences in climate but is also linked to more intensive woodland management in the past. Other taxa are well represented here; for example, glades and sheltered wood-edges are important for the high brown fritillary butterfly *Argynnis adippe,* which does not occur in Scotland. The dormouse *Muscardinus avellanarius* is also present. The woods show transitions to lowland mixed woodland with small-leaved lime *Tilia cordata,* in common with other examples of the type in the south-west.

Taynish Woods (32)

This continuous block of woodland on the west coast of Scotland is one of three representatives of the rich south-west Highlands bryophyte zone. The site is notable for its outstanding lichen and bryophyte communities, which include species with a predominantly southern distribution, such as the rare *Physcia clementei*. In the less

acidic areas a rich ground flora including narrow-leaved helleborine *Cephalanthera longifolia* occurs. Transitions to open bog-filled hollows with marsh fritillary butterfly *Eurodryas aurinia* and a small mesotrophic loch also occur.

2.9.7 *Caledonian forest (42.51)

2.9.7.1 Background to selection

Within the EC, this priority habitat type occurs only in Scotland. It is estimated that between 12,000 and 16,000 ha of this type occurs in Scotland. Although Scandinavian countries hold a far greater amount of Scots pine *Pinus sylvestris* woodland, the Scottish pinewoods represent genetically distinct oceanic variants and are therefore extremely important in a European context. The UK has a special responsibility to ensure adequate representation of the habitat type. Site selection has ensured that there is coverage of the full genetic and ecological variation of the habitat type within its geographic range. The sites chosen are amongst the largest in the UK and include over 80% of the area of **Caledonian forest** in the UK.

These woodlands correspond to the W18 *Pinus sylvestris-Hylocomium splendens* woodlands of the NVC.

Relict indigenous forests of *Pinus sylvestris* var. *scotica* occur throughout the central and north-eastern Grampian mountains and in the northern and western Highlands of Scotland. Studies of the terpenes in the resin of shoots have shown that there are biochemical differences between the pinewoods that are an expression of the genetic differences. These studies have identified seven distinct biochemical regions, namely:

North
North Central
North West Exclusion Zone
North East
East Central
South Central
South West Exclusion Zone.

Sites have been selected from each biochemical region in order to ensure representation of the full range of ecological and genetic variation across Scotland. There is geographic and ecological variation within the regions, particularly in the large North Central and North east regions. In these areas there is also a particular concentration of high quality pinewoods. This distribution is represented in the site series.

The sites selected are the best examples of Caledonian forest from each biochemical region. The site selection has concentrated on the largest and most diverse examples of the remaining Caledonian Pine Forest resource that have good internal woodland structure and the capacity for regeneration. Selection has positively excluded very small, scattered remnants woodlands with poor structure and that are isolated from other woodlands and/or where there appear to be poor prospects for regeneration.

Where adjacent or neighbouring woodlands appear to be fragments of a formerly more extensive woodland, they have been linked together as complexes for the purposes of site selection. The essential feature of these complexes is that the individual woodlands, both large and small, form a coherent ecological unit by reducing isolation and providing the opportunity to restore the connections between wooded habitats.

2.9.7.2 Site list

The list of sites for this habitat type is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

Amat Woods (57)

This is a complex of two woodland areas, Amat Woods and Alladale Woods, selected as a representative of the North Central biochemical region. The complex has been selected to represent the northern variation of this geographically wide ranging region. Although comprising only remnants of a formerly more extensive woodland, the pinewood area is still large. The soils are mainly acidic, although basic flushes are a major feature of the wood, leading to the occurrence of plants not normally associated with pinewood, such as primrose *Primula vulgaris.*

Ardgour Pinewoods (154)

This complex of woodland includes the principal pinewoods of northern Ardgour, including Cona Glen Doire Mor and Loch Shiel Woodlands. These have been selected to represent the South West Exclusion Zone. The pinewood of this zone is considered to be genetically distinct from that elsewhere in Scotland. Its origins are believed to be similar to those of the North West Exclusion Zone, in that the woods may have recolonised from pinewood remnants that survived the ice age on the then west coast of Scotland. The pinewoods in this complex are the largest, most intact and diverse remnants of semi-natural pinewood in this biochemical region. There is a rich flora of oceanic mosses and liverworts (including the nationally scarce *Cephalozia catenulata* and *Plagiochila carringtonii*) and a notable invertebrate fauna, including the rare beetle *Boletophagus reticulatus* and the chequered skipper butterfly *Carterocephalus palaemon.*

Black Wood of Rannoch (55)

This site is the most extensive area of relict Caledonian pinewood remaining in Perthshire. It is representative of the South Central biochemical region and is the most southerly pinewood selected. The wood contains important communities of species characteristic of old pinewoods, particularly lichens and fungi, and supports a number of rare species, such as coralroot orchid *Corallorhiza trifida* and serrated wintergreen *Orthilia secunda*. It also supports populations of the Scottish crossbill *Loxia scotica* and capercaillie *Tetrao urogallus*.

Cairngorms (209)

This complex, consisting of six individually large pine woodland sites, including Abernethy and North Rothiemurchus, has been selected to represent the more 'continental' East Central biochemical region, typically with W18a *Pinus sylvestris-Hylocomium splendens* woodland *Erica cinerea-Goodyera repens* sub-community. This complex of woodlands is the most extensive area of native pinewood in the UK and comprises almost half the total area of remnant Caledonian forest in Scotland. In common with the rest of Scotland, the upper limits of the pine woodland are mostly artificially depressed by grazing, but a natural tree-line occurs at 640 m on Creag Fhiachlach. This is the highest natural altitudinal limit in the UK and consists of bushy stunted growth of pine *Pinus sylvestris* admixed with juniper *Juniperus* spp. of a similar stature. The pine woodland shows transitions to a wide range of other vegetation ,including bog woodland on the forest mires. There are areas of calcicolous herb-rich pinewood at Mor, similar to those described at Ballochbui. This type of forest is of very restricted distribution in Scotland.

Glen Tanar (54)

This site has been chosen as a representative of the North East biochemical region. It is the largest pinewood in the region and is the third largest pinewood in the UK. Although genetically part of the North East region, ecologically the site may be considered part of the adjacent Cairngorms complex. An unusual range of age classes is present, with active colonisation of open areas by young trees. The site contains nationally important populations of capercaillie *Tetrao urogallus* and black grouse *Tetrao tetrix* and is probably the most important locality in Britain for the Scottish crossbill *Loxia scotica*.

Kinveachy Forest (56)

The pinewood of Kinveachy is one of the major tracts of remnant Caledonian forest in Strathspey and is the third largest pinewood in the region. Although genetically part of the North East biochemical region, ecologically it may be considered part of the adjacent Cairngorms complex. The range of forest habitat present is important for several bird species, including capercaillie *Tetrao urogallus*, Scottish crossbill *Loxia scotica* and crested tit *Parus cristatus.* The site is characterised by dense stands of pine with extensive juniper *Juniperus communis* scrub and birch *Betula* and alder *Alnus* woodland, within a matrix of open moorland, providing an opportunity for the woodland to function naturally through regeneration onto open areas.

Loch Maree Complex (173)

This complex is consists of four individual sites, and is representative of the North West Exclusion Zone. The pinewoods in this region are considered to be genetically distinct from those elsewhere in Scotland. Their origins are believed to be similar to those of the South West Exclusion Zone. Genetic variation is high and the woods have affinities with the pinewoods of Spain and southern France. Pollen records from peatbogs in the area suggest that these pines may be the descendants of trees which survived the last ice age somewhere off the

present west coast of Scotland when the sea-level was much lower. Together these woods show a strong oceanic influence and mostly fall within the W18d *Sphagnum capillifolium/quinquefarium* and W18e *Scapania gracilis* sub-communities of the W18 *Pinus sylvestris-Hylocomium splendens* woodland community. The woodland at Beinn Eighe is scattered and of variable canopy structure and shows a mixed range of age groups. The diversity of Atlantic bryophytes is a major feature of the site, and several national rarities are present, including *Daltonia splachnoides* and *Andrea nivalis*. The Loch Maree Islands support one of the least disturbed remnants of native pinewood in Scotland. In the wettest areas within the woodland there are small-scale examples of Scandinavian-type bog woodland. At Shieldaig there is the most westerly pinewood in the UK and one of the most extensive blocks of woodland in this biochemical region. Part of the wood has major bryophyte interest, being important for the diversity of species and the presence of several national rarities, including *Daltonia splachnoides* and *Kurzia sylvatica.*

Rhidorroch Woods (184)

The complex has been selected to represent the North biochemical region and is part of a larger mosaic of woodland. Virtually the complete range of woodland types characteristic of the north-west Scottish Highlands is found here, centred on the unmodified Rhidorroch river system and interspersed with areas of heathland, peatland and semi-natural grassland. The diversity of the ground flora reflects site diversity and species include serrated wintergreen *Orthilia secunda* and creeping lady's-tresses *Goodyera repens*.

Strathglass Complex (185)

The pinewoods in this complex have been selected as a representative of the North Central biochemical region and are intermediate in type between the western and eastern geographic variants. The individual woodlands within the complex are some of the largest remaining intact stands of native pinewood in Scotland. Glens Strathfarrar and Affric are the most important pinewoods in the UK for the epiphytic lichen communities they support. A number of nationally rare lichen species occur in the woods, including *Bryonia furcellata* and *Pannaria ignobilis*.

2.9.8 *Bog woodland (44.A1 to 44.A4)

2.9.8.1 Background to selection

This priority habitat type is extremely rare in the UK and only four sites are considered to be of sufficiant size and conservation of structure and function to merit selection. They represent the geographic range of the habitat type in the UK. Such woodlands are very extensive in Fenno-Scandia and the UK is not therefore considered to have special responsibilities for their conservation.

Under rare combinations of physical circumstances in the UK, scattered trees can occur across the surface of a bog, in a relatively stable ecological relationship as open woodland, without the loss of bog species. This is a much rarer condition than the progressive invasion of bog by trees, through natural colonisation or afforestation following changes in the drainage pattern, which leads to the loss of the bog community. It has tended to be overlooked in most ecological accounts of Britain.

A few examples of this unusual habitat type are found in areas of Scotland with a more characteristically continental climate, where summer drying may permit the establishment and growth of roots in the upper peat layers. The structure and function of this habitat type is characteristic and is finely balanced between tree growth and bog development. Tree growth, however, is always slow (or the trees would take over the bog); the trees are likely to be widely spaced (because much of the surface area is too wet for them to establish) and dead trees may be common even among the fairly small individuals (because their weight depresses the peat locally leading to waterlogging and death). The key elements in evaluation are therefore: relative ecological stability of the open woodland-bog species combination; and the characteristic patterns of growth and survival of the tree species on the bog surface.

The principal tree species on these sites is Scots pine *Pinus sylvestris.* The nature of the habitat type means that it is difficult to classify and it has not been well described in the UK. Communities present are likely to be intermediate in character between the NVC community W18 *Pinus sylvestris-Hylocomium splendens* woodland and open mire types such as M18 *Erica tetralix-Sphagnum papillosum* mire.

An extremely rare variant of this habitat type in the UK occurs where birch *Betula* spp., willow *Salix* spp. or alder *Alnus* spp. occur in long-term stable combinations with bog vegetation. Fragments of this variant have been recorded only on the New Forest valley bogs.

2.9.8.2 Site list

Cairngorms (209)

This is one of the largest areas of native Caledonian pinewood in the UK, lying on gently undulating glacial deposits in the foothills of the Cairngorms. Pine *Pinus sylvestris* bog woodland can develop because the irregular glacial topography allows marked variations in geomorphology and drainage pattern . The drier slopes and knolls support mature pine woodland and the hollows between support wet mires with abundant stunted pine bog woodland. These stands are composed of mire vegetation, either M18 *Erica tetralix-Sphagnum papillosum* mire or M19 *Calluna vulgaris-Eriophorum vaginatum*, with a scattering of stunted pine trees and saplings. A good example of this community occurs at Moormore within Rothiemurchus forest. The bog woodland appears to be stable, and the trees, although stunted, continue to grow. In total the hollows form an extensive area representing the largest example of this habitat type in Scotland.

Monadh Mor (175)

This site in northern Scotland is a complex area of ridges and hollows resulting from glacial deposition. Many of the hollows have become filled with peat and swamp, though larger areas contain open water. The ridges are largely wooded with pine *Pinus sylvestris* and birch *Betula* spp., while more extensive hollows support raised bog on which stunted pine is abundant. These communities are classed as bog vegetation (M18 *Erica tetralix-Sphagnum papillosum*) with scattered trees. The pine-bog relationship appears to be stable, and the pines are still growing. This site has been selected to represent one of the largest areas of bog woodland in a single location in the UK.

Pitmaduthy Moss (176)

This bog in northern Scotland has, unusually, developed under relatively dry climatic conditions. The site is relatively undamaged and has strong affinities with Scandinavian bog. It consists of a system of pools in a shallow hollow bounded by low ridges. On the slightly drier areas within the hollow scattered stunted pine *Pinus sylvestris* occurs, with the characteristic slow growth pattern and in a stable relationship with the bog surface. The trees become more abundant and attain greater size on the drier ridges.

The New Forest (5)

At this location within the New Forest, in southern England, birch-willow *Betula-Salix* stands occur over valley bog vegetation, with fringing alder *Alnus-Sphagnum* stands where there is some water movement. These stands appear to have persisted for long periods in stable association with the underlying *Sphagnum* communities. The rich epiphytic lichen communities and pollen record provide evidence for the persistence of this association.

2.9.9 *Residual alluvial forests (*Alnion glutinoso-incanae*) (44.3)

2.9.9.1 Background to selection

In general, this habitat type is widespread in Europe. Because of the nature of the habitat type it occurs in small fragments, for which discrete boundaries cannot readily be defined. In the UK sites have been selected to take account of the priority status of this habitat type and the wide range of ecological situations in which it occurs. Selection has favoured the rare, extensive examples of this habitat type that also represent its geographic range.

Alder *Alnus glutinosa* woods are found on floodplains in a range of situations from islands in river channels to low-lying wetlands alongside the channels. Many alder woods are part of a dynamic system, being in some cases part of a successional series of habitats. Their structure and function are best maintained within a larger unit that includes the open communities of earlier successional stages. On the drier margins of these areas other tree species, notably ash *Fraxinus excelsior* and elm *Ulmus* spp., may become abundant. In other situations the alder woods occur as a stable component within transitions to surrounding dry ground forest. These transitions from wet to drier woodland and from open to more closed communities provide an important part of the ecological variation on which site selection has been based.

In the UK, this habitat type falls within the NVC communities W5 *Alnus glutinosa-Carex paniculum* woodland, W6 *Alnus glutinosa-Urtica dioica* woodland and W7 *Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum* woodland.

9.9.2 Site list

Coed y Cerrig (58)

This site in south Wales has been selected as a valley-bottom alder *Alnus glutinosa* wood with transitions to ash-elm *Fraxinus-Ulmus* and oak *Quercus* spp. woodland. As such it represents an example of the habitat type as part of a managed woodland mosaic, with good conservation of structure and function.

Conon Islands (165)

This site at the mouth of the River Conon in the Highlands of Scotland has been selected as an example of a relatively unmodified dynamic alluvial woodland system - a rare situation in Europe. It provides one of the most complete examples in the site series of transition from woodland through scrub and freshwater fen to saltmarsh communities. The upper part of the site has a cover of alder *Alnus glutinosa* wood, which is subject to regular inundation and which gives way downstream to alder and willow *Salix* spp. scrub.

Lower River Spey/Spey Bay (291)

The Lower River Spey in the north-east of Scotland is unique within Britain in comprising an extensively braided channel along the whole length of the river. The active river channel provides a mosaic of substrates and in more stable, damper situations large stands of valley alder *Alnus glutinosa* woods occur.

Mound Alderwoods (164)

This site in the north-east of Scotland is the most northerly site selected and is the largest estuarine alder *Alnus glutinosa* wood in Britain. It provides examples of successional stages from estuarine mud to dense woodland and is representative of the more stable habitat type.

The Broads (166)

This complex of sites in the Broads in East Anglia contains the largest blocks of alder *Alnus glutinosa* wood in England. Within the complex complete successional sequences occur from open water through reedswamp to alder woodland, which has developed on fen peat. There is a correspondingly wide range of flora, including a number of uncommon species such as the marsh fern *Thelypteris palustris*.

The New Forest (5)

The New Forest contains many streams and some small rivers that are less affected by drainage and canalisation than those in any other comparable area in the lowlands of England. Associated with many of the streams, particularly those with alkaline and neutral groundwaters, are strips of alder *Alnus glutinosa* woodland which, collectively, form an extensive resource with a rich flora. In places there are examples of transitions from open water through reedswamp and fen to alder woodland The small rivers show natural meanders and debris dams, features that are otherwise rare in the lowlands, with fragmentary ash *Fraxinus excelsior* stands as well as the alder strips. In other places the transitions grade into old acidophilous oak woods with ***Quercus robur* on sandy plains** and **Beech forests with *Ilex* and *Taxus*, rich in epiphytes (Ilici-Fagion)**, for which this site has also been selected.

2.9.10 **Taxus baccata* woods** (42.A71 to 42.A73)

2.9.10.1 Background to selection

This is a priority habitat type that is relatively rare in Europe and in the UK is scattered mainly in the southern part of the country. Sites were selected to take account of the priority status of this habitat type and to encompass its geographic range and ecological variation (especially the variety of associated woodland types), as well as representation on chalk and on limestone substrates. Sites were selected that were either extensive pure yew *Taxus baccata* stands or where yew groves occur as distinct communities in larger woodland blocks, so that the range of structural and functional relationships between yew and other types could be adequately represented.

Yew woodland occurs predominately on calcareous substrates scattered mainly in the south of the UK. It is classified as NVC type W13 *Taxus baccata* woodland. Ecological variation arises according to the nature of the yew wood, which may be either the senescent phase of a beech *Fagus sylvatica* wood forming clusters of yew after the fall of beech, or primary woodland developing on unstable slopes. In the UK more northerly examples tend to be associated with ash *Fraxinus excelsior* and elm *Ulmus* spp., and the yew is more likely to remain as the main overstorey species. Association with beech and holly *Ilex aquifolium* is less common than on the continent.

2.9.10.2 Site list

Castle Eden Dene (60)

This site in the north-east of England represents the most northerly part of the habitat type's UK range. Extensive yew *Taxus baccata* groves are found in association with ash-elm *Fraxinus-Ulmus* woodland and it is the only site selected for yew woodland on Magnesian limestone in north-east England.

Great Yews (61)

This is one of three sites selected on chalk and is representative of the habitat type in the south-west of its range. Although it is the smallest listed site, it is important for the presence of about 300 old trees. It probably originated as yew *Taxus baccata* wood following beech *Fagus sylvatica* or ash *Fraxinus excelsior*. It has some regeneration and so has the full structural and functional range expected of yew stands.

Kingley Vale (59)

This is one of three sites representing yew *Taxus baccata* on the southern chalk. It has been selected primarily because of its size, as it is the largest area of yew woodland in Britain. However it also shows excellent conservation of the full range of structure and function.

Mole Gap to Reigate Escarpment (72)

At this site, the third to represent the habitat type on chalk in the central southern part of its UK range, yew *Taxus baccata* woodland has been formed both by invasion of chalk grassland and from development within beech *Fagus sylvatica* woodland following destruction of the beech overstorey. Yew occurs here in extensive stands, with, in places, an understorey of box *Buxus sempervirens* at one of its few native locations.

Morecambe Bay Pavements (191)

This site has been selected as an example of the habitat type in north-west England. The site is functionally considered alongside the Roudsea Wood and Mosses site. These yew *Taxus baccata* woods are on the northern Carboniferous limestone and, as in the Wye Valley, yew occurs both as dense groves and as scattered trees in the understorey of ash or ash-elm *Fraxinus-Ulmus* woodland. Yew here represents the development of long-established stands on unstable scree and rocky slopes.

Roudsea Wood and Mosses (275)

The yew *Taxus baccata* woods of Roudsea Wood have strong similarities with the yew stands of the Morecambe Bay Pavements site, and the two sites are adjacent and functionally linked. They are on the northern Carboniferous limestone, and as in the Wye Valley yew occurs both as dense groves and as scattered trees in the understorey of ash or ash-elm *Fraxinus-Ulmus* woodland.

Wye Valley Woodlands/Coetiroedd Dyffryn Gwy (45)

This site is representative of the habitat type in the south-west of its range. It lies on the southern Carboniferous limestone, and the yew *Taxus baccata* in the woods occurs both as an understorey to other types and as major groves, particularly on the more stony slopes and crags.

Part 3: Annex II species accounts

Section 3.1: Mammals

3.1.1 Greater horseshoe bat *Rhinolophus ferrumequinum*

3.1.1.1 Background to selection

The greater horseshoe bat *Rhinolophus ferrumequinum* is a rare species in Europe. It has suffered a considerable decline in central Europe and a loss of over half its range in the UK. In the UK populations are close to the climatic limits for this species. The total UK population of between 4,000 and 6,000 individuals can be divided into about twelve discrete populations, based on maternity (summer) roosts and their associated hibernation sites (hibernacula). Populations range in size from about 80 to 600 breeding females and there is relatively little interchange between populations. In order to maintain populations, both summer and winter roosts must be protected, so sites were selected, where possible, as composites of maternity and hibernation sites belonging to a single population.

Sites were selected to include those with the best representation of features required for survival (including overwintering survival) and reproduction and to cover the geographical range of the species. Large sites were favoured, based on population estimates calculated as double the number counted at the maternity roost.

While the site series will make a contribution to securing the favourable conservation status of this species, wider measures are essential to conserve it in the UK.

3.1.1.2 Site list

Bath and Bradford-on-Avon Bats (12)

This site in southern England includes the hibernation sites associated with 15% of the UK species population and so has been selected on the basis of the importance of this exceptionally large overwintering population.

Limestone Seacliffs of S.W. Wales/Clogwyni Calchfaen Deorllewin Cymru (197)

This site in south-west Wales contains the main hibernation site for the population associated with Pembrokeshire bat sites/Safleoedd Ystlumod Pemfro. It may thus be used by up to 5.5% of the UK population of greater horseshoe bats.

Mells Valley (26)

This site in southern England been selected on the basis of the size of its exceptional breeding population. It contains the maternity site associated with a population comprising about 12% of the UK species population. A proportion of the population also hibernates at the site, though other hibernation sites remain unknown.

North Somerset and Mendip Bats (313)

This site in south-west England has been selected on the basis of the size of population represented (3% of the UK species population) and its good conservation of structure and function, having both maternity and hibernation sites. This site contains an exceptionally good range of the sites used by the population, comprising two maternity sites in the lowland North Somerset district and a variety of cave and mine hibernation sites in the Mendips.

Pembrokeshire Bat Sites/Safleoedd Ystlumod Penfro (203)

This site in south-west Wales supports approximately 5.5% of the UK species population. It has been selected as an important representation of the species in the north-western extremity of its range. The site contains a mixture of maternity, transitory and hibernation sites and so demonstrates good conservation of features required for survival.

South Hams (25)

This site in south-west England is thought to hold the largest population of the species in the UK and is the only one containing more than 1,000 adult bats (31% of the UK species population). It contains the largest maternity roost in England and possibly in Europe. As the site contains both maternity and hibernation sites it demonstrates good conservation of the features required for survival.

Wye Valley and Forest of Dean Bat Sites/Safleoedd Ystlumod Dyffryn Gwy a Fforest y Ddena (204)

The Wye Valley and Forest of Dean, which lies on the border between England and Wales, has been selected to provide representation of the species in the northern part of its distribution, with about 6% of the UK population. The site contains the main maternity site for these bats, which are believed to hibernate in the many disused mines in the Forest.

3.1.2 Lesser horseshoe bat *Rhinolophus hipposideros*

3.1.2.1 Background to selection

The lesser horseshoe bat *Rhinolophus hipposideros* is a rare but widely dispersed species in Europe. The total UK population of about 15,000 individuals is also dispersed, occurring in over 170 maternity roosts and over 300 hibernation sites (hibernacula) in south-western England and Wales. In order to maintain populations, both maternity and hibernation sites must be protected, so sites were selected, where possible, as composites of maternity and hibernation sites considered to belong to a single population or group of closely associated populations.

Population estimates are based on double the number counted at the maternity roosts, and sites with large populations were selected to cover the geographical range of the species.

While the site series will make a contribution to securing the favourable conservation status of this species, wider measures are essential to conserve it in the UK.

3.1.2.2 Site list

The list of sites for this species is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

Coleg Glynllifon (27)

This single site in north Wales is both a maternity and hibernation site for a large population of bats, comprising about 6% of the UK species population.

Tanat and Vyrnwy Bat Sites/Safleoedd Ystlumod Tanat ac Efyrnwy (195)

This area of central Wales contains a good mixture of maternity and hibernation sites thought to support about 4% of the UK species population, though counts in hibernation sites suggest this may be an underestimate.

Usk Bat Sites/Safleoedd Ystlumod Wysg (196)

The Usk Valley area in south-east Wales contains one of the largest maternity roosts for the lesser horseshoe bat as well as a number of important hibernacula in caves in the area. The area contains up to 5% of the UK species population, though counts in hibernation sites suggest this may be an underestimate.

Wye Valley and Forest of Dean Bat Sites/Safleoedd Ystlumod Dyffryn Gwy a Fforest y Ddena (204)

This complex of sites, which lies on the border between England and Wales, contains by far the greatest concentration of lesser horseshoe bats anywhere in the UK, totalling about 26% of the national species population. It has been selected on the grounds of the exceptional breeding population, and the majority of sites within the complex are maternity roosts. The bats are believed to hibernate in the many disused mines in the area.

3.1.3 Barbastelle *Barbastella barbastellus*

3.1.3.1 Background to selection

The barbastelle *Barbastella barbastellus* is one of the UK's rarest mammals, recorded from only a handful of sites. Only one, very recently discovered, maternity site is currently known. The great majority of other records come from caves or abandoned mines, which are important hibernation sites for a range of bat species. The barbastelle is widely distributed across southern Britain but there are few records to demonstrate the long-term viability of populations.

This is a rare species and only one site is considered to have sufficient records over a long period to justify its selection. This one site has been selected.

While the site series will make a contribution to securing the favourable conservation status of this species, wider measures are essential to conserve it in the UK.

3.1.3.2 Site list

Chilmark Quarries (208)

This complex of abandoned mines in central-southern England is regularly used by small numbers of barbastelles as a hibernation site. The site also contains an important assemblage of other species, including Bechstein's bat *Myotis bechsteini*, another Annex II species for which this site has also been selected, indicating that conditions at this site are particularly favourable for the survival of these bat species.

3.1.4 Bechstein's bat *Myotis bechsteini*

3.1.4.1 Background to selection

Bechstein's bat *Myotis bechsteini* is one of the UK's rarest mammals, recorded from only a small number of sites. Only one, very recently discovered, maternity site is known. The great majority of other records come from caves or abandoned mines, which are important hibernation sites for a range of bat species. Bechstein's bat is closely associated with mature woodland and probably breeds in tree holes.

This is a rare species known from very few sites in the UK. Only two sites, both in the south-west of England, are considered to have sufficient records over a long period to justify selection and both sites have been selected.

While the site series will make a contribution to securing the favourable conservation status of this species, wider measures are essential to conserve it in the UK.

3.1.4.2 Site list

Beer Quarry and Caves (13)

This complex of abandoned mines in south-west England is regularly used as a hibernation site by small numbers of Bechstein's bats as well as an important assemblage of other species.

Chilmark Quarries (208)

This complex of abandoned mines in central-southern England, is regularly used as a hibernation site by small numbers of Bechstein's bats. The site also contains a nationally important assemblage of other species, including the barbastelle *Barbastella barbastellus*, another Annex II species for which this site has also been selected, indicating that conditions are particularly favourable for the survival of these bat species.

3.1.5 Otter *Lutra lutra*

3.1.5.1 Background to selection

The otter *Lutra lutra* has a rather discontinuous distribution in the EC. There are strong populations in Greece, Spain and Portugal. Over most of continental western Europe the species is scarce to extinct. It is still scarce over much of England, with stronger populations in Scotland, Wales and Ireland.

Historically, otters occurred over most of the UK. However, persecution, habitat loss and, most recently, the impact of toxic organochlorine insecticides caused a marked reduction in the range of this species. At present, approximately 90% of the otter population in Great Britain occurs in Scotland, with a significant proportion of this number being found in the north and west of the country. The otter is still scarce or absent over most of the UK. The highest concentrations in England are in the south-west. However, recent survey suggests that the otter population is recovering in England and parts of Scotland and Wales where it was formerly uncommon.

Otters can occur in a wide range of ecological conditions. Populations occur in coastal areas (particularly in Scotland), where they utilise shallow, inshore marine areas for feeding but also require fresh water for bathing and terrestrial areas for resting and breeding holts. Coastal otter habitat ranges from sheltered wooded inlets to more open, low-lying coasts. Inland populations utilise a range of running and standing fresh waters. These must have an abundant supply of food (normally associated with high water quality), together with suitable habitat, such as vegetated river banks, islands, reedbeds and woodland, which are used for foraging, breeding and resting.

The site series reflects the otter's present discontinuous distribution in the UK. Sites that are known to have high densities have been selected to represent the current strongholds of the population. The sites selected also cover the ecologically variable conditions in which the species is found across its range. As well as a known high density of otters, sites selected have good quality habitat features necessary for feeding and reproduction. This is demonstrated by a known record of continuous occupation of the site, even, in England, during the period of population decline.

The otter population is widespread and individuals are wide ranging, normally occurring at low densities. While the site series will make a contribution to securing the favourable conservation status of this species, wider measures are essential to conserve it in the UK.

3.1.5.2 Site list

The list of sites for this species is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

Loch Sunart Woodlands (263)

Loch Sunart Woodlands supports a relatively high density of otters. Records show that the site has supported consistently strong populations, indicating that the habitat is suitable for the species. The site is representative of coastal otter populations on the west coast of Scotland, which is a stronghold for the species. The otters mainly forage in the extensive alga beds that occur throughout the shallow areas of the loch and which serve as habitat for important prey species. High densities of otter holts have been recorded in many terrestrial areas bordering the edge of the loch and on the main islands, often in areas of dense vegetation and rock boulder cover. There is also a large influx of freshwater from numerous streams and rivers around the site, which are important to the otter for washing.

River Wye/Afon Gwy (22)

Survey indicates that the Wye holds the densest and most well-established otter population in Wales. It is representative of otters occurring in lowland freshwater habitats in the borders of Wales. The river has bankside vegetation cover, abundant food supply, clean water and undisturbed areas of dense scrub suitable for breeding, making it particularly favourable as otter habitat. The population remained even during the lowest point of the UK decline, confirming that the site is particularly favourable for this species and the population likely to be

highly stable. The River Wye supports a number of Annex I habitat types and Annex II species for which it has been proposed in their own right.

Upper Lough Erne (220)

This site provides representation of the otter in Northern Ireland. The province holds one of the strongest populations of otters in the UK. Upper Lough Erne consists of a large eutrophic lake with very extensive associated wetland habitats that holds a dense and large population of otters. In addition the surrounding countryside is rich in relatively unpolluted rivers and lakes and has a high density of semi-natural habitats, especially wetlands, supporting the population within the site.

3.1.6 Grey seal *Halichoerus grypus*

3.1.6.1 Background to selection

The UK holds some 115,000 grey seals, approximately 50% of the world population and 95% of the EC population. There are breeding colonies all round the coast, from the Scilly Isles clockwise to the North Norfolk Coast. These colonies vary greatly in size.

Site selection takes account of the UK's responsibility to protect the population of this species. The largest breeding colonies have been selected, based on pup production. Sites were selected using the most up-to-date population information available at the time, although populations at individual sites may fluctuate. Colonies have also been selected to ensure coverage of the geographical range of breeding in the UK. The sites recommended for selection contain a significant proportion of the UK breeding population of grey seals.

While the site series will make a contribution to securing the favourable conservation status of this species, wider measures are essential to conserve it in the UK.

3.1.6.2 Site list

The list of sites for this species is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

Berwickshire and North Northumberland Coast (230)

This is an extensive and diverse stretch of coastline in north-east England and south-west Scotland. There is variation in the distribution of features of interest along the coast. The north-east England coastal stretch has been selected as representative of grey seal breeding colonies in the south-eastern section of the breeding range in the UK. This is the largest breeding colony on the North Sea coast, with some 3% of the British annual pup production, and is the most south-easterly site selected.

Faray and Holm of Faray (236)

These two uninhabited islands in the northern part of Orkney support a well-established grey seal breeding colony. The seals tend to be found in areas where there is easy access from the shore, and fresh water pools on the islands appear to be particularly important. The islands support the second largest breeding colony in the UK, with some 10% of the annual British pup production.

Monach Islands (35)

The Monach Islands, off the Outer Hebrides, Scotland, offer a wide area of largely undisturbed habitat for breeding seals, and there is easy access to the grassy swards and dune systems of the islands. These islands hold the largest breeding colony in the UK, with some 25% of the British annual pup population.

North Rona (36)

This remote and very exposed site is in the North Atlantic off the north-west tip of mainland Scotland. The islands are rarely disturbed by human activites in the breeding season. Seals are found over much of the island and use many of the submerged sea caves that are found around the coast. North Rona supports the third largest breeding colony in the UK, representing some 5% of the British annual pup production.

Pembrokeshire Islands/Ynysoedd Sir Benfro (160)

This site in Wales is representative of colonies in the south-western part of the breeding range in the UK. It is the largest breeding colony on the west coast south of the Solway Firth, representing over 2% of the UK annual pup production.

3.1.7 Common seal *Phoca vitulina*

3.1.7.1 Background to selection

The UK holds some 28,000 common seals, approximately 50% of the EC population. The species is found from Strangford Lough, Northern Ireland, and the south shores of the Clyde clockwise round the coast to the Thames estuary. The common seal is widespread, but population density varies greatly from place to place, with low numbers at many sites. This means it can be difficult to define the boundaries of specific sites. The census of the common seal population is based on numbers hauling-out in coastal locations during the moulting period in August. Such haul-out areas are thought to be very important for the conservation of the species, as are the most important breeding colonies. Sites were selected using the most up-to-date population information available at the time, although populations at individual sites may fluctuate.

Site selection has favoured sites that are important both as haul-out sites and for pupping. The largest breeding colony has been selected, and this is in the south of the species' range in the UK. The geographic range of breeding has been covered by the selection of a representative sample of larger colonies in the north of the country. As well as their importance in maintaining overall population size, such large sites are significant as sources of emigration to smaller or newly-established colonies.

3.1.7.2 Site list

The list of sites for this species is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

Mousa (37)

The exposed rocky island of Mousa, on the east coast of Mainland, Shetland, supports one of the largest groups of common seals in the Shetland Islands and one of the most northerly groups in the UK. The large rocky tidal pools on the island are of particular importance, as they are frequently used by the seals for shelter from the exposed conditions on the open coast. The site supports some 2-3% of the total British population.

The Wash and North Norfolk Coast (233)

The Wash, on the east coast of England, is the largest embayment in the UK. The extensive intertidal flats here and on the North Norfolk Coast provide ideal conditions for breeding and hauling out of common seal. This site holds some 7% of the total British common seal population and is the largest colony of common seals in the UK.

3.1.8 Bottlenose dolphin *Tursiops truncatus*

3.1.8.1 Background to selection

This species is widely distributed in North Atlantic, West African, Mediterranean and UK coastal waters. It occurs predominantly in two areas in UK inshore waters - Cardigan Bay and the Moray Firth. In addition, small groups appear to be resident or near-resident in waters off Cornwall and Dorset. The total population in the inshore waters of the UK is probably between 300 and 500 individuals. The species used to be more widespread, especially in the southern North Sea and English Channel, and has certainly declined in range.

In order for site designation under the Directive to be an appropriate mechanism for protection of Annex II species, it is expected that clearly identifiable areas can be defined that have the physical and biological factors essential to the life and reproduction of a population of the species. Only two areas in UK waters have been identified that meet this criterion for bottlenose dolphins; both these localities have been selected. The sites hold the only two substantial resident populations of the species in UK waters. While the individuals using the two sites may range further afield for some times of the year, dolphins are present throughout the year and individuals have been seen over periods of several years. This repeated occurrence and continual presence indicates that the sites are critical for the maintenance of these populations.

3.1.8.2 Site list

Cardigan Bay/Bae Ceredigion (38)

The population of dolphins in this locality off the west coast of Wales is estimated to be in the order of 100+ individuals. Dolphins are present all year round.

Moray Firth (marine) (267)

On present knowledge, this site in north-east Scotland supports the only resident population of bottlenose dolphins in the North Sea. The population is estimated to be around 130 individuals. Dolphins are present all year round, and, while they appear to range widely in the Moray Firth, they appear to favour particular areas.

Section 3.2: Amphibians

3.2.1 Great-crested newt *Triturus cristatus*

3.2.1.1 Background to selection

The great-crested newt is found widely throughout northern Europe and is distributed throughout much of England and Wales, although occurring only sparsely in south-west England and Scotland. It does not occur in Northern Ireland. The total UK population is relatively large and is distributed over sites that vary greatly in their ecological character.

One estimate has put the national population at around 400,000 animals in 18,000 breeding sites. Many of the sites are small and many of the populations ephemeral. The great-crested newt is mainly associated with early successional stages of pond and lake development, when fish are absent, as it is heavily predated by fish. Sites may therefore lose this species over time. This has posed a problem for site selection, and sites have been chosen where there is evidence of persistence.

Many of the largest populations are associated with pools created by mineral extraction and similar industrial activities. There are also large populations of this species in coastal dunes and shingle structures. The site list reflects this range of site types. Sites have been selected to reflect the geographical range and ecological variation of the habitat in which the species occurs. The populations at the sites selected are amongst the largest and most persistent in the UK. In addition sites have been favoured where the water bodies required for breeding are surrounded by habitat that is considered to be of importance for shelter and feeding of adults, favouring the long-term survival of the breeding population.

While the site series will make a contribution to securing the favourable conservation status for a species such as this, wider measures, including those identified under the UK Biodiversity Action Plan, such as pond creation and management, will play an important part in supporting the population in the UK.

3.2.1.2 Site list

Clints Quarry (300)

Situated in north-west England, this disused quarry contains several pools that support a large population which showed much evidence of recruitment in 1994. Terrestrial habitat associated with the breeding areas is quarry spoil, early successional vegetation and surrounding pasture.

Denby Grange Colliery Pond (301)

Situated in north-east England, this water body created by coal mining activity has consistently yielded high counts in recent years. The pond is surrounded by wooded slopes, with adjacent anthropogenic habitat associated with the previous mining activities. The population is currently reliant on a single water body and therefore some work, including pond creation, may be necessary to ensure the persistence of the population over the longer term.

Dungeness (150)

Situated in south-east England, Dungeness has the largest shingle expanse in Europe and contains a large number of water bodies within its 2,000 ha. This extensive site hosts a large and viable population in a range of natural and anthropogenic habitats. These include natural pools and those resulting from gravel extraction and other activities. Terrestrial habitat of importance for feeding and shelter is provided by a range of open shingle vegetation with scrub in the vicinity of some of the water bodies.

Glan-traeth (305)

Situated in north-west Wales, high counts since the mid 1980s confirm the presence of a large and viable population occupying water-filled depressions that have resulted from sand extraction from the dune system.

The site is lightly grazed by domestic stock, thereby maintaining the open terrestrial habitat required for feeding and sheltering of adults.

Orton Pit (314)

Situated in central England, this site contains the largest known population of great-crested newt in the UK and possibly in Europe. The extensive pond systems occupy disused ridge and furrow areas created by clay workings, at various successional stages. Management of water levels and predatory fish is essential for the maintenance of the large newt population. New ponds are created in ways that allow water control, and measures are taken to encourage rapid colonisation by newts in order to maintain the population. The range of habitats found throughout the site, including surrounding areas of grassland and scrub, provide good conditions for feeding and sheltering great-crested newts.

Section 3.3: Fish

3.3.1 River lamprey *Lampetra fluviatilis*

3.3.1.1 Background to selection

The river lamprey *Lampetra fluviatilis* is found only in western Europe, where it has a wide distribution from southern Norway to the western Mediterranean in coastal waters, estuaries and accessible rivers. The river lamprey is widespread in the UK, occurring in many rivers from the Great Glen in Scotland southwards, and populations are both strong and currently unexploited. The UK populations are considered important for the conservation of the species at an EC level. Sites that hold healthy populations, with clear water and spawning gravels, silt or sand required for the survival of this species, are proposed for selection. The selection of sites has covered the geographical range and has included a range of high quality river types in which the species occurs. The selected sites are generally extensive river systems, including important tributaries, to provide conservation of habitat features required by the river lamprey.

In general, lamprey species are widespread and relatively common. These species may often occur together in high quality river systems, and sites that have been chosen to represent these interests tend to be those of known value where several Annex II species are found.

Pollution or obstacles that the adults cannot surmount during the spawning migration, such as weirs or artificial dams, impede migration. The species is normally anadromous (i.e. spawning in freshwater but completing part of its life cycle in the sea), but there are a few land-locked populations, including one in Scotland. This population has been seen as having special European importance.

While the site series will make a contribution to securing favourable conservation status for this species, wider measures are essential to support the population in the UK.

3.3.1.2 Site list

The list of sites for this species is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

River Derwent and Bassenthwaite Lake (297)

This site has been selected to provide representation of river lamprey *Lampetra fluviatilis* in a more oligotrophic river type in northern England. Good numbers of this species are known to occur and this river has features that provide the necessary conditions for both spawning and nursery areas - extensive gravel shoals, good water quality and areas of marginal silt. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in its own right.

River Eden (23)

This site is selected as an example of a river lamprey *Lampetra fluviatilis* population associated with an extensive river system on a very varied and base-rich geology in northern England. The highly erodible nature of the rock results in extensive areas of gravel and finer silt being deposited throughout the system, providing conditions for spawning and nursery areas. The high quality of these habitats and their accessibility, even in the upper reaches, means that a large, healthy population of river lampreys occurs widely within the catchment. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

River Usk/Afon Wysg (133)

This site in South Wales supports a healthy population of river lamprey *Lampetra fluviatilis* and is considered to provide exceptionally good quality habitat likely to ensure the continued survival of this species in this part of its UK range. The river also supports important populations of the brook lamprey *Lampetra planeri*, for which it has been proposed in its own right

River Wye/Afon Gwy (22)

The River Wye is an extensive river system crossing the border between England and Wales, and the river lamprey population is widely distributed in its catchment. The river provides exceptionally good quality habitat for the river lamprey and the site supports a healthy population. The river also supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

3.3.2 Brook lamprey *Lampetra planeri*

3.3.2.1 Background to selection

The brook lamprey *Lampetra planeri* is a purely freshwater species, occurring in streams and occasionally in lakes in north-west Europe. Like other species of lampreys, the brook lamprey requires clean gravel beds for spawning and soft marginal silt or sand for the ammocoete larvae. It spawns mostly in parts of the river where the current is not too strong. Sites that hold healthy populations, with clean water and the spawning gravels, silt or sand required for the survival of the species, are proposed for selection as representative of the overall UK population of the species. The selection of sites provides representation over its geographical range and has included a range of high quality river types in which the species occurs. Sites selected are generally extensive river systems, including important tributaries, to provide conservation of habitat features required by the brook lamprey.

In general, lamprey species are widespread and relatively common. These species may often occur together in high quality river systems, and sites that have been chosen to represent these interests tend to be those of known value where several Annex II species are found.

The species has declined in some parts of its European range and in parts of the UK, although it is still widespread. It is still common in many areas of England but is absent from much of Scotland north of the Great Glen, including Orkney and Shetland and all but a few of the Western Isles. It is the most abundant and widespread of the British lampreys and is often found in the absence of the other two species, for example above a barrier that precludes the presence of the anadromous lamprey species (i.e. those spawning in fresh water but completing part of their life cycle in the sea).

While the site series will make a contribution to securing favourable conservation status for this species, wider measures are essential to support the population in the UK.

3.3.2.2 Site list

The list of sites for this species is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

River Avon (135)

This site is chosen as a high quality river that represents the southern part of the range of the brook lamprey *Lampetra planeri*. A healthy, stable population of brook lamprey occurs in the main river and in a number of tributaries. The main river, and in particular its tributaries, provides clean beds of gravel for spawning and extensive areas of fine silt for juveniles to burrow into. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

River Derwent and Bassenthwaite Lake (297)

This site is selected to provide representation of the brook lamprey *Lampetra planeri* in a high quality, more oligotrophic river in northern England. Good populations of this species are known to occur, and this river has features that provide the necessary conditions for both spawning and nursery areas - extensive gravel shoals, good water quality and areas of marginal silt. The river supports a variety of other Annex I and II interests for which it has been proposed in its own right.

River Eden (23)

This site is selected as an example of a brook lamprey *Lampetra planeri* population associated with an extensive river system on a varied and base-rich geology in northern England. The highly erodible nature of the rock results in extensive areas of gravel and finer silt being deposited throughout the system, providing conditions for spawning and nursery areas. Brook lamprey is supported widely within the catchment. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

River Usk/Afon Wysg (133)

This site in South Wales supports brook lamprey *Lampetra planeri* and is considered to provide exceptionally good quality habitat likely to ensure the continued survival of the species in this part of its UK range. The river also supports important populations of the river lamprey *Lampetra fluviatilis*, for which it has been proposed in its own right.

River Wye/Afon Gwy (22)

The River Wye is an extensive river system crossing the border between England and Wales and the brook lamprey population is widely distributed in its catchment. The river provides exceptionally good quality habitat for the brook lamprey and the site supports a healthy population. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

3.3.3 Sea lamprey *Petromyzon marinus*

3.3.3.1 Background to selection

The sea lamprey *Petromyzon marinus* occurs over much of the Atlantic coastal area of western and northern Europe (from northern Norway to the western Mediterranean) and eastern North America, and is found in estuaries and easily accessible rivers in these regions. The sea lamprey has declined in some parts of its European range including parts of the UK, although in some places it is still common. The sea lamprey is reasonably widespread in UK rivers. Sea lampreys have a preference for warm waters in which to spawn, and it appears likely that the species is at the limit of its distribution in Scotland. The sea lamprey is absent from rivers north of the Great Glen in Scotland and has become extinct in a number of other rivers.

In general, lamprey species are widespread and relatively common. These species may often occur together in high quality river systems, and sites that have been chosen to represent these interests tend to be those of known value where several Annex II species are found.

The sea lamprey is an anadromous species (i.e. spawning in fresh water but completing its life cycle in the sea). Features such as weirs and dams, as well as polluted sections of river, may act as a barrier to the fish, impeding migration to spawning grounds. Rivers where there are significant barriers to migration have been rejected during site selection.

Sites where there are reliable records of this species, with the clean water and spawning gravels, silt or sand required for its survival, are proposed for selection as representative of the overall UK population of the species. The selection of sites encompasses the geographical range of the species and has included a range of high quality river types in which it occurs. Like the other species of lamprey, sea lamprey needs clean gravel for spawning, and marginal silt or sand for the burrowing juvenile ammocoetes. However, unlike the other species, they tend to spawn in the lower to middle reaches of rivers, in deep, fast-flowing waters.

While the site series will make a contribution to securing favourable conservation status for this species, wider measures are essential to support the population in the UK.

3.3.3.2 Site list

The list of sites for this species is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

River Avon (135)

This site in England has been selected to represent sea lamprey *Petromyzon marinus* in a high quality river in the southern part of its range. There are excellent examples of the features that the species needs for survival, including extensive areas of sand and gravel in the middle to lower reaches of the river where sea lampreys are known to spawn. The river supports a variety of other Annex I and Annex II interests for which it is proposed in their own right.

River Derwent and Bassenthwaite Lake (297)

This site has been selected to represent the sea lamprey *Petromyzon marinus* in a high quality oligotrophic river in northern England. The extensive occurrence of gravels and silts in the middle to lower reaches of this river means that it is able to support a large population of sea lamprey. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

River Eden (23)

The site has been selected as a representative site for sea lamprey *Petromyzon marinus* population associated with an extensive river system on a varied and base-rich geology in northern England. The highly erodible nature of the rock results in extensive areas of gravel and finer silts being deposited throughout the system, providing conditions for spawning and nursery areas. A large and healthy population of sea lamprey is

supported in the middle to lower regions of the river. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

River Wye/Afon Gwy (22)

The River Wye is an extensive river system crossing the border between England and Wales and the sea lamprey *Petromyzon marinus* population is found in the main stem below Llyswen. The site provides exceptionally good quality habitat for the sea lamprey and supports a healthy population. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

3.3.4 Atlantic salmon *Salmo salar*

3.3.4.1 Background to selection

The Atlantic salmon *Salmo salar* is widely distributed within the EC, ranging from Portugal in the south to Sweden and Finland in the north. The species is subject to many pressures in Europe, including pollution, the introduction of non-native salmon stocks, physical barriers to migration, exploitation from netting and angling and physical degradation of spawning and nursery habitat. Statistics indicate that the UK salmon population comprises a significant portion of the catch from the Atlantic Biogeographical Region.

The Atlantic salmon is a widespread species in the UK and is found in several hundred rivers, many of which have large populations. These rivers vary considerably in their ecological and hydrological characteristics and in the life-cycle strategies adopted by the salmon within them. Sites have been selected from amongst the rivers with large populations, as representative of the overall UK population of this species. The selection of sites has covered the geographical range of the species and the ecological variability it displays within this range.

The Atlantic salmon is an anadromous species (i.e. adults migrate from the sea to breed in fresh water). Spawning takes place in shallow excavations called redds, found in shallow gravelly areas in clean rivers and streams where the water flows swiftly. The young that emerge spread out into other parts of the river. The spawning and nursery requirements are well represented in all the selected rivers. After a period of 1-6 years the young salmon migrate downstream to the sea as 'smolts'. Salmon have a homing instinct which draws them back to spawn in the river of their birth after 1-3 years in the sea. This behaviour has resulted in genetically distinct stock within individual rivers, with some evidence of further genetic distinctiveness in the tributaries of large rivers. River systems selected have included the main tributaries where significant redds occur.

Sites have been selected to reflect the diversity of salmon rivers in the UK. There are particularly strong contrasts between southern and northern rivers, and the UK's varied climate, geology and terrain means that high diversity can be found within some of the large rivers. The cool and wet climate in the north, often with harder, more resistant rock and steeper slopes, results in salmon rivers that are sparsely vegetated, nutrient poor and prone to sudden increases in flow ('spates') in response to heavy downfalls or sudden snowmelt. As a result, salmon may take several years to reach the smolt stage and migrate to sea. In the south, rivers flow across gentler terrain and softer rocks, in a warmer, drier climate. Here, salmon may often grow sufficiently quickly to smolt as yearlings.

Whilst the site series will make a contribution to securing favourable conservation status for a species such as this, wider measures are essential to support its population in the UK. Extensive legislation exists in the UK to enable the protection and enhancement of populations here.

3.3.4.2 Site list

The list of sites for this species is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

River Avon (135)

The Salisbury Avon is selected as a south coast chalk river in England supporting Atlantic salmon *Salmo salar*. The salmon populations here are typical of a high quality chalk stream, unaffected by the introduction of genetic stock of non-native origin. The Avon has an excellent mosaic of aquatic habitats, which include extensive areas of gravels essential for spawning and growth of juvenile fry. There has been limited modification of the river course by comparison with many other southern lowland rivers in England.

River Derwent and Bassenthwaite Lake (297)

This site is chosen to represent Atlantic salmon *Salmo salar* populations in northern England and is a particularly good example of a large oligotrophic river flowing over base-poor geology, providing a contrast to the more mesotrophic River Eden. Low intensity land-use in the catchment means there is good water quality throughout much of the system. This water quality, coupled with the presence of extensive gravel shoals, makes it a

particularly suitable river for breeding and enables it to support a large population. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

River Eden (23)

The River Eden has been chosen to represent one of the largest populations of Atlantic salmon *Salmo salar* in northern England. It is an excellent example of a large river system which flows over varied, base-rich geology. This coupled with its large range in altitude, results in the development of distinct habitat types, supporting diverse plant and invertebrate communities. The high ecological value of the river system and the fact that the salmon are able to use most of the catchment, (even above Ullswater, a large natural lake on the main river) mean that the Eden is able to maintain a large population of salmon. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

River Wye/Afon Gwy (22)

The Wye is the most famous and productive river in Wales for Atlantic salmon *Salmo salar*, with high quality spawning grounds and juvenile habitat in both the main stem and tributaries; water quality in the system is generally favourable. It is also one of the most diverse river systems in the UK, with a transition from hard geology, high gradients, rapid flow fluctuations and low nutrient content in its upper reaches, to a more nutrient-rich river with lower gradient, more stable flow and softer geology in the lowlands. The effect of river engineering work on migration and spawning has been limited, although there is a localised influence from the Elan Valley reservoirs, through inundation of spawning and nursery habitat and fluctuations in flow and water levels in the Upper Wye. The most important tributaries for spawning have been included. Although in the past non-native salmon may have been released to the system, more recent stocking activity has been carried out with fish native to the Wye. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

3.3.5 Spined loach *Cobitis taenia*

3.3.5.1 Background to selection

The spined loach *Cobitis taenia* is a small bottom-living fish that has an extremely wide distribution across Europe and Asia. It is found in a variety of slow-flowing or still water bodies but even with such a broad range and ecological niche it is generally regarded as threatened, if not rare, in Europe.

Limited information exists on its distribution in the UK, but it appears that populations are centred on the catchments of three east-flowing river systems - the River Ouse, River Witham and River Trent. Within these catchments it appears to be associated with a range of watercourses, including small streams, large rivers and both large and small drainage ditches. Little is known about its occurrence in open water, although it is also known from a number of small lakes and gravel pits.

Spined loach display a wide habitat choice but are most frequently associated with submerged (and possibly emergent) macrophytes, which are important for spawning, and sandy (also silty) substrate, into which juvenile fish tend to bury themselves.

Present lack of knowledge has imposed severe constraints on site selection and further survey is necessary within other catchments. Sites have been selected to provide representation of the species within the River Ouse catchment.

Given the diversity and wide distribution of apparently suitable habitats, it is likely that wider measures in addition to the site series will be necessary for the achievement of favourable conservation status for this species in the UK.

3.3.5.2 Site list

Ouse Washes (134)

This site is chosen to represent spined loach *Cobitis taenia* populations based within the River Ouse catchment. The Counter Drain, with its clear water and abundant macrophytes, is particularly important, and a healthy population of spined loach is known to occur.

3.3.6 Allis shad *Alosa alosa*

3.3.6.1 Background to selection

The allis shad *Alosa alosa* is rare in the UK and throughout its range on the western coasts of Europe, from southern Norway to Spain, and in the Mediterranean eastwards to northern Italy. Sites in the UK where allis shad have been reliably recorded as present, where there is previous evidence of breeding and which appear still to offer favourable conditions for breeding have been selected.

The allis shad is a member of the herring family. It is difficult to distinguish from its close relative the twaite shad *Alosa fallax*. Both fish have streamlined bodies covered with distinct, large, circular scales which form a toothed edge on the lower margin and an adipose membrane which partially covers each eye. However, measuring 30-50 cm, allis shad are usually larger than twaite shad, which are rarely longer than 25-40 cm. Comb-like gill rakers, which are used to filter zooplankton, provide a further means of distinguishing the two species. On the first gill arch, allis shad have 90-130 gill rakers; twaite shad have 40-60.

Relatively little information is available on the habitat requirements of allis shad in fresh water. It grows in coastal waters and estuaries but migrates into rivers to spawn, swimming up to 100 km upstream. Population declines in many parts of Europe have been attributed to the effects of pollution, over fishing and river obstructions to migration. The most successful breeding populations are thought to be in a few rivers in western France and Portugal.

3.3.6.2 Site list

The list of sites for this species is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

River Usk/Afon Wysg (133)

Allis shad *Alosa alosa* have been reported as spawning in the River Usk, Wales. Water quality and quantity are considered favourable for this species to survive and breed.

River Wye/Afon Gwy (22)

Allis shad *Alosa alosa* have been recorded as spawning in the River Wye, an extensive river system crossing the border between England and Wales, and their presence in the river has recently been verified. The river has good water quality, a suitable flow regime, an unobstructed main channel and a wide range of aquatic habitats that are conducive to supporting this fish species.

3.3.7 Twaite shad *Alosa fallax*

3.3.7.1 Background to selection

The twaite shad *Alosa fallax* is found along the western coastline of Europe, from southern Norway to Morocco and along the eastern Mediterranean. Only a small number of rivers in the UK have breeding populations of the twaite shad. These have been selected where evidence indicates there are extensive areas suitable for spawning, with good prospects for conservation of structure and function.

The twaite shad is a member of the herring family. It is difficult to distinguish from its close relative the allis shad *Alosa alosa*. Both fish have streamlined bodies covered with distinct, large, circular scales which form a toothed edge on the lower margin and an adipose membrane which partially covers each eye. However, rarely longer than 25-40 cm, twaite shad are usually smaller than allis shad, which are 30-50 cm. Comb-like gill rakers which are used to filter zooplankton provide a further means of distinguishing the two species. On the first gill arch, twaite shad have 40-60 gill rakers; allis shad have 90-130.

The habitat requirements of twaite shad are not fully understood. In the UK, spawning stocks are known to occur in only a few rivers in Wales and the Welsh/English borders, with the possibility of additional populations in rivers flowing into the Solway Firth. On the River Usk and the River Wye, twaite shad are known to spawn at night in a shallow area near deeper pools, in which the fish congregate. The eggs are released into the water column, with a proportion being deposited in the gravel. The remainder are carried downstream, developing as they go. This species returns from the sea to spawn in spring. Population declines in many parts of Europe have been attributed to pollution, over-fishing and migratory route obstructions.

3.3.7.2 Site list

The list of sites for this species is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

River Usk/Afon Wysg (133)

There is a history of twaite shad *Alosa fallax* spawning in the River Usk, Wales. Most recently a single reach south of Abergavenny has been confirmed as a spawning area. Water quality and quantity are considered favourable for this species. The main channel is unobstructed and a variety of aquatic habitats, including deep pools used for congregation prior to spawning, are present.

River Wye/Afon Gwy (22)

Spawning populations of twaite shad *Alosa fallax* have been recorded in the River Wye, an extensive river system crossing the border between England and Wales. Data held by the Environment Agency indicate that, of the three selected rivers, the most extensive spawning areas for this species occur on the Wye. The river has relatively good water quality, adequate flows through an unobstructed main channel and a wide range of aquatic habitats conducive to supporting this fish species. In particular, the deep pools used for congregation before spawning are present.

3.3.8 Bullhead *Cottus gobio*

3.3.8.1 Background to selection

The bullhead *Cottus gobio* is widespread and often common in rivers across Europe. The UK is not known to host a significant part of the European population and as such the UK is not considered to have special responsibilities for its conservation within the EC.

This species often occurs together with other Annex II fresh-water species in high quality river systems, and sites that have been chosen to represent this species tend to be those of known value where several Annex II species are found.

Good populations are widely distributed in fresh waters across the whole of England and Wales, but in Scotland the bullhead is restricted to the Clyde and Forth catchments, where it is thought to be an introduction. Sites have been selected to encompass the geographical range of the species and to include a range of ecological situations in which the species occurs.

The bullhead is a small bottom-living fish which inhabits a variety of rivers, streams and stony lakes. It appears to favour fast-flowing, clear shallow water and is frequently found in the headwaters of upland streams.

Whilst the site series will make a contribution to securing favourable conservation status for this species, wider measures are essential to support the population of this species in the UK.

3.3.8.2 Site list

The list of sites for this species is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

Craven Limestone Complex (190)

This site has been included to provide representation of the bullhead *Cottus gobio* in calcareous, upland becks and streams in the northern part of its range in England. The clean calcareous waters with their stony bottoms support good numbers of bullhead. The site supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

River Avon (135)

The Avon has been included as a representative site for the bullhead *Cottus gobio* in a more calcareous, relatively unmodified river in the southern part of its range in England. The River Avon has a mosaic of aquatic habitats that support a diverse fish community. The bullhead is an important component of this community, particularly in the tributaries. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right

River Eden (23)

The River Eden has been included to represent bullhead *Cottus gobio* in a high quality, relatively unmodified river in the northern part of its range in England. The presence of extensive areas of gravel and generally good quality water provides good habitat for bullheads, which are widely distributed throughout the system. The tributaries, in particular those flowing over limestone, hold abundant numbers of bullhead. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

River Usk/Afon Wysg (133)

This site provides a representation of bullhead *Cottus gobio* in the southern part of its range in Wales. It is considered to have exceptionally high quality habitat with good water quality and a variety of aquatic habitats. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

River Wye/Afon Gwy (22)

This site provides a representation of bullhead *Cottus gobio* in an extensive river system crossing the border between England and Wales. The Wye is one of the most diverse river systems in the UK, with a range of nutrient conditions and aquatic habitats and generally good water quality for fish species. The river supports a variety of other Annex I and Annex II interests, for which it has been proposed in their own right.

Section 3.4: Arthropods

3.4.1 White-clawed (or Atlantic stream) crayfish *Austropotamobius pallipes*

3.4.1.1 Background to selection

The white-clawed (or Atlantic stream) crayfish *Austropotamobius pallipes* is widespread in most parts of England and is common in parts of eastern Wales. It is present in the south-west of Northern Ireland, and is widespread in the Republic of Ireland. A significant part of the EC resource is found in the UK, but the species is now seriously threatened over most of its range in this country.

The sites chosen are those that have recent (post-1990) records of healthy, recruiting, white-clawed crayfish populations free of plague and that have high quality aquatic habitats. Because of the widespread distribution of the species, sites have been chosen to give a representation over a wide geographical area. The sites selected cover a variety of habitats, including rivers (generally also selected for other features, but also holding healthy white-clawed crayfish populations), natural lakes and some 'refuges' of artificial origin that contain large isolated populations with a good chance of remaining free of crayfish plague.

The white-clawed crayfish lives in a diverse variety of clean aquatic habitats but especially favours hard-water streams and rivers. A major threat to the native white-clawed crayfish is posed by the introduction of non-native species of crayfish, which have been farmed in Britain since the mid 1970s. Soon after this, crayfish plague (a virulent disease caused by the fungus *Aphanomyces astaci*) broke out and spread rapidly, causing drastic losses of native crayfish in rivers in England. It is believed that this disease was introduced and is spread by the most frequently farmed species, the North American signal crayfish *Pacifastacus leniusculus*, a carrier of the disease.

Signal and other non-native crayfish are larger and more aggressive than the native species and are able to produce more young. Consequently, the introduced species pose a threat not only because some are disease carriers, but also through predation and competition with the white-clawed crayfish. In Northern Ireland no crayfish farms have been established and crayfish plague is unknown. In the rest of the UK, the signal crayfish is now well established in the wild. The chosen sites lie within parts of the country where the Joint Nature Conservation Committee proposed that the keeping of live non-native crayfish should be strictly controlled through legislation (this came into force on 29 May 1996), because it is only in areas free of disease that the white-clawed crayfish is likely to survive in the future. A number of these safe havens in the north of England have been selected, as they are well away from the main outbreaks of crayfish plague.

3.4.1.2 Site list

Craven Limestone Complex (190)

The site has been selected primarily as a standing water site in the north of England. Strong populations of the native white-clawed crayfish *Austropotamobius pallipes* occur in both Malham Tarn and the associated limestone streams. This site is chosen because it is well north of areas with crayfish plague and should remain free of the disease as long as no introductions of non-native crayfish are made nearby. The site includes populations in both standing and running natural waters.

Ensor's Pool (24)

This lowland site is selected to represent standing water habitat for this species in central England. This 1 ha marl pit in Warwickshire holds a very large population of native white-clawed crayfish *Austropotamobius pallipes*, estimated at 50,000. Although crayfish plague outbreaks have occurred in the Midlands, this water body is isolated from river systems and is a good example of a 'refuge' site in an important part of the species' former range.

Magheraveely Marl Loughs (225)

These four marl loughs have strong isolated populations of native white-clawed crayfish *Austropotamobius pallipes*. This site, which provides representation of the species in Northern Ireland, has been chosen because of this hydrological isolation and the lack of crayfish plague incidents in Northern Ireland.

Peak District Dales (281)

The River Dove provides representation of native white-clawed crayfish *Austropotamobius pallipes* in a high-quality, upland limestone river in England. It provides representation of the species in running water in the north-east part of its UK range.

River Eden (23)

The Eden is a river with high water quality which supports a large population of native white-clawed crayfish *Austropotamobius pallipes* in the northern part of its range in England. As with the River Wye, the tributaries of the Eden, especially those flowing off limestone, are of particular importance. The river supports a variety of other Annex I and Annex II interests for which it has been selected in their own right.

River Wye/Afon Gwy (22)

The River Wye system is the best site known river system in Wales for the native white-clawed crayfish *Austropotamobius pallipes*. The tributaries are the main haven for the species, which is especially abundant at the confluences of the main river and the Edw, Dulas Brook, Sgithwen and Clettwr Brook. The river supports a variety of other Annex I and Annex II interests, for which it has been selected in their own right.

3.4.2 Violet click beetle *Limoniscus violaceus* (Müller)

3.4.2.1 Background to selection

The violet click beetle *Limoniscus violaceus* is very rare throughout its European range and has always been extremely rare in the UK, where it was first noted in 1937 at Windsor Forest. There are only two sites in the UK that are known to support the violet click beetle; both are in England and both have been selected.

The violet click beetle is primarily associated with ancient trees, as it breeds in cavities filled with wood mould near the base of these trees. At Windsor Forest it breeds exclusively in beech *Fagus sylvatica*, but at Bredon Hill ash *Fraxinus excelsior* appears to be the main species used. It is probable that a large population of ancient trees is necessary for a site to support this click beetle.

3.4.2.2 Site list

Bredon Hill (15)

Violet click beetle *Limoniscus violaceus* was discovered at this site in 1989, although there is a 1939 record from 'Tewkesbury', which may refer to Bredon Hill. It is a very important site for fauna associated with decaying timber on ancient trees, including many Red Data Book and Nationally Scarce invertebrate species.

Windsor Forest and Great Park (14)

Violet click beetle *Limoniscus violaceus* was first noted in 1937 at Windsor Forest. The site is thought to support the larger of the two known populations of this species in the UK. There is a large population of ancient trees on the site, which, combined with the historical continuity of woodland cover, has resulted in Windsor Forest being listed as the most important site in the UK for fauna associated with decaying timber on ancient trees. It is also recognised by the Council of Europe as an important site for this fauna at a European scale.

3.4.3 Stag beetle *Lucanus cervus* (L.)

3.4.3.1 Background to selection

The stag beetle *Lucanus cervus* is included in the Red Data lists of a number of countries, although it is said to be widespread and locally abundant in southern France and the Iberian peninsula. In the UK it is largely restricted to the south and south-east of England. Elsewhere in northern England and Wales the stag beetle is rare or extinct. Sites were selected to provide representation from the main population centres and to span the main geographic range.

The stag beetle occurs in a broad belt in England extending from southern Essex, through the London area, Sussex and Hampshire to the south coast of Hampshire and Devon. Although it is relatively common in some of the areas, it is listed as Nationally Scarce Category B, which means that it is likely to occur in 100 or fewer 10 km squares of the national grid.

The stag beetle is the UK's largest and most spectacular terrestrial beetle and can reach 7 cm in length. Larvae develop in the decaying roots of old tree stumps, especially of elm *Ulmus* spp., lime *Tilia* spp. and beech *Fagus sylvatica*, and these are essential features for conservation of structure and function of the habitat for this species. Development takes around 3-4 years. Adults are active on warm evenings, but probably only the males fly regularly and come readily to lights. Adults have been recorded from May to September or even October, though they are most abundant in early summer. The selected sites both have large populations and have features which make them particularly favourable for the survival and reproduction of this species.

3.4.3.2 Site list

Epping Forest (42)

This is a large forested area in which records of stag beetle *Lucanus cervus* are widespread and frequent; the site straddles the Essex and east London population centres. Epping Forest is a very important site for fauna associated with decaying timber, which supports many Red Data Book and Nationally Scarce invertebrate species.

The New Forest (5)

This site represents the stag beetle *Lucanus cervus* in its Hampshire/Sussex population centre. It is one of the most important sites in the UK for fauna associated with rotting wood and one of only three sites recognised by the Council of Europe as being of importance for this fauna at a European scale, and it is a major stronghold for the stag beetle in the UK.

3.4.4 Marsh fritillary *Eurodryas aurinia* L.

3.4.4.1 Background to selection

The marsh fritillary *Eurodryas aurinia* has declined dramatically in Europe and is regarded as endangered or vulnerable in most of its European range. On the basis of existing knowledge the UK and Spain constitute the European stronghold for this species.

Although formerly widespread in central and eastern England, the marsh fritillary *Eurodryas aurinia* is now mainly confined to western and northern parts of the UK. It has become extinct over a large part of its former range, having declined by about 60% since records began. The species continues to be vulnerable in many parts of its range. Important centres of distribution are in south-west England, particularly Devon, Dorset and Wiltshire, south and west Wales and south-west Scotland. Sites have been selected to take account of the relatively high proportion of the EC population of this species found in the UK, the diversity of ecological situations in which it occurs, the broad geographical area over which it is found and the presence of distinctive forms in Scotland. Sites have been chosen to take account of the dependency of closely linked populations (metapopulations) and so include the larger and more complex sites where the species occurs.

Populations of marsh fritillaries vary greatly in size from year to year, and, at least in part, this is related to cycles of attack from parasitic wasps. Adults tend to be sedentary and remain in a series of linked populations, forming numerous temporary colonies, which fequently die out and recolonise. Where it is unable to do this, populations do not seem to be able to persist in habitat fragments. It is therefore essential to conserve a cluster of sites in close proximity. The marsh fritillary is an extremely variable butterfly and 34 sub-species are described in Europe alone. The sedentary behaviour of the adults and increasing fragmentation of their favoured habitats has led to the establishment of local races. Populations of this species found in Argyll and the Inner Hebrides are regarded as a distinct form *E. aurinia scotica*.

This butterfly is found in a range of habitats in which its larval food plant, devil's-bit scabious *Succisa pratensis,* occurs. Marsh fritillaries are essentially grassland butterflies in the UK, and although populations may occur occasionally on wet heath, bog margins and woodland clearings, most colonies are found in damp acidic or dry calcareous grasslands. In Northern Ireland it occurs in fens and on sand dunes. Management in both wet and dry situations is predominantly by low-intensity cattle or pony grazing. Sheep selectively graze devil's-bit scabious and are therefore detrimental to marsh fritillary colonies, except at very low stocking rates. Burning and mowing are also known to have caused the extinction of colonies

While the site series will make a contribution to securing the favourable conservation status of this species, wider measures are essential to conserve it in the UK.

3.4.4.2 Site list

Culm Grasslands (29)

Culm Grasslands in Devon, south-west England, contains the largest cluster of sites for the marsh fritillary *Eurodryas aurinia* in the south-west peninsula. It is judged to be the most important location for the species in its major UK stronghold.

Gower Commons/Tiroedd Comin Gwyr (34)

This is a cluster of at least five large colonies in a small area within the south-west Wales stronghold of the marsh fritillary *Eurodryas aurinia.* This cluster of sites has been chosen to represent the range of the species in south Wales, and recent survey work has shown that these colonies now constitute the second most important area for the species in Wales.

Rhos Llawr-cwrt (30)

This is an exceptionally large colony (possibly the largest in the UK), which represents marsh fritillary *Eurodryas aurinia* in its mid-Wales stronghold. This is a site at which both core and satellite populations can

exist. This site was chosen because of the population size and because it is judged to be viable on its own merits (i.e. not relying on other sites in the vicinity).

Rooksmoor (31)

Representing marsh fritillary *Eurodryas aurinia* in the southern part of its range in England, this is an exceptionally large population within a cluster of colonies in the Dorset stronghold. A large outlying population at Lydlinch has been included in this site as it is considered to be part of the metapopulation in this area.

Salisbury Plain (33)

Salisbury Plain, which represents the species in the central southern parts of its range in England, contains a cluster of large colonies where marsh fritillary *Eurodryas aurinia* breeds on dry calcareous grassland. The site was chosen to extend the range of ecological variability covered by the site list and to include representation of the species in chalk grassland.

Taynish Woods (32)

A large population at this site in western Scotland is chosen to include the full geographical range of marsh fritillary *Eurodryas aurinia*. It provides a representative site at the northern part of its UK distribution. The site also ensures representation of the Scottish form, which is completely isolated from populations in England and Wales.

3.4.5 Southern damselfly *Coenagrion mercuriale* (Charpentier)

3.4.5.1 Background to selection

The southern damselfly *Coenagrion mercuriale* is widespread but rare in southern central and south-west Europe, and its range extends to northern Africa. In the UK it occurs mainly in south-west England and in south Wales. It is, however, declining in many places and appears to be present in low numbers only at most of its localities. With a fairly stable distribution in the south-west of the UK, this appears to constitute a major European stronghold of the species and this fact has been taken into consideration in site selection. Sites for the southern damselfly have been selected to include the largest known populations in the main part of the species' range in the UK, where the prospects for long-term conservation of structure and function are good.

Strong populations, numbering hundreds to thousands, occur in Dorset, the New Forest and elsewhere in Hampshire and on the Pembrokeshire Commons, and these large sites have been seen as the most important in site selection. Smaller populations occur elsewhere, mainly in the south-west and in Wales, and the larger of these sites have been selected to provide fuller representation of its range in the UK.

The southern damselfly has very specialised habitat requirements, being confined to shallow, well-vegetated, base-rich runnels and flushes in open areas. Most sites are on wet heath, where the larvae live in flushes and shallow runnels, often less than 10 cm deep, with slow flowing water. Adults fly from June to August. Females lay eggs onto submerged plants and the aquatic larvae are predatory, probably taking two years to mature.

3.4.5.2 Site list

Dorset Heaths (279)
Dorset Heaths (Purbeck and Wareham) and Studland Dunes (280)

These sites have been chosen to provide representation in the Dorset stronghold for southern damselfly *Coenagrion mercuriale* in south-west England. The large size of these sites, and a long history of records indicating well-established populations, should ensure the future viability of the small populations that occur here.

East Devon Pebblebed Heaths (19)

This site holds several relatively small populations selected to represent the occurrence of southern damselfly *Coenagrion mercuriale* in the far south-west part of its range in England. These populations occur in wet flushes within the site.

Gower Commons/Tiroedd Comin Gwyr (34)

This site has been selected to provide representation of southern damselfly *Coenagrion mercuriale* in the south Wales part of its range. Small populations at two localities contribute to representation of the UK range of the species.

Preseli (17)

Selected to provide representation of southern damselfly *Coenagrion mercuriale* in the west Wales part of its range, this is one of the strongest populations in the UK, with numbers of adults estimated to be in the thousands and with a long history of records. Conditions on the site, created by its current management, appear to be optimal for this species.

River Itchen (18)

Strong populations of southern damselfly *Coenagrion mercuriale* occur here, estimated to be in the hundreds of individuals. The site in central, southern England has been selected to represent one of the four major population centres in the UK. It also represents a population in a river floodplain, an unusual habitat for this species in the UK, rather than on heathland.

The New Forest (5)

This is an outstanding site in southern England for southern damselfly *Coenagrion mercuriale,* with several population centres and strong populations estimated to be in the hundreds or thousands of individuals and with a long history of records. It is selected, with Preseli, Dorset Heaths and the River Itchen, to represent one of the four major population centres in the UK.

Section 3.5: Molluscs

3.5.1 Narrow-mouthed whorl snail *Vertigo angustior* Jeffreys

3.5.1.1 Background to selection

The narrow-mouthed whorl snail *Vertigo angustior* is widely distributed in central Europe northwards to southern Norway and Sweden but is considered threatened in most countries. In the UK it has a very scattered distribution in England, Wales and the extreme south of Scotland, and this geographical range has been reflected in site selection. Sites have been selected to encompass the range of habitat variation in which the narrow-mouthed whorl snail is found. The chosen sites have strong populations of the species and ecological conditions considered to be particularly favourable for its survival. In the UK the largest known population is found where freshwater seeps onto the upper edges of a saltmarsh. However, elsewhere in Europe calcareous fen is the species' most typical habitat.

This tiny snail is found primarily in marshy ground of high, even humidity, subject neither to periodic desiccation nor to deep or prolonged flooding. It requires unshaded conditions and lives amongst short vegetation, composed of grasses, mosses or low herbs, that is quickly warmed by the sun. The vegetation may be grazed.

3.5.1.2 Site list

Burry Inlet: Dunes/Cilfach Burry: Twyni (292)

This site is selected to represent the narrow-mouthed whorl snail *Vertigo angustior* in the south Wales part of its range. Whiteford Burrows contains by far the largest known population of this snail in the UK and possibly one of the largest in Europe. The snail occurs at this site in areas of freshwater seepage at the junction between sand dune and saltmarsh habitat, where horse grazing maintains the open conditions this species requires.

Morecambe Bay Pavements (191)

This site in north-west England provides a representation of the narrow-mouthed whorl snail *Vertigo angustior* in the northern part of its range. Gait Barrows supports strong populations of the species in mossy clint tops of limestone pavements at transitions to woodland, an unusual habitat for the species.

Waveney and Little Ouse Valley Fens (94)

This site is selected to represent the narrow-mouthed whorl snail *Vertigo angustior* in East Anglia, England. At Weston Fen the species occurs in calcareous fen, the most typical habitat for the species in Europe.

3.5.2 Round-mouthed whorl snail *Vertigo genesii* (Gredler)

3.5.2.1 Background to selection

The round-mouthed whorl snail *Vertigo genesii* is a tiny boreal and alpine snail that is virtually restricted to the Alps and the mountains of central Scandinavia and is very local throughout its range. It is known from only two upland localities in the UK: Upper Teesdale, in Durham, northern England, and the Blair Atholl area in Perthshire, Scotland. Sites from both areas have been selected.

At the two known locations, the snail occurs in calcareous flushes with a remarkably similar ecological character, including a rich assemblages of rare and local arctic-alpine plants, confirming the status of the species as a relict of the fauna and flora of the post-glacial period.

3.5.2.2 Site list

Moor House - Upper Teesdale (188)

In Upper Teesdale the round-mouthed whorl snail *Vertigo genesii* lives amongst moss, low-growing sedges and a rich assemblage of rare and local arctic-alpine plants such as bird's-eye primrose *Primula farinosa* and Scottish asphodel *Tofieldia pusilla*. It is found in a base-rich flush fed by springs, within a gentle depression at an altitude of 495 m, which fills up with drifted snow in the winter to a depth of up to 10 m.

Tulach Hill and Glen Fender Meadows (100)

The round-mouthed whorl snail *Vertigo genesii* occurs at an altitude of 315-430 m in several base-rich flushes at this site in Perthshire, Scotland. In some of these flushes it has been recorded with Geyer's whorl snail *Vertigo geyeri*, another Annex II species. The flushes contains a rich assemblage of arctic-alpine plants, including false sedge *Kobresia simpliciuscula* and Scottish asphodel *Tofieldia pusilla*.

3.5.3 Geyer's whorl snail *Vertigo geyeri* Lindholm

3.5.3.1 Background to selection

This species is found at widely scattered localities in Europe between northern Sweden and south-east Germany and Ireland, in both upland and lowland localities. Throughout its range it is local and found in calcareous flushes. In the UK this species is known from only a small number of sites, although recent survey has increased the number of known sites.

Sites have been selected that encompass the range of ecological situations in which Geyer's whorl snail *Vertigo geyeri* is found and across the range of its geographical distribution. The chosen sites have ecological conditions that are considered to be particularly favourable for its survival, namely relatively exposed, base-rich sites that remain constantly humid.

This tiny snail is recorded in calcareous flush-fens that are fed by tufa-depositing springs. It occurs at a wide range of altitudes. Species that have been found with it at all sites are black bog-rush *Schoenus nigricans* and yellow sedge *Carex viridula*.

3.5.3.2 Site list

Asby Complex (192)

Sunbiggin Tarn provides representation of Geyer's whorl snail *Vertigo geyeri* in north-west England. It supports a large population of this species in upland calcareous flushes with a rich assemblage of arctic-alpine plants.

Corsydd M^n/Anglesey Fens (96)

Cors Erddreiniog has been selected to represent Geyer's whorl snail *Vertigo geyeri* in north Wales. The site contains one of the largest populations of *V. geyeri* in calcareous fen at low altitude.

Ellers Wood and Sand Dale (303)

This site provides a lowland representation of Geyer's whorl snail *Vertigo geyeri* in north-east England; the population exists at this site in a tufa-rich flush.

Tulach Hill and Glen Fender Meadows (100)

Geyer's whorl snail *Vertigo geyeri* is found at this site in Perthshire, Scotland, in upland, base-rich flushed mires at an altitude of 170-345 m. It occurs in a rich assemblage of arctic-alpine plants, and at some flushes it has been recorded with the round-mouthed whorl snail *V. genesii*.

3.5.4 Desmoulins' whorl snail *Vertigo moulinsiana* (Dupuy)

3.5.4.1 Background to selection

In Europe Desmoulins' whorl snail *Vertigo moulinsiana* is widely distributed north to Denmark and the extreme south of Sweden, although recent records are few and it is regarded as rare in all countries, except Hungary. Recent surveys in England have indicated that the snail is not as rare here as previously considered. It occurs at scattered sites in a band across southern England from Norfolk to Dorset, with isolated populations elsewhere.

Sites have been selected to represent the geographical strongholds in England, with extensive sites selected in the south and west and in the north-eastern part of its range. Sites have been chosen to favour the largest populations and also a range of ecological conditions, incorporating variation in river catchment type as well as representation of its occurrence beside standing waters. It is abundant in some patches at certain localities, and clusters of these patches of greatest abundance have been included in site selection.

Desmoulins' whorl snail is a tiny snail that is easily overlooked. It is restricted to calcareous wetlands, usually bordering lakes or rivers. It normally lives on tall reed-grasses and sedges, e.g. in reed sweet-grass *Glyceria maxima* and tussocks of greater pond-sedge *Carex riparia* and lesser pond-sedge *C. acutiformis*, where it feeds on the microflora. Southern chalk streams have been shown to be as important as the East Anglian fens as strongholds for this species.

3.5.4.2 Site list

Kennet and Lambourn Floodplain (132)

The cluster of sites selected in these valleys supports one of the most extensive known populations of Desmoulins' whorl snail *Vertigo moulinsiana* in the UK and is one of two sites selected to represent the species in the south western part of its range in the important chalk stream habitat. Integrity of the population is being maintained by taking measures, including habitat creation, to safeguard populations. The habitat occupied at this site differs from the fenland sites in East Anglia in that it is predominantly reed sweet-grass *Glyceria maxima* swamp or tall sedges at the river margins, in ditches and in depressions in wet meadows.

Norfolk Valley Fens (101)

This is one of three sites representing the distribution of Desmoulins' whorl snail *Vertigo moulinsiana* in East Anglia. Within Norfolk Valley Fens there are a number of marginal fens around pingos - pools that formed in hollows left when large blocks of ice melted at the end of the last ice age. These are very ancient wetlands and several support strong populations of *V. moulinsiana* as part of a rich assemblage of Red Data Book and Nationally Scarce species. These areas were chosen for their strong populations and representation of the species in standing water habitat.

River Avon (135)

There is an extensive population of Desmoulins' whorl snail *Vertigo moulinsiana* along about 20 km of the margins and associated wetlands of the Rivers Avon, Bourne and Wylye. This is the second site providing representation in the south-western part of its range, in chalk stream habitat. It occurs here in a separate catchment from the Kennet and Lambourn, within an environment more heavily dominated by arable agriculture. The importance of this site is underpinned by its selection for a number of other Annex II species: brook and sea lamprey, salmon and bullhead, as well as the Annex I habitat type **Floating vegetation of *Rannunculus* of plain and sub-mountainous rivers**.

The Broads (166)

This is the main stronghold of Desmoulins' whorl snail *Vertigo moulinsiana* in East Anglia and is one of three sites selected in this part of its range. Several large populations are known, associated with standing and flowing water and ditch systems. This is a very important area for its wetland invertebrate fauna,and many Red Data Book and Nationally Scarce species occur here.

Waveney and Little Ouse Valley Fens (94)

This site is one of three in East Anglia selected to represent Desmoulins' whorl snail *Vertigo moulinsiana.* At Weston Fen populations of this snail occur in a valley fen.

3.5.5 Freshwater pearl mussel *Margaritifera margaritifera*

3.5.5.1 Background to selection

The freshwater pearl mussel *Margaritifera margaritifera* has suffered serious decline over much of its former range. It is now a scarce species whose conservation is giving rise to concern, and its increasing rarity in mainland Europe gives extra significance to UK populations. In Germany and Spain only a few populations remain, although it has been reported that some strong populations have recently been found in France. Population declines have been caused by factors such as industrial pollution, acidification, organic enrichment, siltation, river engineering and over-fishing for pearls. The UK is one of the last remaining strongholds for this species in western Europe.

Site selection has been based on an analysis of past records and more recent survey of potentially important rivers. One of the main characteristics of rivers selected is the population size; many rivers now contain only scattered individuals. A second principal characteristic of the sites selected is the presence of juvenile mussels, a feature rarely recorded in recent surveys, yet essential to the long term sustainability of mussel populations. As this species does not reach reproductive maturity until at least twelve years old and may live for 80-100 years, population age structure is vitally important when assessing viability. The presence of juveniles is a clear indicator of the structure and functional features of the habitat required for the survival and reproduction of the species. Most continental strongholds consist of mussels at least thirty years old, and these populations may disappear, owing to lack of recruitment.

While the site series will make a contribution to securing favourable conservation status for this species, wider conservation measures are essential to ensure its recovery in the UK.

3.5.5.2 Site list

The list of sites for this species is incomplete. Details of additional sites will be published when further preparatory work has been completed. In some cases SSSI notification will be necessary and this will take place at the same time as consultation on proposed SACs.

River Ehen (317)

Recent survey has shown that the River Ehen supports the largest pearl mussel population in England. Exceptionally high densities were found at some locations, with the population estimates for the entire river exceeding 100,000. The conservation importance of the site is further enhanced by the presence of juvenile pearl mussels, indicating recruitment within the last four years.

Section 3.6: Plants

3.6.1 Floating water-plantain *Luronium natans*

3.6.1.1 Background to selection

Floating water-plantain *Luronium natans* is endemic to Europe. In the UK it has been recorded in 34 10 km squares since 1980; approximately half of these records are from canals and similar artificial habitats. Populations fluctuate from year to year and at many sites records are infrequent. Sites that are known to hold consistently large, naturally occurring populations and where conditions are considered to be particularly favourable to the species' survival have been selected.

The 'core' natural habitat is considered to be in lakes in Snowdonia, and in mid-Wales, where the plant has a very long and consistent history of occurrence. It appears to have spread eastwards along the canal system during the nineteenth century. It is absent from Northern Ireland but has recently been discovered in Ireland. Elsewhere it occurs only as an introduction to ditches in the Norfolk Broads and to a few localities in Scotland.

Floating water-plantain occurs in a range of freshwater situations, including nutrient-poor lakes in the uplands and slowly-flowing lowland rivers, pools, ditches and canals that are moderately rich. The plant thrives best in open situations with a moderate degree of disturbance, where the growth of emergent vegetation is held in check. Populations fluctuate greatly in size, often increasing when water levels drop to expose the bottom of the water body. At many sites records of floating water-plantain have been infrequent, suggesting that only small populations occur, in some cases possibly as transitory colonists of the habitat.

3.6.1.2 Site list

Cannock Extension Canal (28)

Cannock Extension Canal, in central England, was chosen to provide an example of anthropogenic, lowland habitat supporting floating water-plantain *Luronium natans*. This is at the eastern limit of the plant's natural distribution in England. A very large population of the species occurs in the Canal, which has a diverse aquatic flora and rich dragonfly fauna, indicative of good water quality. The low volume of boat traffic on this terminal branch of the Wyrley and Essington Canal has allowed open water plants, including floating water-plantain, to flourish, while depressing the growth of emergents.

Eryri/Snowdonia (118)

This north Wales site is chosen to provide an example of a montane lake habitat supporting floating water-plantain *Luronium natans* at the limit of its northern distribution in the UK. Records date back to the eighteenth century, indicating thathabitat conditions are particularly favourable for this species.

3.6.2 Early gentian *Gentianella anglica*

3.6.2.1 Background to selection

Early gentian *Gentianella anglica* is endemic to the UK. There has been a rapid decline in this species since 1970, largely because of the ploughing of old chalk grassland and the abandonment of grazing on some of the remaining grasslands. The sites selected are mainly those supporting the largest naturally occurring populations that are known to have persisted for many years. These sites are relatively large areas of calcareous grassland that are generally botanically diverse and of high conservation value. The number of sites chosen reflects the fact that this species is endemic to the UK and provides representation over the relatively wide geographic area in which it occurs.

Early gentian is an annual species, occurring in calcareous grassland, mainly on steep, south-facing slopes. It grows in bare ground, or in thin turf that is kept open by intense rabbit- or sheep-grazing, or trampling by livestock. In dense turf the species becomes shaded out and unable to compete with other more vigorous species. Early gentian occurs mainly on chalk escarpments in southern central England, but its range extends westwards to Cornwall and northwards to Lincolnshire. It is found on a variety of substrates and in different habitats, but particularly coastal grasslands. Some of the existing populations of early gentian are large, particularly on the Isle of Wight, in Wiltshire and in Dorset, in some sites numbering many hundreds of thousands of plants, and emphasis has been given in site selection to these larger populations.

3.6.2.2 Site list

Fontmell and Melbury Downs (2)

This inland site in Dorset supports consistently large populations of early gentian *Gentianella anglica*, numbering many thousands of individuals. The site includes large areas of species-rich chalk grassland and is one of three sites selected in the centre of the main range of the species.

Godrevy Head to St Agnes (1)

Although not one of the largest populations, this site in Cornwall is considered to be important because it is representative of early gentian *Gentianella anglica* subsp. *cornubiensis* on a non-calcareous substrate in the extreme west of its range. This population has recently been reported to be a hybrid between *G. anglica* and *G. amarella* and its inclusion on the site list is under review.

Grimsthorpe (306)

This site in Lincolnshire has been selected as the most northerly outpost for early gentian *Gentianella anglica*, where there are 2-3 colonies totalling several hundred plants in old oolitic limestone quarries.

Isle of Portland and Studland Cliffs (283)
St Albans Head to Durlston Head (285)

These two sites on the Dorset coast supports important long-standing populations of early gentian *Gentianella anglica* numbering several thousands of individuals in botanically-rich limestone grassland.

Isle of Wight Downs (205)

Chalk grasslands on the southern coast of the Isle of Wight support very large populations of early gentian *Gentianella anglica*, numbering hundreds of thousands, although these populations have varied in size from year to year. Compton Down supports the largest populations.

Pewsey Downs (3)

This site is one of three selected in the central part of the range for early gentian *Gentianella anglica*. It holds a very significant population of hundreds of thousands of individuals growing in high quality chalk grassland.

Prescombe Down (4)

This site is one of three selected in the central part of the range for early gentian *Gentianella anglica.* It holds very significant populations of hundreds of thousands of individuals in high quality chalk grassland that has been sympathetically managed for many years.

3.6.3 Slender naiad *Najas flexilis*

3.6.3.1 Background to selection

The slender naiad *Najas flexilis* has a northern distribution in Europe, extending south to Switzerland. It is rare throughout its European range. In the UK, this species is found almost exclusively in Scotland. Since 1980, the plant has been recorded from 35 Scottish lochs, with the majority of sites in the Outer and Inner Hebrides. The Scottish mainland distribution is centred in a cluster of lochs in Perthshire (Tayside), although there are a few locations on the west coast. The only known site elsewhere in the UK is Esthwaite Water, a mesotrophic lake in the Lake District. However, slender naiad has not been found there since 1982 and it may have been lost as a result of nutrient enrichment. Although it occurs in a number of sites in Ireland, it is not recorded from Northern Ireland.

Slender naiad is found in clear lowland lakes with low or medium concentrations of plant nutrients (oligotrophic or mesotrophic). Underlying shell sand or limestone outcrops are often present, making the water rich in lime. The plant is seldom found in water less than 2 m deep. The best sites for slender naiad tend to support a wide range of other aquatic plants. Characteristically, the plant is found in clusters of adjacent lochs. This distribution is thought to be due to very slow, local, dispersal. The main threat to the existence of the slender naiad is pollution of the clear water it requires, from sources such as sewage effluent, fertiliser run-off or fish-farming.

Sites selected for slender naiad *Najas flexilis* are representative of its main geographic occurrence and take account of its clustered distribution. Only lakes with good water quality and with large populations evident over many years were considered. The sites selected contain between them around half of the British lakes with post-1980 records of this species.

3.6.3.2 Site list

Coll Machair (183)

This site is representative of the occurrence of slender naiad *Najas flexilis* in the Inner Hebrides and in south-west Scotland. This site contains a large population of slender naiad with a long history of its presence in very clear water, indicating that conditions are particularly favourable for its survival.

Dunkeld - Blairgowrie Lochs (21)

This site in Perthshire contains the most easterly occurrence of slender naiad *Najas flexilis* on the Scottish mainland and is the second largest known population. The site consists of a cluster of five lochs lying along a river valley - the Lochs of Butterstone, Craiglush and Lowes are about 5 km upstream of Lochs Clunie and Marlee. They are all mesotrophic water bodies with a diverse macrophyte flora. Conditions in these lochs seem particularly favourable for survival of this species. Slender naiad has been recorded since the nineteenth century in the lochs and it was present in all of them in 1994.

South Uist Machair (39)

A cluster of eleven lochs with slender naiad *Najas flexilis* lies within the boundary of this site, the largest cluster of lochs containing the species in the UK. Nearly one third of the UK lochs with recent (post-1980) records for slender naiad are found on this site and the site is considered to be the best in the UK for slender naiad. It has been recorded in South Uist since the 1930s. The South Uist machair site is an extensive complex of grassland, dunes, foreshore and freshwater and brackish lochs, situated on the west coast plain of South Uist. The freshwater lochs within the site are of diverse types, with a transition from oligotrophic waters situated on the peatlands to more nutrient-rich, calcareous lochs on the shell sand near the coast. Lochs of an intermediate type occur at the junction of peat and sandy substrates. Slender naiad occurs in both the oligotrophic and intermediate loch types. Water quality is high and conditions are particularly favourable for the species.

3.6.4 Fen orchid *Liparis loeselii*

3.6.4.1 Background to selection

In Europe the fen orchid *Liparis loeselii* appears on the IUCN threatened list for every country in its range and has legal protection in Belgium, Finland, France, Germany, Liechtenstein, Switzerland and the UK. In the UK the fen orchid has severely declined over its former range. The major factors leading to its widespread decline have been habitat loss and deterioration. Sites have been selected to include the largest and most well established populations of this species and to cover the variation in ecological and morphological types, as well as its geographical range.

The fen orchid is a small flowering plant that grows in a few fens and dune slacks in the UK, where it occurs as two morphologically distinct forms. The type form has acute oblong-elliptical leaves and is restricted to the fenlands of East Anglia. The form occurring in the dune slacks of south Wales and north Devon, variety *ovata*, is shorter, generally fewer-flowered and has blunt ovate-elliptical leaves. The two forms are mutually exclusive with respect to their distribution between habitats, but on the Continent the type (fenland) form also occurs in dune slacks.

Once known from at least 30 fenland sites in eastern England in the 1990s, only three populations of fen orchid have been recorded in the Norfolk Broads. All sites are subject to high water tables throughout the year and some experience winter flooding. In this area the fen orchid is confined to tall-herb fens that have experienced disturbance through peat-cutting. The cessation of peat cutting in the fens is probably the most important contributory factor leading to the decline of this species.

The principal British population centre for the fen orchid is now the dune slacks of the south Wales coast. During the past 70 years it has been recorded on at least one occasion from eight of the nine major south Wales dune systems. However, during the mid-1990s it has been recorded from just five sites, which collectively support more than 90% of the British population.

In dune slacks the fen orchid occurs across quite a wide range of vegetation types, though principally in younger dune slack communities where some open soil remains. These dune slacks are all subject to winter flooding, with inundation often occurring for up to five months in a year. A high summer water table appears to be essential for the survival of this drought-sensitive species. In common with many other orchids, the fen orchid appears to rely on regular disturbance for its long-term survival at any one site, and dune system over-stabilisation has been a major causal element in its decline.

3.6.4.2 Site list

Burry Inlet: Dunes/Cilfach Burry: Twyni (292)

Whiteford Burrows, on the Burry Inlet, south Wales, is one of the few sites in the west where fen orchid *Liparis loeselii* is still known to occur. Populations are somewhat smaller in size than those at Kenfig but nevertheless the site supports over 10% of the UK resource. The fen orchid on this site is var. *ovata.*

Kenfig/Cynffig (7)

This site, on the south Wales coast, holds the largest populations of fen orchid *Liparis loeselii* in the UK, comprising about 50% of the UK resource. Management of the site is directed towards the maintenance and enhancement of the populations of fen orchid. The variety that occurs here, as at Whiteford Burrows, is var. *ovata*, which is currently known to occur only in Wales and on the coast of Brittany, as well as in the past at Braunton Burrows, Devon, England.

The Broads (166)

This site in eastern England provides representation of the fenland form of fen orchid *Liparis loeselii* in the eastern part of its UK range. Three small populations of var. *loeselii* are known to occur on this site, and in 1996 only 242 plants were found.

3.6.5 Lady's-slipper orchid *Cypripedium calceolus*

3.6.5.1 Background to selection

This orchid with large, colourful flowers has always been local in the UK. Primarily because of collecting of the plant by botanists and others, it is now known as a native plant at only a single locality. Until recently only a single individual plant survived, but artificial propagation is now being used to increase the population in the wild. The single native site for this species has been selected.

3.6.5.2 Site list

Owing to the extreme rarity of this species in the UK and the threat from unauthorised collecting, details of the selected site are withheld.

3.6.6 Shore dock *Rumex rupestris*

3.6.6.1 Background to selection

The shore dock *Rumex rupestris* is one of Europe's most threatened endemic vascular plants. Outside the UK, it is restricted to coastal margins of Normandy and Brittany in France and Galicia in Spain, where it is declining and in low numbers. In the UK this endangered plant is now restricted to a handful of localities, most of them in south-west England, and is declining in numbers and locations. The UK is the world stronghold for this species. Sites with the largest extant populations have been selected to take account of the species' rarity and the UK's special responsibilities for its conservation and to cover its geographical range and the ecological variation in the localities where it occurs.

The shore dock grows on rocky, sandy and raised beaches, wave-cut platforms and the lower slopes of cliffs, and rarely in dune slacks. Plants can be found growing in isolation on the strand-line, through to tall-herb perennial communities at the base of flushed cliffs. However, it occurs only where a constant source of fresh water, running or static, is available. It is most commonly found growing by the side of streams entering beaches, on oozing soft-rock cliffs, and in rock clefts where flushing occurs.

About ten populations have been recorded on the UK mainland in the past two years, with additional sites on the Isles of Scilly and the Channel Islands. However the number of plants within these populations has varied greatly, with the largest mainland colonies supporting up to 50-60 individuals, whilst others support fewer than 10 individuals, and one site contains a single mature plant. The total mainland population may number only 150 plants. The Isles of Scilly as a whole contain the largest population.

Populations of shore dock are known to fluctuate according to the severity of winter storms. In the past, culverting of streams and boat-ramp construction on beaches have altered many of the shore dock's former localities, making them unsuitable, by separating perennial vegetation at the bases of cliffs from the strand-line community and interfering with the natural geomorphological processes of slumping cliffs and streams entering beaches. Visitor pressure appears to be a significant factor in the decline of shore dock at several sites. A high proportion of the localities for this plant are owned by conservation bodies or public authorities, so favouring the maintenance and enhancement of populations at these localities. Other measures to promote species recovery are also being undertaken.

3.6.6.2 Site list

Fal and Helford (158)

The location within this south-west England site holds a moderate population of shore dock *Rumex rupestris* within the centre of the distribution of the species in the UK. The number of individuals has fallen from 18 in 1989 to 9 in 1994.

Glannau M^n: Twyni/Anglesey Coast: Dunes (294)

This site in north Wales is important because of its geographical location in the far north-west of the UK distribution of shore dock *Rumex rupestris.* It is remote from other known sites for this species, and the shore dock occurs in an unusual situation: along a small stream bed and on damp pond edges, formerly in dune-land, now in a clearing in a conifer plantation. There are two small colonies, which held 21 flowering plants in 1994, 26 in 1995 and 53 in 1996.

Isles of Scilly Complex (179)

Shore dock *Rumex rupestris* has been recorded on seven of the larger islands, and also on small outcrops, including the Eastern Isles. Scilly is an important stronghold of the species at the south-west limit of its UK range. It supports some 50% of the UK population (a total of 165 flowering plants in 1994) and some of the largest colonies, although even these generally number fewer than 100 plants at any single locality. Populations fluctuate, but the plant appears to have declined overall. A rise in sea-level and increased storminess are likely to be detrimental.

Penhale Dunes (6)

This is an important site for shore dock *Rumex rupestris,* with possibly the largest population in the west of its UK mainland distribution. More than 50 plants were recorded at this site in the late 1980s; in 1994 the number had apparently declined to fewer than 40, but in 1996/7 a total of about 70 plants were recorded in five colonies.

Plymouth Sound and Estuaries (157)

Two populations of shore dock *Rumex rupestris* have recently been recorded in this area in the centre of its UK distribution, and there is a sizeable area of suitable habitat. However, the populations may have declined: at one site 69 plants were recorded in 1989 but only 31 flowering plants in 1995.

South Devon Shore Dock (319)

In 1995 ten colonies of shore dock *Rumex rupestris* were found at this site, which represents the species at the east of its UK range. Seven colonies, totalling thirteen flowering and sixteen non-flowering plants, were noted at one site, while the other supported three colonies with ten flowering plants in 1995.

The Lizard (70)

At the west of the UK mainland range for shore dock *Rumex rupestris*, sites in the Lizard have held more than 50 individuals. Numbers have recently declined but a species recovery programme which aims to address this is in place.

3.6.7 Marsh saxifrage *Saxifraga hirculus* L.

3.6.7.1 Background to selection

The marsh saxifrage *Saxifraga hirculus* is widely distributed in Europe but it is declining or threatened in most countries. In the UK the marsh saxifrage is found only at a very few sites in the uplands of Scotland, England and at one site in Northern Ireland. Sites have been selected to encompass a large proportion of the UK resource and to cover the full geographical range of the species.

The centre of distribution of marsh saxifrage is in the North Pennines in England. In this area there are several localities with thriving populations where more than 1,000 flowering shoots can be counted annually. When considered together, these localities cover 80-90% of the UK population of the species. Sites in Scotland and Northern Ireland tend to have much smaller populations, although that at Craigengar is large.

Marsh saxifrage is a perennial that requires base-rich and wet conditions. It is now considered an upland species because its favoured habitats in the lowlands have been lost. Since the nineteenth century, marsh saxifrage has become extinct in several areas, mostly in Scotland. Many of the sites for the species are heavily grazed, although moderate levels of grazing are probably beneficial to this plant.

3.6.7.2 Site list

Craigengar (10)

This site has been selected because it contains the largest population of marsh saxifrage *Saxifraga hirculus* in Scotland. It is the largest single colony outside the North Pennines and consists of over 1,000 individuals. Marsh saxifrage is found in base-rich flushes in an area of upland heather moorland on this site in the Pentland Hills.

Garron Plateau (212)

The site has been selected as the only extant locality for marsh saxifrage *Saxifraga hirculus* in Northern Ireland. The marsh saxifrage is currently restricted to a small population on one of the flushes that occurs on this extensive area of blanket bog overlying basalt.

Hill of Towanreef (9)

Marsh saxifrage *Saxifraga hirculus* occurs on the scattered base-rich soligenous mires associated with this low-lying hilly area of dolomitic serpentine in north-east Scotland. About 500 individuals of marsh saxifrage grow at this site, which has been selected to represent the most northerly locality for the species in the UK.

Moor House - Upper Teesdale (188)

This northern England site is the most important site for marsh saxifrage *Saxifraga hirculus* in the UK. It contains 80-90% of the UK population of the species - a total of more than 20,000 plants. There are approximately ten locations for this species at this site. Individually the populations in these localities can be large, with over 1,000 individuals in some cases. The site consists of an extensive upland complex on limestone and gritstone, with acid grassland, blanket mire, limestone outcrops and flushes. Drainage water in many of the flushes is influenced by the underlying limestone. Several of the flush areas within this very large site support populations of marsh saxifrage, including areas in the Appleby Fells, Cross Fell and Upper Teesdale.

3.6.8 Creeping marshwort *Apium repens*

3.6.8.1 Background to selection

Creeping marshwort *Apium repens* has been recorded in the past in scattered localities from East Anglia and Oxfordshire north to Fife and Kintyre. The plant is now confined to Oxfordshire, where it has recently been confirmed from only a single grazed flood-meadow near Oxford. The number of individuals fluctuates widely from year to year, with wet springs and summers apparently favouring the plant. This, the only known site where this species occurs, has been selected.

There has recently been a debate about the taxonomy of the Oxfordshire population of creeping marshwort, as the closely related fool's water-cress *Apium nodiflorum* also grows at the site. It was thought that the hybrid *Apium nodiflorum* x *A. repens* occurred. However, DNA analysis of *Apium* populations carried out in 1994 has confirmed that both species are present in the Oxfordshire site and showed no evidence for hybridisation.

3.6.8.2 Site list

Oxford Meadows (88)

Port Meadow, part of the Oxford Meadows site, is selected because it is the only known site in the UK for creeping marshwort *Apium repens*.

Section 3.7: Lower plants

3.7.1 Green shield-moss *Buxbaumia viridis* (Moug.) Moug. & Nestl.

3.7.1.1 Background to selection

Green shield-moss is widespread in Europe, but is apparently declining, rare and threatened in most countries. This may be because of the general destruction and over-management of semi-natural coniferous woodland. In the UK, the species has only ever been found in a small number of sites in northern and eastern Scotland, with a very small number of plants at each site. Since 1950 it has been seen at only two sites, in Inverness and Strathspey, and in 1993 it was found only at the site near Inverness.

This is a highly specialised and atypical moss with a much reduced vegetative (i.e. gametophyte) generation and a well developed and distinctive capsule (i.e. sporophyte). Green shield-moss is very specific in its habitat requirements in the UK, being restricted to well-decayed wood, particularly conifer logs, in damp, sheltered places in woodland. However, on the continent it apparently occurs on rotten wood of various sorts and has been recorded growing on humus-rich soil and on weathered, acidic rocks.

3.7.1.2 Site list

Moniack Gorge (11)

Moniack Gorge in northern Scotland is a steep wooded ravine with predominantly base-rich soils. This is the only UK site where green shield-moss *Buxbaumia viridis* is currently known to occur - two sporophytes were recorded at the site in 1993 and a single sporophyte in 1995. Habitat conditions appear suitable, as there is evidence that the species has been present on the site for many years.

3.7.2 Slender green feather moss *Drepanocladus vernicosus* (Mitt.) Warnst

3.7.2.1 Background to selection

Slender green feather-moss *Drepanocladus vernicosus* is widely distributed throughout Europe, although it is thought to be declining because of the widespread destruction and damage of its habitat. In the UK it is widespread in the upland areas of north Wales and north-west England but it is very infrequent in Scotland. Sites have been selected to take account of the geographical range and ecological variation in the habitats occupied.

This moss (referred to in most recent literature as *Hamatocaulis vernicosus* (Mitt.) Hedenäs) is a medium-sized straggling species of base-rich flushes and springs in the uplands and, more rarely, lowland sedge fens. It may grow with a number of small sedges *Carex* spp., black bog-rush *Schoenus nigricans* and other characteristic mosses of base-rich flushes and fens, such as *Campylium stellatum* and *Scorpidium scorpioides*, and liverworts such as *Leiocolea bantriensis*. Although more frequent in the uplands, it does not reach very high altitudes, and the highest record is at 450 m on Snowdon. Site selection covers this range of variation, including sites at a range of altitude.

There is variation in the appearance and structure of the leaves of this species, the leaves of some specimens being clearly more plicate than those of others. The genus *Drepanocladus* and related genera are taxonomically difficult and the group has recently been revised. British records of *D. vernicosus* are thought to be referable to two taxa, *Hamatocaulis vernicosus* and *Scorpidium cossonii*, the distributions of which are currently under investigation. As formally agreed by the EC Habitats Committee the older, wider concept of *Drepanocladus vernicosus* has been applied to site selection.

3.7.2.2 Site list

Asby Complex (192)

Sunbiggin Tarn is an upland site and has been selected to represent slender green feather-moss *Drepanocladus vernicosus* in the north-west part of its range in England. The site contains a large population of this species in extensive upland flush systems and wet calcareous sedge fen on Carboniferous limestone. Slender green feather-moss grows here with black bog-rush *Schoenus nigricans* and the liverwort *Leiocolea bantriensis*.

Eryri/Snowdonia (118)

Slender green feather-moss *Drepanocladus vernicosus* occurs on open grassy flushes on Snowdon, up to an altitude of 450 m, and provides a representation of the species in north Wales.

Norfolk Valley Fens (101)

This site is selected to represent the occurrence of slender green feather-moss *Drepanocladus vernicosus* in lowland fens in East Anglia, England, the centre of its distribution. The moss occurs in black-bog rush *Schoenus nigricans*-rich fens and small sedge fen (fen with low-growing sedge vegetation).

Preseli (17)

This site is representative of slender green feather-moss *Drepanocladus vernicosus* in the south-west Wales part of its range. It grows here in upland flushes and seepages amidst wet heathland habitat.

Rum (16)

Rum provides a representation of slender green feather-moss *Drepanocladus vernicosus* in western Scotland, a region where records of the species are relatively sparse. Here the species occurs in upland flushes with small sedge fen.

3.7.3 Western rustwort *Marsupella profunda* Lindb.

3.7.3.1 Background to selection

Western rustwort *Marsupella profunda* is the only Annex II priority species to occur in UK. It is a very rare liverwort, endemic to Europe and known only from a small number of sites in Portugal, Madeira, the Canary Islands and south-west England. Its status in the UK is Critically Endangered, and in the rest of Europe it is Vulnerable. Site selection has taken into account the priority status of this species and both sites known to support it have been selected. Western rustwort is rare and threatened throughout its range and nearly always occurs in small populations.

Western rustwort is a small reddish liverwort of crumbling granite and china clay. It was recently detected in Cornwall after examination of herbarium specimens and was rediscovered at a single small hill with old china clay workings during a survey in 1993. More recent survey work has led to a better understanding of its distribution, and in 1996 it was found to be present in quantity at another location, with the more widespread *Marsupella sprucei* and the common liverwort *Nardia scalaris* on banks of china clay spoil. It was most abundant on acidic clay surfaces that had been exposed for little more than five years, where other vegetation was only just beginning to colonise. The species is probably fairly mobile within its very restricted habitat, new plants growing rapidly from spores as older plants are eventually out-competed by surrounding vascular plant vegetation. However, it is very similar to the more widespread *Marsupella sprucei*, and may have been overlooked.

3.7.3.2 Site list

Lower Bostraze and Leswidden (321)

This site comprises two closely adjacent locations that have been selected for western rustwort *Marsupella profunda*. The colony at Lower Bostraze is in the southern half of a recently-disused china clay quarry (extraction ended here around 1991). There are many exposed clay surfaces with little or no colonisation by bryophytes and vascular plants. Filamentous green algae are however widespread on the clay. Most vascular plants present are only immature individuals, with heather *Calluna vulgaris* and bell heather *Erica cinerea* the most common species. Lower Bostraze supports the largest population of western rustwort, with an estimated 4,000 cm² cover, while Leswidden has an estimated 200 cm². Leswidden is also a former china clay quarry, where working ceased before 1965. Banks of clay spoil have been exposed more recently during work to clear and flatten the area to the south now used as a coal merchant's yard. As at Lower Bostraze, the clay surfaces are colonised by filamentous green algae and, very sparsely, by calcifuge vascular plants such as heather *Calluna vulgaris* and bell heather *Erica cinerea*.

Tregonning Hill (20)

Western rustwort *Marsupella profunda* was found here in 1993 on two small stones of crumbling, soft, mica-rich granitic material that were mostly embedded in the soil and surrounded by coarse grass and other weedy vegetation. One stone, at the entrance to a pit, was more sheltered and supported a small colony of the species. The other, more exposed stone had a north-western exposure and a more vigorous-looking colony about 2 cm across that was producing sporophytes. As a site of former china clay extraction, the top and slopes of Tregonning Hill are pock-marked with pits and gullies, along with mounds of waste material from these operations. Much of the hill is overgrown with gorse *Ulex* spp., and the pits are choked with brambles *Rubus fruticosus* agg., roses *Rosa* spp. and willow *Salix* spp. scrub. Bryophyte cover is therefore sparse on the floor of the pits, but there is still some reasonable bryophyte growth on the sides, where the substrate is more or less vertical and relatively bare. The colonies at Tregonning cover approximately 9 cm².

3.7.4 Petalwort *Petalophyllum ralfsii* (Wils.) Nees & Gott. ex Lehm.

3.7.4.1 Background to selection

Petalwort *Petalophyllum ralfsii* is considered vulnerable in both Britain and Europe. It has a predominantly Mediterranean distribution in Europe but is not frequent anywhere in its range, being rather closely confined to dune slacks of a certain kind, which are themselves under threat in many areas.

Petalwort has always been widely but sparsely distributed in the UK. A high proportion of the known localities are in the south-west and this is reflected in site selection, with other sites selected to cover its geographical range. Most of the sites support large populations but in some parts of the species' range only small populations occur. All the sites are large dune systems with extensively developed dune slack habitat.

This pale green liverwort grows in open, damp, calcareous dune slacks, often on low hummocks rather than on the very wet ground, on compacted sandy/muddy bryophyte-rich turf. It has occasionally been recorded on other coastal grassland where conditions are similar. Closely associated species may include the mosses *Barbula convoluta*, *Barbula tophacea*, *Bryum* spp., *Ditrichum flexicaule* (*sensu latu*), *Hypnum cupressiforme* var. *lacunosum*, common bent *Agrostis capillaris*, glaucous sedge *Carex flacca*, red fescue *Festuca rubra*, Yorkshire-fog *Holcus lanatus* and buck's-horn plantain *Plantago coronopus*. At one site, the area where petalwort grows is clearly used by vehicles and it can be found on the sides of paths, where the soil is more compacted. It does not grow in water-filled slacks or in slacks where willow *Salix* spp. scrub predominates.

3.7.4.2 Site list

Braunton Burrows (8)

A large population of petalwort *Petalophyllum ralfsii* is recorded from this site, which is one of two sites chosen for this species in south-west England. There are extensive open dune slack habitats of the types required by this species for survival.

Burry Inlet: Dunes/Cilfach Burry: Twyni (292)

This is one of two sites chosen for petalwort *Petalophyllum ralfsii* in south Wales. Whiteford Burrows is included in this site and has a large population of the liverwort. Some of the largest and least disturbed calcareous dune slack systems in the UK occur in this area, a high proportion of which are very open in character.

Glannau M^n: Twyni/Anglesey Coast: Dunes (294)

The site is an extensive complex of sand dunes, dune slacks, marsh, shingle and cliffs in south-west Anglesey, north Wales. There is a large population of petalwort *Petalophyllum ralfsii* here that was first recorded in 1828. This historical continuity indicates that the site is especially favourable for the survival of this species. Although partly afforested, the open dunes have a very rich bryophyte flora, including the mosses *Amblyodon dealbatus*, *Catoscopium nigritum* and the liverwort *Southbya tophacea*, particularly in damp, calcareous slacks and flats.

Kenfig/Cynffig (7)

This is one of two sites selected for petalwort *Petalophyllum ralfsii* in south Wales and supports a large population of the species. The calcareous dune system has many dune slacks that include the early successional, open slack vegetation this species requires.

North Northumberland Dunes (237)

This site provides a representation of petalwort *Petalophyllum ralfsii* in north-east England. There are extensive dune systems with slacks here, both on the mainland and on Holy Island. Petalwort has been recorded recently on Holy Island.

Penhale Dunes (6)

This site supports a large population of petalwort *Petalophyllum ralfsii* and is one of two sites selected to represent its occurrence in south-west England. Petalwort occurs on this large dune system in damp, calcareous dune slacks, influenced by a range of human activities.

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Appendix

Map A1: Locations of sites (see Tables A1 and A2)

Map A1: Locations of sites (see Table A1 and A2)

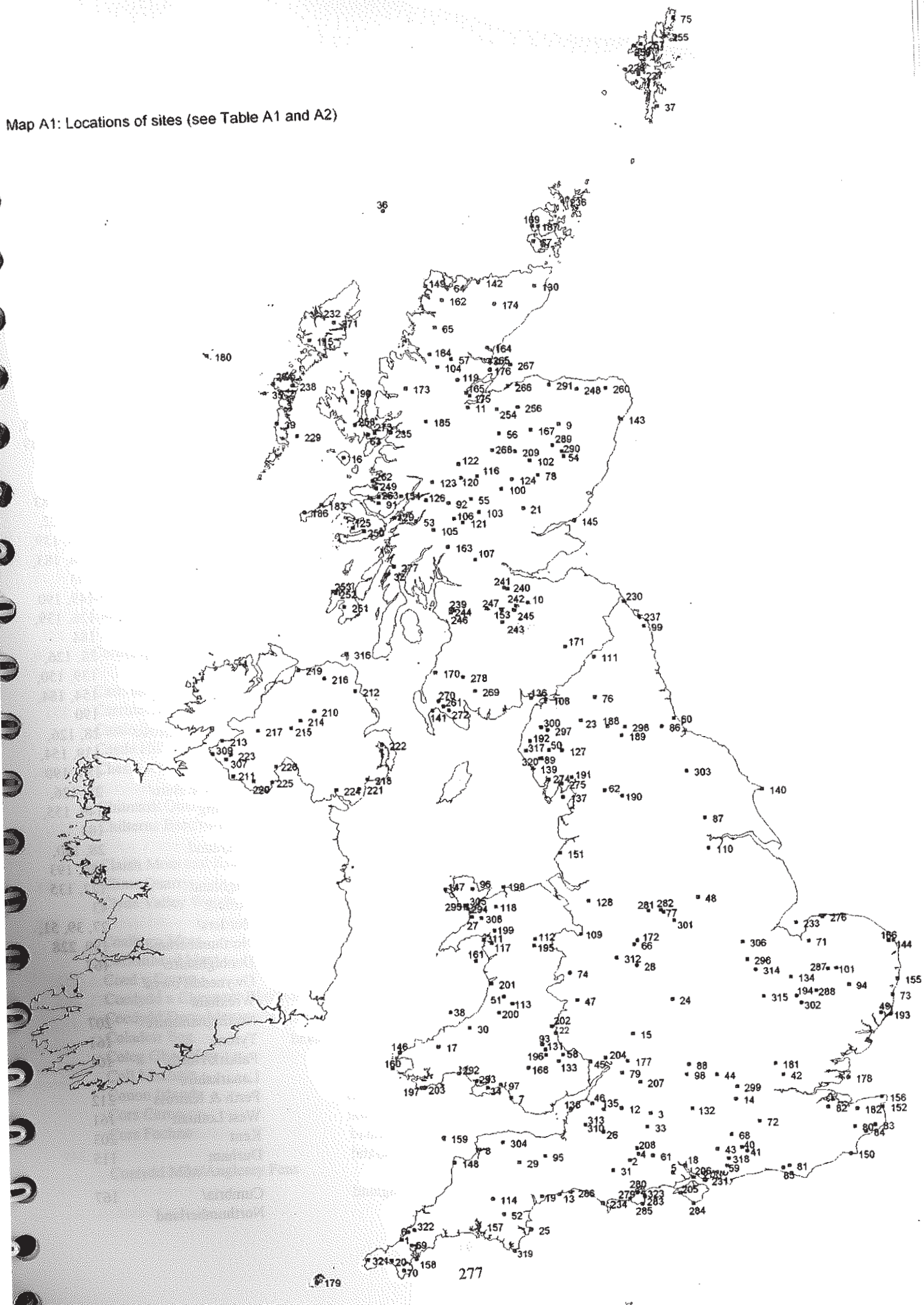

Table A1 Alphabetical list of site names

Site name	No. on Map A1	Country	County/Region	Page(s)
Achmore Bog	271	Scotland	Western Isles	167
Amat Woods	57	Scotland	Highland	211
Ardgour Pinewoods	154	Scotland	Highland	212
Ardmeanach	125	Scotland	Argyll & Bute	149
Asby Complex	192	England	Cumbria	28, 152, 178, 180, 196, 256, 271
Avon Gorge Woodlands	46	England	Avon	28, 204
Ballynahone Bog	210	Northern Ireland	Londonderry	161
Bankhead Moss, Beith	239	Scotland	North Ayrshire	161
Barnack Hills and Holes	296	England	Cambridgeshire	146
Barry Links	145	Scotland	Angus	26, 72, 75, 81, 83, 89
Bath and Bradford-on-Avon Bats	12	England	Avon/Wiltshire	221
Beer Quarry and Caves	13	England	Devon	225
Beinn a'Ghlo	124	Scotland	Perth & Kinross	149, 183
Beinn Dearg	104	Scotland	Highland	28, 122, 135, 139, 154, 183, 193
Beinn Iadain and Beinn na h'Uamha	91	Scotland	Highland	149, 190
Ben Alder and Aonach Beag	120	Scotland	Highland	126, 139, 184
Ben Heasgarnich	106	Scotland	Argyll & Bute/ Stirling	28, 126, 139, 150, 154, 184, 190
Ben Lawers	103	Scotland	Perth & Kinross/ Stirling	28, 126, 139, 154, 184, 190
Ben Lui	105	Scotland	Argyll & Bute/ Stirling	28, 126, 140, 155, 184
Ben Nevis	123	Scotland	Highland	28, 140, 186, 193
Ben Wyvis	119	Scotland	Highland	122, 135
Benacre to Easton Bavents Lagoons	155	England	Suffolk	43
Berwickshire and North Northumberland Coast	230	England & Scotland	Borders/ Northumberland	27, 39, 51, 199, 228
Berwyn	112	Wales	Denbighshire/ Gwynedd/Powys/ Wrexham	167
Birklands and Bilhaugh	48	England	Nottinghamshire	207
Black Bog	215	Northern Ireland	Tyrone	161
Black Loch Moss	240	Scotland	Falkirk/North Lanarkshire	161
Black Wood of Rannoch	55	Scotland	Perth & Kinross	212
Blawhorn Moss	241	Scotland	West Lothian	161
Blean Complex	182	England	Kent	203
Bollihope, Pikestone, Eggleston and Woodland Fells	298	England	Durham	115
Border Mires, Kielder - Butterburn	111	England	Cumbria/ Northumberland	167
Borrowdale Woodland Complex	50	England	Cumbria	208

Table A2 Numerical list of sites

No. on Map A1	Site name	Country	County/Region	Page(s)
1	Godrevy Head to St Agnes	England	Cornwall	261
2	Fontmell and Melbury Downs	England	Dorset	261
3	Pewsey Downs	England	Wiltshire	261
4	Prescombe Down	England	Wiltshire	262
5	The New Forest	England	Hampshire & Wiltshire	96, 107, 112, 117, 174, 201, 207, 215, 217, 249, 253
6	Penhale Dunes	England	Cornwall	79, 87, 267, 274
7	Kenfig/Cynffig	Wales	Bridgend	79, 87, 90, 264, 273
8	Braunton Burrows	England	Devon	26, 75, 78, 86, 90, 273
9	Hill of Towanreef	Scotland	Aberdeenshire/ Moray	268
10	Craigengar	Scotland	Borders/ South Lanarkshire	268
11	Moniack Gorge	Scotland	Highland	270
12	Bath and Bradford-on-Avon Bats	England	Avon/Wiltshire	221
13	Beer Quarry and Caves	England	Devon	225
14	Windsor Forest and Great Park	England	Berkshire/Surrey	207, 248
15	Bredon Hill	England	Hereford & Worcester	248
16	Rum	Scotland	Highland	112, 117, 151, 189, 271
17	Preseli	Wales	Pembrokeshire	252, 271
18	River Itchen	England	Hampshire	109, 253
19	East Devon Pebblebed Heaths	England	Devon	116, 252
20	Tregonning Hill	England	Cornwall	272
21	Dunkeld-Blairgowrie Lochs	Scotland	Perth and Kinross	263
22	River Wye/Afon Gwy	England & Wales	Gloucestershire/ Hereford & Worcester/ Monmouthshire/ Powys	109, 226, 234, 236, 238, 240, 242, 243, 245, 247
23	River Eden	England	Cumbria	109, 233, 235, 237, 240, 244, 247
24	Ensor's Pool	England	Warwickshire	246
25	South Hams	England	Devon	222
26	Mells Valley	England	Somerset	221
27	Coleg Glynllifon	Wales	Gwynedd	223
28	Cannock Extension Canal	England	Staffordshire/ West Midlands	260
29	Culm Grasslands	England	Devon	152, 250
30	Rhos Llawr-cwrt	Wales	Cardiganshire	250
31	Rooksmoor	England	Dorset	251
32	Taynish Woods	Scotland	Argyll & Bute	209, 251
33	Salisbury Plain	England	Hampshire/ Wiltshire	131, 144, 251

34	Gower Commons/Tiroedd Comin Gwyr	Wales	Swansea	111, 250, 252
35	Monach Islands	Scotland	Western Isles	92, 228
36	North Rona	Scotland	Western Isles	228
37	Mousa	Scotland	Shetland	229
38	Cardigan Bay/Bae Ceredigion	Wales	Cardiganshire/ Pembrokeshire	230
39	South Uist Machair	Scotland	Western Isles	93, 96, 102, 104, 263
40	Ebernoe Common	England	West Sussex	201
41	The Mens	England	West Sussex	201
42	Epping Forest	England	Essex	201, 249
43	East Hampshire Hangers	England	Hampshire	202, 205
44	Chilterns Beechwoods	England	Buckinghamshire/ Oxfordshire	130, 202
45	Wye Valley Woodlands/Coetiroedd Dyffryn Gwy	England & Wales	Gloucestershire/ Hereford & Worcester	202, 206, 219
46	Avon Gorge Woodlands	England	Avon	28, 204
47	Downton Gorge	England	Hereford & Worcester	205
48	Birklands and Bilhaugh	England	Nottinghamshire	207
49	Staverton Park and The Thicks, Wantisden	England	Suffolk	207
50	Borrowdale Woodland Complex	England	Cumbria	208
51	Coedydd a Cheunant Rheidol/Rheidol Woods	Wales	Cardiganshire	208
52	South Dartmoor Woods	England	Devon	209
53	Loch Etive Woods	Scotland	Argyll & Bute/ Highland	209
54	Glen Tanar	Scotland	Aberdeenshire	212
55	Black Wood of Rannoch	Scotland	Perth & Kinross	212
56	Kinveachy Forest	Scotland	Highland	212
57	Amat Woods	Scotland	Highland	211
58	Coed y Cerrig	Wales	Monmouthshire	216
59	Kingley Vale	England	West Sussex	218
60	Castle Eden Dene	England	Durham	218
61	Great Yews	England	Wiltshire	218
62	Ingleborough Complex	England	North Yorkshire	130, 191, 197
63	Strath	Scotland	Highland	141, 179, 191, 198
64	Durness	Scotland	Highland	28, 78, 101, 140, 197
65	Inchnadamph	Scotland	Highland	127, 140, 179, 188, 191, 197
66	Pasturefields Salt Marsh	England	Staffordshire	69
67	Hoy	Scotland	Orkney	111, 123, 179
68	Thursley, Ash, Pirbright and Chobham	England	Surrey	112, 118, 175
69	Carrine Common	England	Cornwall	113
70	The Lizard	England	Cornwall	62, 102, 107, 112, 119, 267
71	Roydon Common and Dersingham Bog	England	Norfolk	174
72	Mole Gap to Reigate Escarpment	England	Surrey	128, 218
73	Minsmere to Walberswick Heaths and Marshes	England	Suffolk	55, 116
74	The Stiperstones and The Hollies	England	Shropshire	117
75	Keen of Hamar	Scotland	Shetland	132, 189

76	Tyne and Allen River Gravels	England	Northumberland	133
77	Gang Mine	England	Derbshire	132
78	Caenlochan	Scotland	Aberdeenshire/ Angus/ Perth & Kinross	28, 126, 132, 155, 184, 188, 191
79	Rodborough Common	England	Gloucestershire	144
80	Wye and Crundale Downs	England	Kent	147
81	Lewes Downs	England	East Sussex	146
82	Queendown Warren	England	Kent	147
83	Lydden and Temple Ewell Downs	England	Kent	146
84	Folkestone to Etchinghill Escarpment	England	Kent	146
85	Castle Hill	England	East Sussex	146
86	Thrislington	England	South Yorkshire	144
87	Lower Derwent Valley	England	Humberside/ North Yorshire	157
88	Oxford Meadows	England	Oxfordshire	157, 269
89	Wasdale Screes	England	Cumbria	192, 195
90	Trotternish Ridge	Scotland	Highland	151, 189, 192
91	Beinn Iadain and Beinn na h'Uamha	Scotland	Highland	149, 190
92	Rannoch Moor	Scotland	Argyll & Bute/ Highland/ Perth & Kinross	105, 171, 173
93	Drostre Bank	Wales	Powys	152
94	Waveney and Little Ouse Valley Fens	England	Norfolk/ Suffolk	153, 177, 254, 258
95	Holme Moor and Clean Moor	England	Somerset	153, 177
96	Corsydd Môn/Anglesey Fens	Wales	Anglesey	29, 101, 176, 180, 256
97	Crymlyn Bog/Cors Crymlyn	Wales	Neath & Port Talbot	176
98	Cothill Fen	England	Oxfordshire	181
99	Newham Fen	England	Northumberland	181
100	Tulach Hill and Glen Fender Meadows	Scotland	Perth & Kinross	182, 255, 256
101	Norfolk Valley Fens	England	Norfolk	181, 257, 271
102	Morrone Birkwood	Scotland	Aberdeenshire	130, 185
103	Ben Lawers	Scotland	Perth & Kinross/ Stirling	28, 126, 139, 154, 184, 190
104	Beinn Dearg	Scotland	Highland	28, 122, 135, 139, 154, 183, 193
105	Ben Lui	Scotland	Argyll & Bute/ Stirling	28, 126, 140, 155, 184
106	Ben Heasgarnich	Scotland	Argyll & Bute/ Stirling	28, 126, 139, 150, 154, 184, 190
107	Flanders Mosses	Scotland	Dumfries & Galloway/ Stirling	163

108	Solway Mosses	England & Scotland	Cumbria/ Dumfries & Galloway	164
109	Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses	England & Wales	Shropshire/ Wrexham	163
110	Thorne Moor	England	Durham	165
111	Border Mires, Kielder - Butterburn	England	Cumbria/ Northumberland	167
112	Berwyn	Wales	Denbighshire/ Gwynedd/Powys/ Wrexham	167
113	Elenydd	Wales	Cardiganshire/ Powys	168
114	Dartmoor	England	Devon	111, 168
115	North Harris	Scotland	Western Isles	112
116	Drumochter Hills	Scotland	Highland/ Perth & Kinross	122, 127, 136
117	Rhinog	Wales	Gwynedd	117
118	Eryri/Snowdonia	Wales	Conwy/Gwynedd	98, 136, 155, 187, 191, 194, 260, 271
119	Ben Wyvis	Scotland	Highland	122, 135
120	Ben Alder and Aonach Beag	Scotland	Highland	126, 139, 184
121	Meall na Samhna	Scotland	Highland	127, 141, 150
122	Creag Meagaidh	Scotland	Highland	127, 136
123	Ben Nevis	Scotland	Highland	28, 140, 186, 193
124	Beinn a'Ghlo	Scotland	Perth & Kinross	149, 183
125	Ardmeanach	Scotland	Argyll & Bute	149
126	Glen Coe	Scotland	Highland	150, 156, 187, 194
127	Helvellyn and Fairfield	England	Cumbria	156
128	Oak Mere	England	Cheshire	96
129	Lismore Lochs	Scotland	Argyll & Bute	102
130	Loch Watten	Scotland	Highland	103
131	Llangorse Lake/Llyn Syfaddan	Wales	Powys	103
132	Kennet and Lambourn Floodplain	England	Berkshire	257
133	River Usk/Afon Wysg	Wales	Monmouthshire/ Newport/Powys	233, 236, 242, 243, 244
134	Ouse Washes	England	Cambridgeshire/ Norfolk	241
135	River Avon	England	Dorset/Hampshire/ Wiltshire	108, 235, 237, 239, 244, 257
136	Solway Firth	England & Scotland	Dumfries & Galloway/ Stewartry	33, 37, 41, 64, 67
137	Morecambe Bay	England	Cumbria/ Lancashire	40, 48, 58, 63, 67

138	Severn Estuary/Môr Hafren	England & Wales	Bristol/Cardiff/ Gloucestershire/ Monmouthshire/ Newport/North Somerset/ Somerset/South Gloucestershire/ Vale of Glamorgan	33, 37, 40, 67
139	Drigg Coast	England	Cumbria	26, 36, 84, 86
140	Flamborough Head	England	Humberside/ North Yorkshire	51, 60, 200
141	Torrs Warren - Luce Sands	Scotland	Dumfries & Galloway	74, 77, 82, 85
142	Invernaver	Scotland	Highland	79, 82, 84, 87, 94, 123, 141
143	Sands of Forvie	Scotland	Aberdeenshire	73, 76, 82, 91
144	Winterton - Horsey Dunes	England	Norfolk	74, 85, 91
145	Barry Links	Scotland	Angus	26, 72, 75, 81, 83, 89
146	St David's/Ty Ddewi	Wales	Pembrokeshire	61
147	Glannau Ynys Gybi/Holy Island Coast	Wales	Anglesey	60
148	Tintagel - Marsland - Clovelly Coast	England	Cornwall/Devon	62
149	Oldshoremore and Sandwood	Scotland	Highland	93
150	Dungeness	England	East Sussex/Kent	55, 58, 231
151	Sefton Coast	England	Merseyside	74, 80, 87, 91
152	Sandwich Bay	England	Kent	74, 77, 80, 87
153	Clyde Valley Woods	Scotland	North Lanarkshire/ South Lanarkshire	205
154	Ardgour Pinewoods	Scotland	Highland	212
155	Benacre to Easton Bavents Lagoons	England	Suffolk	43
156	Thanet Coast	England	Kent	200
157	Plymouth Sound and Estuaries	England	Cornwall/Devon	33, 37, 49, 267
158	Fal and Helford	England	Cornwall	32, 40, 48, 67, 266
159	Lundy	England	Devon	52
160	Pembrokeshire Islands/Ynysoedd Sir Benfro	Wales	Pembrokeshire	36, 49, 52, 228
161	Pen Llín a'r Sarnau/Lleyn Peninsula and the Sarnau	Wales	Cardiganshire/ Gwynedd/Powys	37, 53
162	Foinaven	Scotland	Highland	123, 155, 194
163	Loch Lomond Woods	Scotland	Argyll & Bute/ Stirling/West Dunbartonshire	209
164	Mound Alderwoods	Scotland	Highland	216
165	Conon Islands	Scotland	Highland	216
166	The Broads	England	Norfolk/Suffolk	104, 173, 177, 181, 216, 257, 264
167	Creag nan Gamhainn	Scotland	Moray	179
168	Cwm Cadlan	Wales	Rhondda Cynon Taff	152

169	Stromness Heaths and Coast	Scotland	Orkney	61, 117
170	Lendalfoot Hills Complex	Scotland	South Ayrshire	150
171	Whitlaw and Branxholme	Scotland	Borders	173
172	West Midlands Mosses	England	Cheshire/ Shropshire/ Staffordshire	105, 173
173	Loch Maree Complex	Scotland	Highland	116, 123, 187, 194, 209, 212
174	Caithness and Sutherland Peatlands	Scotland	Highland	105, 167
175	Monadh Mor	Scotland	Highland	214
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