PART B OPERATIONAL APPROACH AND CRITERIA

1 Defining the basis for selecting the national network of sites

1.1 Great Britain is ecologically diverse, but the most conspicuous contrast is the broad geographical separation between low-lying, flat and fertile land to the south and east, and mountainous, steep and infertile terrain to the north and west. Superimposed upon and magnified by these geological/topographic differences are major gradients of climate across the country. With increasing latitude and altitude mean temperatures fall, and with increasing distance west and altitude there is an increase in rainfall, wind and cloud cover. Range of temperature also falls in a westerly direction and with proximity to the sea. These environmental gradients have produced the familiar geographical differences in both agricultural and urban/industrial development and, hence, the converse pattern in extent of undeveloped, natural and semi-natural habitat. They have also produced wide diversity within these undeveloped habitats, in both physical and biological character. A detailed classification and description of the overall wildlife resource of Britain has been given in A Nature Conservation Review (NCR) (Ratcliffe 1977), but the vegetational component has now been defined in a more standard and detailed way in the National Vegetation Classification (NVC) (Rodwell in prep.), which will in future be used as the reference classification for each formation (see 2.7–2.9 below).

1.2 The main need is to ensure that the series of Sites of Special Scientific Interest throughout Great Britain is sufficient in kind, number and extent to conserve the total national "special interest" of this range of variation in habitats, with their associated flora and fauna. While the classification of this countrywide field of variation into habitats and species-groups is the basic reference system for the selection process, it is necessary for practical purposes to relate this to some geographical subdivision of Britain. The Areas of Search (AOSs) defined in Figure 2 (on p. 18) and discussed in A, 4.11 provide such a framework, and on an appropriate scale. They correspond quite well to the geographical scale on which nature has traditionally been studied, recorded and conserved, as the focus of such activities has been on counties and Watsonian vice-counties (Dandy 1969). County floras and faunas have been a major source of information on important sites, and the most recent mapping schemes and habitat surveys have also tended to be county-based. This has, accordingly, become a widely accepted scale for the setting of nature conservation objectives and strategies. **Within each AOS, a minimum aim will be to represent all the different habitats and species that are present by at least one – and preferably the best – example or population.** This involves selecting enough relevant sites which satisfy certain minimum standards of quality. Provided that selection is adequate within each AOS, representation of national gradients in features determined by climate and other environmental factors will automatically be accommodated in the countrywide network of SSSIs. **For many habitats and species, the minimum of one example or population per AOS will not be enough, and the guiding principle is that, as rarity or other special value increases, so does the need to notify a larger proportion of the total remaining area or population.** Where rare or otherwise especially important habitats or species are wholly or nearly confined to one AOS, there may be no limit on the number or area of sites qualifying for selection (see 2.10.5 and 2.11.7).

1.3 The subdivision of Britain into AOSs of roughly similar size gives the basis for representing different habitats and species-groups with a countrywide distribution of sites which takes at least some account of the main geographical gradients of climate. One site per habitat per AOS would on average be approximately 50 km apart, and this is close to the distance at which the major gradients of climate begin to exert measurable biological effects. In practice, the local yet often considerable differences in climate and other environmental factors often require that several examples of each main habitat are chosen to represent the field of variation within each AOS. Needs for interchange amongst mobile species also require that many types of site be much closer together than 50 km. Previous experience has been that, for many of the more widespread habitat types, selection of the five best examples per AOS has on average given adequate representation.

1.4 For many habitats and species assemblages, however, choice of sites according to minimum standards will override this procedure. Selection for best examples will apply mainly to those habitats which are still extensive and continuous, notably uplands and some (but not all) types of coastland. Since the size discrepancy between AOSs is mainly in industrialised and heavily populated districts where the principle of minimum standards especially applies, the problem which this discrepancy might cause is largely theoretical. Most of the AOSs where selection of best examples especially applies are of similar size. Part C gives more detailed guidance for each habitat formation and species-group by providing a more specifically designed framework for selection according to a countrywide analysis of variation and conservation need.

2 The principles of site evaluation and selection

2.1 The criteria for site evaluation continue to be those defined in A Nature Conservation Review, namely size, diversity, naturalness, rarity, fragility and typicalness as primary criteria, and recorded history, position in an ecological/geographical unit, potential value and intrinsic appeal as secondary criteria. Their application is complex, and different criteria or different combinations or emphases are needed for evaluation and selection:

2.1.1 between the use of minimum standards and of exemplary representation;

2.1.2 between habitats and species-groups;

2.1.3 between different habitats;

2.1.4 between different species-groups.

2.2 An attempt will be made in the following paragraphs to outline general principles applying under 2.1.1 and 2.1.2, but specific guidance on 2.1.3 and 2.1.4 is given under 2.10 and 2.11 respectively. Little use has been made of scoring systems for habitats, because of these complexities of treatment and hence the difficulty - if not impossibility - of finding a standard approach which can be applied over the whole of Great Britain. Attributes being assessed are nevertheless quantified whenever possible, through the standardised recording of survey information.

2.3 A general point needs to be made about the subject of **representation.** Some evaluation systems adopt the criterion of **representativeness,** but this practice is not followed here. The issue is about selecting a site which best represents a particular field of interest, in the possession of as many as

possible of both the characteristic and the special features of habitat and species. On closer analysis, it will be clear that this selection requirement really involves such a mixture of desirable attributes that it is best to try to separate these. In other words, the concept of representativeness subsumes the separate criteria of diversity and typicalness in particular, but also of size and rarity to some extent. It seems better to regard representation as the underlying principle which the selection process aims to satisfy, both within a single site and through the totality of all sites, and then to satisfy this principle by the application of criteria relating to it. Representativeness is sometimes simply equated with typicalness, but to avoid confusion the second term is preferred here.

2.4 Some criteria are used in a more general way than others, and typicalness is an instance. Selection aims to choose sites with examples of habitats and species which are not only characteristic (i.e. typical) of that ecosystem in the particular AOS, but are also the best examples. This may at times give a tendency to select for the unusual, so that, while most typical features are nearly always present, some may be underrepresented or not represented at all. It is necessary to be aware of this and, when appropriate, to select other sites not for unusual features, but as good examples of typical features which also have special interest.

2.5 The criterion of fragility also applies generally, in that it is a measure of the intrinsic sensitivity of nearly all natural and semi-natural habitats and native species to human impact, combined with the probability of such impact arising. Fragility is a property which causes natural and semi-natural habitats and native species as a class to be more highly valued than any of the artificial substitutes which replace them through human activity; and the greater their fragility, the higher their value. Similar habitats usually have an equal fragility, however, so that the criterion has less value than others in comparative evaluation of sites. It is clearly related also to size, naturalness and rarity, but the other face of the coin of fragility is irreplaceability.

2.6 The quality of non-recreatability is probably a better integrating measure of nature conservation value than any other single factor or criterion. The more natural an ecosystem, the greater the difficulty of ever re-creating it in original richness and complexity once it has been destroyed. Restoring the physical conditions of former habitats is sometimes possible, but it is especially difficult to restore their full and identical range, and even more problematical to replace the full species complement originally present. Many species of plant and animal are difficult to reintroduce, but the greater problem is that the full list of species formerly present is seldom known. Re-created habitats thus usually tend to be regarded as inferior substitutes for the originals, and this explains why such emphasis has to be placed on the conservation of natural and semi-natural ecosystems while and where they still remain.

2.7 Application of evaluation criteria has to be against a background framework of reference (i.e. a classification) describing the range of variation in ecosystems, communities and species which the SSSI series is intended to represent. The National Vegetation Classification is intended to be used as the framework of reference for the evaluation and selection of those habitats which can be defined in terms of plant communities. It provides:

2.7.1 a standardised countrywide description of the range of variation in natural and semi-natural vegetation which the SSSI series is required to represent;

2.7.2 a reference system of nodal points in a complex, multi-dimensional field of variation in vegetation, so that any particular stand (actual plant community) can be identified either as representing one nodal point or as occupying an intermediate position between two or more nodal points;

2.7.3 an indication of both the juxtapositions and geographical biases in distribution of the different plant communities and sub-communities, i.e. the scope for within-site as well as between-site variation;

2.7.4 a datum of floristic composition for each community and sub-community, against which elements of artificiality (e.g. presence of exotic species) can be measured.

2.8 It will be some time before the use of 2.7.2 can be fully developed for all main vegetation formations, but an indication of its utility is given for the lowland grasslands, whose recognition depends especially on detailed floristic composition. A fundamental point to grasp is that, because vegetational variation in the field tends to be continuous, many stands will be intermediate in floristics between abstract nodal types. These intermediates are usually of equal nature conservation value to the type examples and so merit similar representation: it is only when a mixture results from the presence of introduced species or those associated with recent human disturbance that nature conservation value may fall below an acceptable level.

2.9 In field practice, the NVC is a tool for the standardised recording of vegetational diversity within surveyed areas, including the representation of pattern by vegetation mapping. It provides a 'language' for dealing with vegetation in a systematic way and promotes ecological understanding and description when correlated with environmental parameters. It may be possible, in due course, to derive from the NVC a series of lists of 'indicator species' to assist in the evaluation of some habitats and plant communities. These indicators are plants of restricted ecological tolerance, especially characteristic of or confined to certain plant communities, and their presence accordingly points to particular conditions or combinations of climate, soil and land-use. In so far as these specialised conditions are prone to alteration by human activities, these plants often indicate lack of damaging modification, though there are other species which are, conversely, good indicators of disturbance. For certain classes of vegetation, further refinement of the NVC is required, and the need to represent any additional communities, sub-communities or even variants should be remembered. Because of the great significance of structural features to the interest of bogs, a further classification of these peatlands has been based on a decreasing hierarchical scale of variation in structure and topographic relationships (C.8, 3).

2.10 Assessment to identify habitats which meet minimum standards

The main task here is setting the standards in the first place, by defining acceptable levels of quality in nature conservation interest. The following considerations and criteria apply.

2.10.1 Naturalness While truly natural habitats (i.e. not modified by man) are highly valued, they are now rare in Britain, and site selection has, perforce, to deal largely with a wide range of semi-natural types. Habitats must nevertheless satisfy a certain level of quality marked

by lack of features which indicate gross or recent human modification. Adverse indications are given by the presence of non-native plant species, especially those known to have been deliberately planted, but much depends on their relative abundance and their effect on the whole community. Physical modifications to the habitat vary greatly in their impact. Some may be desirable, and even a part of conservation management, such as excavation of water bodies. Others such as ploughing for forestry, drainage works and intrusive buildings are highly damaging in their effects. Chemical modification by pollution is nearly always undesirable. Some degraded but still semi-natural habitats, such as bracken-grown grassland or heath and eroding blanket bog, retain considerable interest and need to be adequately represented.

2.10.2 The main point here is that the surveyor must feel able to describe a site according to NVC communities without too much difficulty. The floristics must show an acceptable degree of conformity with the range of types regarded as semi-natural. There will always be a proportion of stands which are 'intermediates' in terms of the NVC communities, but these are not necessarily of lesser quality. Loss of quality is shown by the number and abundance of aliens and disturbance indicator species. Specific guidance is extremely difficult, since so much depends on particular circumstances, but the guiding principle is that, as signs of artificiality increase, so does the presumption against acceptability. It is those habitats which show continuous variation from natural or semi-natural to artificial that give the greatest problem - woodlands composed partly of planted exotics, grasslands variably modified by 'improvement' and fresh waters showing degrees of chemical enrichment. Sometimes judgement is influenced by the prospects for reversing the loss of quality.

2.10.3 Size (extent) Given that the intrinsic vegetational quality of the habitat is acceptable, its area must be big enough to be viable, in respect of the resistance of the habitat and its flora and fauna to edge effects, loss of species and colonisation by unwanted species. It is impossible to generalise about size limits to viability, so great are the variations according to habitat and species. Much depends on the particular environmental context. A residual piece of fen of 100 ha may continue to dry out if it is surrounded by farmland which is heavily drained, but many drier meadows of 1 ha may retain their floristic composition indefinitely if they are appropriately managed.

2.10.4 This criterion is not entirely separable from the previous one, since reduction in size of habitat is a potent factor for species loss, to the point where many remaining examples of particular habitats no longer retain their full expected complement of constant and characteristic species. The question of acceptable size is thus related to losses in species (and hence quality) which have already taken place. The background question is whether the site is worth having in the first place, if it is too impoverished a version of its kind. This in turn tends to be related to what is available, and hence to the next criterion. In some of the most heavily developed parts of the country, the best remaining examples of certain grassland communities and the surviving localities for some rare species are on road and railway verges. If they are to be represented at all within the particular AOS, their unnaturally linear form has to be accepted.

2.10.5 Rarity The rarity of a habitat has an important effect on assessment and can make selection against uniform minimum standards inappropriate, so that preference is for a differential standard according to geographical variations in extent of the habitat. It is the continuing loss and increasing scarcity of semi-natural habitats over much of lowland Britain which has led to the view that all remaining examples above a certain level of quality should be protected. The scarcer the habitat, the stronger the case that the qualifying standards should be adjusted downwards. Meadow grasslands, in particular, are everywhere now so localised that individual fields are often all that is left in an AOS, and the minimum acceptable area has to be quite small if some types are to be represented in the SSSI series at all. On the other hand, many types of upland grasslands and heaths are so extensive that only sample areas can be justified for inclusion. In general, the rarer the habitat, the larger the proportion of the total area which should be protected: this may in fact be 100%, as in the case of the unique Lizard serpentine heaths and the greatly fragmented Breckland heaths. Any habitat with a total area in Britain of less than 10,000 ha (the area of one 10 km grid square) can be regarded as rare, and for these there should be a general presumption in favour of selecting all remaining areas.

2.10.6 Diversity Diversity tends to be valued positively as it increases, but it has to be considered in relation to scale, which can be on at least three levels. At the plant community or animal assemblage level, some examples are more species-rich than others and so have higher value, unless the greater richness involves non-native species or expresses other recent disturbance. Some plant communities are intrinsically more species-rich than others; so comparisons on this criterion are valid only between examples of the same community and not between different communities. The standard of floristic diversity for each community is guided by the NVC tables, at least in regard to national variability, though the definitive floristics within any particular AOS need more precise analysis. Diversity in number of different communities within a vegetation formation (e.g. woodland) may often influence the value of a site. Diversity between different vegetation formations involves the question of 'habitat mosaics', which have to be considered separately: clearly, the number of different formations will affect site value, but assessment is complicated (see 6). Diversity tends to have greater importance as a criterion of value in the comparative assessment of different sites to choose the best examples.

2.11 Assessment of species-groups against minimum standards

In evaluating the interest of species-groups for minimum qualifying value the emphasis is especially on diversity, population size and rarity.

2.11.1 Diversity Plant community evaluation takes care of the more widespread vascular plant species as a matter of course, but it may neglect the interest of assemblages from different phytogeographical elements within a site (especially where these occur over a range of different communities) and of species refugia in which one phytogeographical element (notably the Arctic-Alpine) is especially represented. These noteworthy species assemblages tend to include rarer species, but their interest derives especially from species

variety within the phytogeographical groupings. Assessment of lower plants (mosses, liverworts, lichens, fungi and algae) is often based more on species aggregations than on distinct communities, for these are imperfectly described. Specific guidelines on minimum levels of phytogeographical interest have not yet been developed.

2.11.2 Diversity of animal species within each main taxonomic group is an important criterion, but qualifying totals may have to be graded geographically when there are marked differences in occurrence of the group as a whole across the country - for example butterflies or dragonflies, which decrease greatly in numbers of species from south to north. Diversity over a range of animal species groups is also important, but it is difficult to prescribe significant combinations, and this has to be judged by examining the criteria for the separate groups concerned. Zoogeographical considerations also apply, as phytogeographical ones do for plants.

2.11.3 Population size For many birds, some other vertebrates and a few invertebrates, there are good data on species' population sizes or on the range of fluctuation between extremes. Especially for species which are colonial or show some degree of aggregation either for breeding or at other times of year, the size of discrete populations can be a useful measure of importance. In international bird conservation, it has become well established practice to regard 1% of a species' total population as significant in terms of safeguard requirements. The application of this principle to evaluation of sites for ornithological interest is set out in the chapter on Birds (C.14) and provides prescribed size limits for some bird groups. Combinations of species, as well as individual species, have to be taken into account. For other animal groups, population size cannot be used in any consistent way, because of unevenness of data, but it is a useful yardstick for certain species.

2.11.4 Amongst vascular plants, populations of the rarer species can be counted, and size differences should be taken into account in site evaluation, though above a certain level of rarity presence or absence becomes the main criterion. Large population size is especially relevant to nationally localised species, including those at the edge of their range. The largest populations of all the scarcer species within an AOS should be regarded as providing a presumption for selecting sites..

2.11.5 Population size is relevant to issues of population viability. Provided that the site is appropriately managed, questions of population viability arise less often for plants than for animals, especially the larger and/or more mobile species. Ideally, an SSSI should contain viable populations of all its species, but for some this is not a practical proposition. There is also the difficulty that for many species we simply do not know what a viable population might be: size is only one factor, and so much depends on the intrinsic population behaviour of a species and on the human influences, including deliberate management, to which it is subjected.

2.11.6 Some of the larger and less numerous upland vertebrates would have little chance of surviving if they became limited to only one pair on one SSSI per AOS. In very small populations, low reproductive rate and genetic problems caused by inbreeding weigh heavily against

indefinite survival, and this depends on there being a continuing supply of new recruits from other areas. Certain more numerous and rapidly breeding species such as some butterflies are also vulnerable to unfavourable episodes and have a propensity to die out in any one locality, so that they too are greatly at risk if restricted to only one SSSI and need opportunities for population replenishment. **The argument that protected sites form an interdependent network providing for such exchange is a key part of the case for establishing a national system of SSSIs. The spacing of related habitats should thus be on a scale that gives realistic opportunities for such interchange by natural migration.** Where there are large predators such as golden eagles, an upland SSSI should be large enough to include the home range of at least one breeding pair. For smaller predators, however, several pairs may appropriately be included. The point to remember is that the SSSI series as a whole should contain samples likely to be viable in terms of national populations and their distribution.

2.11.7 Rarity The rarity of a species is regarded as a measure of its proneness to extinction, and this concept is expressed in the variety of terms (endangerment, vulnerability, threat, etc.) which are adopted in Red Data Book treatments and in legislation for the special protection of nationally rare species (Schedules 1, 5 and 8 of the Wildlife and Countryside Act 1981). As with habitats, the general principle is that the rarer the species, the larger the proportion of the population which qualifies for selection. There is a general presumption that all occurrences of scheduled species are of special interest. The Biological Records Centre's atlases of species distribution (Harding 1985) have become the basis of the convention whereby a **nationally rare species** of plant or animal is defined as one which occurs in 1 to 15 of the 10 x 10 km squares of the National Grid. The next, lower category of rarity is a **nationally scarce species** (previously termed a notable species), defined as one occurring in 16 to 100 grid squares. In the case of vascular plants, the integration of evaluation of several nationally rare and scarce species is achieved by a simple scoring procedure (see C.11, 3.3). It is important also that regionally rare species are taken into account (see the definition in C.11, 3.6). (See also 7.1.)

2.11.8 Although mapping by 10 x 10 km squares gives only an approximation of absolute numbers, it is still useful, but for most rare vascular plants additional data on population size are also collected. For birds, where reliable population data exist for most species, the grid square method is not used, and size classes 6 (1-10 pairs), 5 (10-100 pairs) and 4 (100-1,000 pairs) are used as the principal basis for deriving threshold scores for various habitats (see C.14, Appendix C). It is important that data on population sizes are kept up to date by monitoring, with revision of the lists of rare and restricted species as necessary. Many county recording schemes for flora and fauna are now based on 'tetrads' of the National Grid (i.e. blocks of 4 x 1 km squares) and, where such information is available, it should be used to assess regional or local distribution and rarity, in consultation with the recorders themselves.

2.11.9 Many species tend to become increasingly rare as the limits of their geographical range are approached. These distribution limits are

often particularly interesting, as the critical zone within which a species is especially responsive to beneficial or adverse environmental changes causing its further advance or retreat. Ecological insights about limiting conditions for a species are often best obtained at the edge of its range and are highly relevant to management. **Extra weight should thus be given to representation of species at their geographical limits in a particular AOS.**

2.11.10 In the evaluation of animal species it is particularly important that well-established and not ephemeral populations of residents are evaluated, and regularly occurring rather than sporadic migrants likewise. The status of species must be monitored so that up-to-date knowledge is available, and any significant changes and trends taken into account.

2.12 Assessment to identify best examples which represent a field of variation

There is less need here to consider habitats and species groups separately, since similar statements would have to be made about both. This principle differs from assessment against minimum standards, in that it involves:

2.12.1 the comparison of similar sites, to arrange them in order of merit - whether there be only two or a larger number;

2.12.2 a decision on the number and extent of sites required to represent adequately a given field of ecological variation.

2.13 In so far as it has come to be applied mainly to the more extensive and continuous types of semi-natural habitat, this approach also often involves a more difficult decision on the definition of site boundaries. While minimum standards of quality have still to be observed, the main point is that not all sites above this level have to be selected. The essence of procedure is that, unless they are unique within an AOS, habitats and species assemblages are compared with similar ones to identify the best, and it is only these which are selected. Provided that the evaluation method allows all similar sites to be arranged in order of merit, selection of the 'best' can vary from one to whatever number of examples is judged appropriate. Because of the complex nature of the formations to which this rationale is applied, it is usually combinations of features which are assessed, so that **diversity** above the level of community composition tends to be more important than it does in assessment of minimum standards. In an upland massif, for instance, it is the diversity of plant communities and species groups, and also the variety of main habitats, that is often particularly important.

2.14 Extent of habitat is usually less important, except for rarer types, because there is often a converse problem, that of limiting the choice of site to an area which is not too large. Size and density of species populations are still important in judging which of two similar sites is the better. Naturalness often gives a valuable basis for comparison of quality, for example when one of two otherwise similar areas of montane heath has been more heavily burned and grazed or drained, with loss of dwarf shrub cover, than the other. And, other conditions being similar, the occurrence of a greater number of rare communities or species will place one site ahead of another. Recorded history is a criterion used mostly comparatively, but it may on occasion justify the selection of an important research site which would be of marginal interest according to intrinsic biological features.

2.15 The most difficult aspect in selection according to best examples is not comparative evaluation of sites (2.12.1), but determining how many reference points in the classification to represent (2.12.2). This requires a decision on when two sites are sufficiently different in character to require separate representation in the SSSI series or when a particular type is so important that it should be represented by more than one site. Guidance on these points is developed in the relevant chapters of Part C. Numerical (scoring) systems of evaluation can be especially helpful for comparing similar sites, but they give little if any help in strengthening the essentially subjective decision-making about adequate representation, which rests, ultimately, on the properties of the classification applied to the field of ecological variation.

3 International importance

3.1 Recognition of international importance requires essentially similar procedure and criteria to the evaluation of nationally important sites, but the background framework of reference is a continental or even global classification of ecosystems and species and the overridingly important criterion is rarity on this larger geographical scale. It is the habitats and species rare or highly localised in Europe or the rest of the world that rate as especially important in Britain. Migratory species, for which Britain provides an important seasonal location and refuge, are the other major wildlife category carrying an international conservation obligation. Particular examples of internationally important features are listed below.

3.1.1 Blanket bog, a peatland formation confined to a few cool humid regions of the world.

3.1.2 Plant communities and species with markedly Atlantic or Lusitanian distribution, confined to the extreme western seaboard of Europe. These include ericaceous dwarf shrub heath, all gorse Ulex communities, certain individual vascular plant species, and many oceanic ferns, bryophytes and lichens. Maritime communities generally are important in Britain for their variety and extent.

3.1.3 Migratory bird populations, particularly of waders and wildfowl, wintering in Britain or having important passage refuges. Their habitats are especially estuarine flats and saltmarshes and wetlands away from the coast.

3.1.4 Large concentrations of breeding seabirds, most of which have a highly restricted north Atlantic distribution.

3.1.5 Endemic and island races. There are few true endemics in Britain, but a larger number of species has evolved distinctive British races.

3.1.6 Globally rare animal species, e.g. grey seal, gannet, great skua and large copper butterfly.

3.1.7 Outlying and fringe occurrences of communities and species with distinctive ecological and biogeographical distributions, such as Boreal coniferous forest of Scots pine, montane and tundra vegetation characteristic of Arctic and Alpine regions, Mediterranean communities, and Continental types of woodland and grassland.

3.1.8 Unusual biogeographical combinations, such as the juxtaposition of Arctic-Alpine and Atlantic-Mediterranean species.

3.1.9 Anthropogenic vegetation, such as grasslands and heaths derived from woodland or wetland and representing plagioclimaxes.

3.2 The international obligation to nature conservation in terms of site protection is formalised and defined under the following conventions and treaties entered into by the UK Government. The detailed criteria for these are not reproduced in these Guidelines, but should be consulted as necessary.

3.2.1 Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat. This includes coastal as well as inland wetlands, and also peatlands of importance to plant ecology.

3.2.2 Bonn Convention on the Conservation of Migratory Species of Wild Fauna. This requires appropriate national action, including site safeguard, for conservation of certain listed species, especially migratory birds.

3.2.3 Bern Convention on the Conservation of European Wildlife and Natural Habitats. This includes protection of habitats and certain listed species of plants and animals, especially migratory species.

3.2.4 World Heritage Convention concerning the Protection of the World Cultural and Natural Heritage. This requires each State Party to nominate a list of "cultural and natural properties" that it considers to be of "outstanding universal value" against a set of carefully defined criteria. Major natural and semi-natural ecosystems of international wildlife importance merit consideration under the "natural property" category.

3.2.5 EEC Directive 79/409 on the Conservation of Wild Birds. This sets out rules of a general nature concerning habitat conservation for listed species, and an accompanying resolution invites Member States to take certain steps towards preserving bird habitats.

3.2.6 'Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna (The Habitats Directive). This sets our rules of a general nature concerning the conservation of listed species, their habitats, and other separately-listed habitats. Transposition into law occurred in Britain *via* The Conservation (Natural Habitats &c.) Regulations 1994.

3.2.7 Other site conservation designations. The Unesco "Man and the Biosphere" programme proposed a global system of Biosphere Reserves for conservation and monitoring of major ecosystems, and 13 sites in Britain have been so designated. The Council of Europe has also proposed the establishment of a network of Biogenetic Reserves, complementing the Biosphere Reserve series. The *World Conservation Strategy* (IUCN 1980) has made general admonitions about the importance of reserves and identified the Scottish Highlands as one of the prime biogeographic provinces for the establishment of protected areas.

3.2 It seems axiomatic that, if an area, feature or species is of international importance, it must be of special interest in its total national occurrence. In these cases, it is necessary to select all sites above a critical standard, and not to reply on choosing only exemplary areas, in order to meet the international conservation obligation. This can apply to habitats which are extensive (e.g. blanket bog) and to species which are numerous and may even be regarded as a nuisance locally (e.g. grey seal and great skua) as well as to habitats and species which are localised or rare.

4 Assessment of site value

4.1 These guidelines are set out so that each habitat formation or species-group is assessed independently in its own right. **A site has to reach the qualifying standard in only one category to be eligible for selection when the principle of minimum standards is being applied.** For example, a site qualifies when it contains a single species specially scheduled under the 1981 Act. In practice, species are inseparable from other species and from their habitats; for example, interest for dragonflies and amphibians often overlaps and is also integral to the freshwater systems to which these animals belong. It is important to recognise the reality of nature on the ground in the combinations of habitat and species categories which occur. Thus, while the evaluation process has to be dealt with in a sectional way, it is necessary to take due account of the combinatory value of different habitats and species-groups. It is only the artificiality of the developed British lowlands that causes a single habitat category to occur in isolation, and in the uplands combinations of features usually have to be assessed. Only in a few specialised cases (e.g. bat caves) is there a single interest feature. The practical result is that a site chosen for one interest will often meet other interests as well.

4.2 Probably a majority of sites qualify for selection on the basis of more than one interest category, and many have multiple importance. There is no conceptual problem in this, and the circumstance serves to emphasise that, although all SSSIs have to meet a minimum standard, there are variations in importance between sites. Procedural difficulties in assessment stem especially from integrating different criteria and doing so at different levels of structural complexity. For instance, a plant community (e.g. meadow grassland) which is marginal in terms of floristic quality may pass the overall threshold value through its large size - or it may fail because it is small. A more complex habitat, such as a fen system, may be borderline for floristic quality of its main plant community and also for size, but it may qualify overall because of the diversity or clear successional pattern of the total range of communities. Or, in either example, total botanical value may still be marginal, but, when faunal interest is added, their combined level may pass the mark. Area for area, woodlands are the most difficult habitat to evaluate, because of their structural complexity and the circumstance that each one of their several 'layers' may have a separate community, plant species and animal species value. Yet some of the most difficult cases of all are those involving the conjunction of different major habitats. A grassland may be of uncertain value when assessed alone, but, when considered with associated woodland, marsh and stream (none of any greater value alone), it may easily pass the qualifying standard for overall diversity of communities and species.

4.3 In theory, a scoring system should achieve the consistency of assessment necessary to deal with these problems of combinatory value, but in practice the complexities of evaluation across the whole range of attributes have discouraged such an approach. **The guiding principle is that, for sites which are felt to be important but which do not clearly qualify on a single feature interest, the combined value of all biological components must be taken into account.** Different evaluation systems have been used for the various habitat formations, and the problem of **habitat mosaics** in which only the collective interest of different habitat elements meets the standard for SSSI selection is dealt with under 6.4. Problems of combining values for different species-groups within a single site are discussed under 7.

4.4 Another related issue is that of the incidental representation of features and its bearing on the need for further deliberate selection of these features. A grassland site selected on botanical grounds or a saltmarsh for its birds will both almost invariably support a wide range of invertebrates. And a woodland chosen for a rare orchid will include at least one community and a range of other plant species. In this way, there is a near certainty that the common and widespread species of flora and fauna within an AOS will be represented in at least one SSSI by chance and that many species will have a multiple representation. For these species per se there is no need to select further sites. The same will apply to the more widespread plant communities and animal assemblages. Should any common species or type happen not to be so represented, there will be a case for choosing a further site to include it. Moving along the scale of decreasing abundance, there must be an increasing chance that species and communities will not be represented unless sites are deliberately chosen for them. When this is the case, it is important, wherever possible, to choose sites with the largest populations or the best stands. For rarer species, with specially stated selection requirements, there should be discretion to meet these needs **in addition** to occurrences (especially small populations) that may chance to be represented otherwise.

5 Boundary definition, size of area and site integrity

5.1 Fragmented habitats

Even in the case of maritime islands, the boundaries of important sites are seldom, if ever, wholly defined by clear-cut natural features. Sudden discontinuities between land of high wildlife interest and that which is unimportant usually result from man-made boundaries, separating semi-natural habitats and artificial ground in the form of enclosed farmland, plantation forest or urban/industrial land. Most of these boundaries are precisely delineated by hedges, fences or walls. While these clear-cut edges are usually unnatural, they usually have to be accepted as practical boundaries in the selection of sites. In the lowlands, the important sites, consisting of semi-natural habitats, are often thus delimited as 'islands' within a sea of artificial land.

5.2 For most ancient semi-natural woodland, scrub, acidic heath, meadow grassland, chalk grassland, valley mire, basin mire, fen and raised bog, the important sites are usually so small that there is never any problem in justifying inclusion of the whole area as being of special interest. Many of these remaining lowland habitats are, indeed, too small to be really adequate as conservation areas, and they are selected as the best of what remains. The more usual question about extent of sites is thus whether there is a lower acceptable size limit, below which the habitat or its constituent species may not be viable in the long term. Meadow grasslands are nearly all small, most being isolated fields of no more than a few hectares each, but they are usually viable if properly managed. The chances of any species surviving indefinitely in any area tend to decline with decrease in extent of suitable habitat. While the critical lower size limits for viability are seldom known and vary widely between species, this ecological principle is relevant to site selection and points also to a need for subsequent monitoring. For many animal species belonging to highly fragmented habitats or for those which have small, thinly dispersed populations, it is essential to have a sufficient number and dispersion of SSSIs to allow interchange between them.

5.3 Some habitats, especially dry ground types, may survive indefinitely as tiny islands within a totally modified surrounding environment. They are, however, always vulnerable to 'edge' and 'overspill' effects, which are sometimes unforeseen. Spray drift of pesticides or wind-blow of fertilisers from surrounding farmland may affect the plants and invertebrates, or predators from adjoining forests may have an influence on birds. Wet ground habitats are often influenced by the hydrology of a much larger area than the site itself, so that drainage operations on the surrounding land can cause drying-out or inflow of fertiliser from the catchment can produce eutrophication. For some animals, the semi-natural habitat may be the breeding or roosting area, but surrounding farmland may be needed as additional feeding ground.

5.4 Buffer land

The overspill or peripheral effects have led to the idea of 'buffer land' as a surrounding zone over which control is essential to ensure full protection for an important site. Clearly, in relation to SSSIs, there can be no other category of protected land with legal status. Either surrounding land is regarded, through its ecological relationship with the main area, as being of sufficient importance to the special interest to be included within the site, or it is not. The question to be answered is whether foreseeable human impact on this surrounding land could damage or destroy the special interest of the 'core' area. Decision on this point must be influenced by the ability to draw a boundary which defines the limits of this ecological influence. For hydrological effects this may be possible, but for mobile animals which feed over a variable surrounding area it may not be. In some situations elaborate, lengthy and costly research would be needed before well-informed judgements could be made, but there will always be cases where ecological influence declines slowly across a wide gradient, so that any judgement has to be somewhat arbitrary. There will probably continue to be difficult individual cases where generalised guidance offers little help but is all that can be offered here, and decisions on inclusions and boundaries have to be taken as seems best according to the particular circumstances of each situation.

5.5 Potential value

The NCR listed **potential value** as a secondary criterion for key site assessment, but its use within the legal context of SSSI designation could give rise to difficulties. It could be argued that almost any area of land is potentially of high nature conservation interest, provided that enough creative or restorative effort can be expended upon it. At most, use of this criterion should be applied to situations such as those where the habitat has suffered a deterioration or setback through adverse use, but where the desirable species complement is still largely present or can recolonise readily and recovery is likely to take place of its own accord once the adverse pressure is lifted. Another allowable case might be where vegetational succession can be fairly readily reversed or deflected by suitable management. It is perhaps most appropriately applied in situations where part of a site, sometimes consisting of a different habitat, is in a less good state than the rest but its inclusion contributes strongly to the overall interest. This is not to deny that certain habitats, such as disused mineral workings, may attain special interest through natural processes of colonisation, but it seems preferable to wait until such interest has actually developed before selecting such sites.

5.6 Extensive habitats

In the case of some coastlands, upland grasslands and heaths and certain habitat mosaics, semi-natural habitat is extensive, sometimes covering large continuous areas. It is then usually desirable to select only parts of the total area, and the definition of boundaries becomes a more difficult and arbitrary business. Discontinuities between the semi-natural habitat and developed land still usually occur in some places and provide obvious boundaries. Yet it is often necessary to draw some at least of the boundaries through semi-natural areas, sometimes with no helpful features on the ground; where there are distinctive physical features, these should be used as seems appropriate.

5.7 The guiding principles here are that the diversity which is characteristic of the particular ecosystem in the particular district must be fully represented in the selected site. Its extent must be sufficient to ensure the survival of an adequate amount of all the features concerned, to satisfy the needs of society. The size of areas must also be sufficient to meet international obligations for conservation of ecosystems and species populations. Adequate representation of globally rare habitats and species assemblages may require the selection of especially large areas, as in the case of some blanket bogs (see C.8, 5.10). Saltmarshes and sand-dunes present relatively few problems: both show a characteristic structural diversity and vegetation succession, and most of them are highly localised, with sharply defined landward boundaries. Ornithological requirements usually reinforce the need to select the whole of major systems, and boundary problems usually arise only over whether to exclude small, detached areas or, in the case of saltmarshes, over whether to include desirable areas of 'grazing marsh' behind sea-walls. Rocky coasts are more difficult to select when there are long lines of more or less continuous cliff. Natural breaks may give convenient lateral boundaries, but the desirable length of cliff-line will depend on geological and biological diversity.

5.8 Uplands tend to be the most difficult cases, with blanket bogs the most problematical of all, because they usually lack conspicuous edge features along which to draw boundaries. There are five simple guidelines which help to reach decisions on these complex and extensive habitats, though they also apply more generally to site selection.

5.8.1 At least one example must be included of every biotic feature (except recent artefacts) present - habitat and vegetation types and species of plants and animals. While special consideration should be given to inclusion of rare habitats and species, the common and widespread need to be represented in proportion to their relative extent and abundance. The total animal community 'pyramid' should be represented, from 'top' predators to the bottom of the food chain.

5.8.2 The full complement of abiotic features should also be included, over as complete as possible a range of the variation present in each (e.g. in underlying geology, soil type, slope, aspect, elevation, macro- and micro-topography and hydrological regime). The amount of each site component to be included should be sufficient to ensure the viability of that component or of any other component which is functionally dependent on it. There is usually a correspondence between biotic and abiotic diversity, but this is not always fully understood and sometimes the abiotic features are more readily identified and mapped.

5.8.3 Where the conservation of an important habitat or species depends on the maintenance of a functional relationship with some peripheral habitat or environmental condition, sufficient of the latter must be included to satisfy the needs of the former. Examples are hydrology of adjoining areas and feeding range for some animals (see also 5.4).

5.8.4 Juxtapositions between site components should be treated as further components in their own right, in so far as they reflect varied biotic and abiotic interactions. For instance, where plant community X adjoins communities Y and Z at one place but adjoins communities A and B at another place, the two groups XYZ and XAB should be treated as separate entities and both included within the site boundary.

5.8.5 The total amount and distribution of the ecosystem concerned, as the sum of all the SSSIs representing that particular type, must be sufficient to ensure viability of all component communities and species in case all remaining areas of such habitat outside these SSSIs become subjected to land-use change. This is a matter not only of size but of spacing between sites, to maximise the probability of exchange of mobile species between them. They must also be sufficient to satisfy the national and international conservation needs given under 5.7 above.

5.9 Boundaries should be drawn which are appropriate to these requirements. Roads, railways, fences and ownership limits often have to be used as boundaries-of-convenience. They must, however, always be compatible with the selection guidelines under 5.8 above and must not take precedence over them.

5.10 The problem of whether artificial habitats (lacking special interest) within a site should be excluded from the SSSI, thereby leaving 'holes' within the site map, has to be decided for each case on its merits. Occasional cases arise where artificial habitat is so intermixed with semi-natural that separation of the two within a single site becomes impracticable. A good example is the now largely coniferised woodland complex of Bernwood Forest, where it is mainly the network of rides which retains high entomological interest but broadleaved clumps or edges to the conifer blocks remain important. To attempt deletion of every single piece of conifer plantation from the SSSI would be an absurdly complex and unnecessary exercise. Arguably, too, even the conifers help to provide the shelter which enhances the importance of the rides for butterflies. Deletion of coniferous shelter-belts within an upland site might also be an unnecessarily pedantic exercise, but relevance to the listing of potentially damaging operations must be borne in mind: if there is likely to be an objection from the NCC to the creation of any more of the same kind of feature within the SSSI in future, it may appear inconsistent to have notified existing examples.

5.11 The presence of artificial features, especially those of a recent and highly intrusive kind, can be a perfectly valid reason for rejecting one site in preference to another otherwise similar one, and it is also reasonable to regard their creation as a damaging operation. The presence of constructions, including hill roads, pipes, dams, pylons, ski-tows, snow fences and buildings, can have a disastrous effect on the appearance of naturalness which many people wish to see maintained as an integral quality of important wildlife areas. Even though they may have been quite strongly modified from their original condition, most semi-natural habitats share the

common quality of appearing to be in a wild state, with little obviously visible evidence of human activity. In so far as the "interest" which SSSIs represent is nowadays to do with the informed appreciation of nature as well as with its scientific study, factors affecting the quality of perception are relevant to both the selection and the defence of SSSIs. Large blocks of conifer plantation or land claimed for reseeded pasture and arable will thus normally be excluded from SSSIs, not only because of their artificial character as habitats but also because of their adverse visual impact. All of these intrusive activities have a directly damaging effect on site quality, but the indirect effects often extend over a much larger area.

5.12 Species alien to the site or to its biotic communities likewise do not normally count towards its value except where there is evidence that a species has been present long enough to be considered naturalised to the site or where it is present as the result of some process or phenomenon which is itself of interest. Some alien species have a distinctly negative effect on site quality (see 2.10.1-2).

5.13 The boundaries of a site should be fixed in accordance with these requirements, so that the NCC is able to defend its integrity or 'wholeness'. Whatever variations in importance may be recognisable within a site, all parts collectively assume the minimum standard of "special interest", so that loss of or damage to certain parts would then detract significantly from the value of the whole. Such loss of or damage to any one feature cannot rationally be justified by the survival of the larger fraction, since, once the process has begun, there are no logical stopping points short of total elimination. The setting of arbitrary limits to incursion would merely undermine the consistency of approach which is the credible basis for SSSI selection. 'Limited' incursions are also often disproportionately large in their impact on the visual quality of a site, in addition to their direct ecological effects. The concept of site integrity may seem far-fetched when the defining boundaries are artificial, but the point is that any further intrusions make an already unsatisfactory situation worse. The smaller and more fragmented a site, the more important it is to ensure that still further reduction does not occur.

6 Evaluation of habitat mosaics

6.1 Classification of habitat diversity into various main formations followed by selection according to these major types is a useful procedure, especially where human impact has tended to delimit these formations fairly sharply from each other. It is, nevertheless, immediately obvious that there are a great many situations where different formations are contiguous or associated in various combinations. It is also the case that many organisms depend on two quite different habitats and that some live in the 'edge' or transition zone between them. An adult butterfly which feeds on flowers in an old meadow may have larvae feeding within an adjoining wood or along its edge, and beetles and bumblebees which live in the meadow in summer may hibernate within the wood. Similarly, dragonflies which breed in ponds and streams will disperse to feed or find shelter in adjacent habitats, especially woodland edge. Some birds range over different habitats for feeding, though they may breed in a particular type. In these ecologically diverse situations, site selection based on the primary classification of formations can lead to difficulties.

6.2 Sometimes the juxtaposition of different habitats is largely a matter of chance survival, as in the case of an old meadow adjoining an ancient semi-

natural woodland. Certain landforms, however, such as glacial deposition features, often give a characteristic combination of open water and/or peatland habitats with dry ground types such as grassland, heathland and woodland. Sometimes there is a catena or topographic sequence from hill slope to valley floor, and sometimes different habitats occur in a complex mosaic. The East Anglian Breckland is a good example of a variety of grassland, heath and wetland types existing in complex spatial, and to some extent dynamic, relationships with each other and best treated as continuous areas of diverse, semi-natural habitat. Some transitional habitats (ecotones) are essentially unstable and will fairly quickly change into something else, for example a woodland clearing or an area of scrub in ungrazed grassland. Persistence will depend not only on an appropriate management regime, but also on an area large enough to contain the different stages in a changing spatial pattern. Some mosaics arising through natural succession are relatively recent, such as post-myxomatosis invasion of chalk grassland by scrub. In general, the greater the age of all the components of a mosaic or edge, the greater its overall value.

6.3 These are examples of ecological diversity, and this attribute often adds value to that of the individual components when considered separately. The importance of habitat combinations may, indeed, be much more than the sum of the various parts, through the kinds of functional interdependence mentioned above. When one of the habitat types on its own is regarded as being of SSSI quality, the addition of an adjoining different habitat (even though this might not qualify as an SSSI on its own) will often expand the value of the first. Considered as a single site, the value of the whole is enhanced and not diluted by this addition. Other things being equal, two habitats in juxtaposition tend to be more valuable than the same habitats in isolation: in general, the greater the number of additional habitats, the greater the overall importance of the area as a whole. As a general principle there should thus be a presumption in favour of selecting habitat combinations. The boundaries should then be chosen as far as possible to delineate the combination as a single geographical and ecological entity. Such combinations of habitats within a single area were termed "composite sites" in A Nature Conservation Review. Problems arise mainly when the subsidiary habitat is ecologically borderline between semi-natural and artificial, for example an area of improved grassland which may be important as feeding habitat for birds on adjoining moorland.

6.4 The more difficult cases are mosaics of different habitats where no one component type meets the standards of an SSSI but their combined value appears to deserve selection. These mosaics usually consist of mixtures of three or more of the following - woodland, tall scrub, grassland, heath, valley mire, lake, pond and stream. In addition to mosaics already represented because at least one component habitat is of SSSI quality, the best example of each particular combination in the AOS should be selected: as a particular combination, woodland, heath and valley mire will, for instance, be regarded as different from woodland, grassland and valley mire. Other examples may be selected when a particular combination is rare or appreciably different in detailed community or species composition from those already chosen. In addition, any mosaic should be selected which contains two or more habitat types with a combined rare or scarce species score exceeding that qualifying for SSSI selection. The joint advice of the appropriate CSD specialists should be sought in difficult cases. In assessing habitat representation within the SSSI series, the occurrence of different main types within all sites should be counted.

7 Evaluation of species-group combinations

7.1 Scoring systems have been applied to the assessment of vascular plants (see 2.11.7), birds, amphibians and dragonflies, but different criteria are used for mammals, reptiles, fish and butterflies. For the remaining species-groups, scoring procedures have not yet been developed. Combinations of different species-groups cannot therefore be evaluated by combining scores for each. Thus, while the collective interest of different species-groups should certainly be taken into account, it is difficult to provide specific guidance on procedure, and much will have to be left to individual discretion. Two Red Data Book species from different groups or two nationally rare species (identified from atlas distribution data) would, for instance, qualify a site for selection. Any site which narrowly fails to qualify for selection under one species-group (and does not qualify on habitat criteria) should be examined for additional significant interest under other groups. Aggregations of regionally or locally rare species also need careful consideration. The problem of guidance on combinatory values is still being examined; in the mean time, the Chief Scientist Directorate's specialists should be consulted in cases of difficulty.

8 Total extent of SSSIs

8.1 By whichever principle SSSI selection is approached, an important question arises over the total extent of land needed to conserve the special interest of habitats and species in Great Britain. There are no arbitrary targets in this respect, and the total required area of SSSI land arises as the sum of the separate assessments applied to the different habitats and species-groups. These range from the need to select all that remains in the case of rare and endangered habitats and species to the choice of reasonable and representative samples of widespread and common types. The total extent of natural and semi-natural habitat will particularly affect the extent of SSSI land within any AOS and so will account for the large geographical differences in representation between the Scottish Highlands and the lowlands of England.

8.2 The areas required for adequate representation of the separate interest categories of vegetation, flora and fauna will be influenced by the following factors.

8.2.1 The amount of diversity within these categories. For example, the complexity of variation within woodlands (see C.2) produces a need for a large number of different sites.

8.2.2 The degree of overlap between categories on a site. When different features are well represented on the same site, this will tend to reduce the need for further sites, and vice versa.

8.2.3 Geographical concentration or localisation of categories. When a particular feature occurs mainly in a restricted area of the country or where it is everywhere rare, there is a case for a greater than average representation in those AOSs where it is present.

8.2.4 Vulnerability of features to decline through continuing adverse environmental influences. The rarity of some habitats and species groups, and hence their conservation value, is likely to increase. For instance, if atmospheric pollution does not improve appreciably, the

important Lobarion community of lichens is likely to decline further in many areas; this points to the need to increase its representation in site selection in those districts where it still flourishes.

8.2.5 International importance of categories. This also will tend to indicate a need for greater than average representation.

8.3 Particular guidance is given in Part C on the minimum areas of some habitats and the minimum numbers of some species regarded as having special interest. For the reasons given above, these should not be applied rigidly but used with regard to any significant qualifying factors.

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