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Establishing criteria for identifying Critical Natural Capital in the terrestrial environment - a discussion paper

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Establishing Criteria for Identifying Critical Natural Capital in the Terrestrial Environment

A Discussion Paper

A report prepared for English Nature
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0. SUMMARY

- The UK's current stock of environmental assets represents a level from which there should be no further net loss in quantity or quality if environmental sustainability is to be achieved. It is made up of Critical Natural Capital and Constant Natural Assets. Our Critical Natural Capital comprises those assets which are irreplaceable. Our Constant Natural assets are made up of environmental features which may be traded in issues of land use change, but the loss must be fully and directly compensated to give no overall loss.

- The current lack of scientific certainty surrounding the issue of replaceability of environmental features supports the adoption of a precautionary approach to land use change.

- Existing statutory and non-statutory habitat and species designation systems differ from the identification of environmental features using the concept of Critical Natural Capital. In many cases the two systems will overlap, but it should be recognised that they often have different aims.

- The aim of identifying Critical Natural Capital and Constant Natural Assets is the maintenance of biodiversity as a crucial function of environmental sustainability. This makes a crucial contribution to the broader goal of sustainable development.

- Application of the concept of Critical Natural Capital should not compromise the existing systems of designation. The concept should be promoted across all policy fields including planning, forestry and agriculture and through all bodies with a remit that includes decisions about land use.

- This is an initial discussion document and is intended to generate debate on this approach to implementing this aspect of sustainable development. This debate is important and should take place across all sectors, in order to ensure that a universally adopted defensible approach to the classification of the environment as tradable and non-tradable assets is developed.

- Social considerations are very important in the identification of critical features of the environment for people. This aspect is not covered in detail in this document and warrants further research.

1. INTRODUCTION

This report has been prepared by East Midlands Environmental Consultants Ltd on behalf of English Nature. It presents findings of research into, and discussion on, the implementation of sustainability through an attempt to define a methodology by which the Critical Natural Capital (CNC) of the terrestrial environment can be identified.

The proposed CNC system is not intended at present to replace the existing statutory and non-statutory site designation systems. Until the concept is fully developed and accepted, all proposed developments and land use changes should still take full account of local plan policies and government guidance that expresses a presumption against damage to designated sites and the loss of habitats that support rare, declining and protected species. By the same token, forward planning should maintain its regard for such environmental features.

This is a discussion document on the issue of identifying Critical Natural Capital and is not yet prescriptive guidance. The proposals presented are a starting point and it is hoped that they will generate much debate on this approach to achieving sustainable development. The criteria should be tested through extensive field and desk study trials and subsequently refined in order that a widely accepted and defensible approach to identifying CNC can be developed.

The concept should be promoted as a means of ensuring the maintenance of biodiversity which is a crucial function of a sustainable environment. In this way, the UK can take a significant step towards fulfilling its commitments to achieving sustainable development. The existing statutory and non-statutory designated site series may contribute to the fulfilment of this function, but serves other equally important purposes, such as the maintenance of highly valued sites and a representative range of habitats and species.

2. SUSTAINABILITY AND CRITICAL NATURAL CAPITAL

In 1992 English Nature published a consultation paper on strategic planning and sustainable development (EN, 1992) that proposed a model for achieving environmental sustainability, as a basic requirement of sustainable development. The model uses 'weak' and 'strong' definitions of sustainable development in a hierarchical planning and decision making process, stressing the need to establish limits to development. These limits are defined as critical natural capital (CNC) or critical environmental capital (CEC) and are those assets that are irreplaceable.

It must be accepted that the natural resources currently supported in the UK represent a stock of ecosystem, habitat, species and genetic diversity which must remain at least constant and in some cases may already be at too low a level and require active work to increase levels. CNC forms that part of our constant stock that is considered irreplaceable. The contribution to the UK's natural resources made by those aspects of our constant stock which are replaceable (referred to as constant natural assets - CNA) must also be recognised. The loss of CNA will reduce the quantity and distribution of the nature conservation resource and ultimately our biological diversity. Thus while these assets may be "traded off" against development proposals, their loss must be directly compensated in order that the overall quality and quantity of the stock is not depleted over time.

Pritchard (1994) in a paper on setting environmental capacity limits stresses that setting limits to development should not be interpreted as an invitation for development to proceed to these limits. This would be to reduce the environment to its barest minimum which carries a huge potential risk with it in terms of threat to biodiversity conservation, especially in light of the current low level of knowledge about the functioning of the environment. Implementation of the concept of CNC must carry with it a clear understanding that CNC alone is not a safe level to which development can proceed. The principle is clear: CNC represents a limit in that it must be treated as inviolable because of its irreplaceability; CNA represents a limit in that its destruction or damage can only be allowed if there is certain to be direct environmental compensation for its loss. See Box 1.

In November 1993 English Nature published a position statement on sustainable development which recognises that

> "Sustainable development seeks to improve the quality of human life without undermining the quality of our natural environment"

and that

> "The natural environment can only support human life, health and well-being if its own resources are healthy and if it can continue to assimilate wastes and support a wealth of native biodiversity - our heritage of natural features, wild plants and animals and their natural communities"

English Nature advocate environmental sustainability as meaning the maintenance of the environment's natural qualities and characteristics and its capacity to fulfil its full range of functions, including the maintenance of biodiversity.

Environmental sustainability is a central concern of sustainable development. To achieve environmental sustainability, biodiversity must be maintained in order to ensure the continued presence of a functioning environment and that future generations inherit as diverse an environment as possible. To maintain biodiversity we must identify those elements or features of the natural environment that are non-tradable: those which are, in the case of habitats and sites, irreplaceable; and which are, in the case of species, features essential to the continuance of viable populations throughout their geographical range.

This study considers potential criteria that could be used to identify the critical assets of the terrestrial environment. A decision tree has been devised which will guide this process and focus on the reasons and justifications for identifying particular features as critical. These criteria, when fully developed and widely accepted, need to have a clear basis which can be fully justified and which can stand up to public scrutiny.

Through the identification of CNC and the future development of policies which ensure its maintenance and enhancement, the UK Government will work towards the achievement of environmental sustainability and local authorities can ensure that they make progress towards fulfilling their obligations under Local Agenda 21.

Box 1

Our current stock of natural assets represents our constant stock.

The irreplaceable components of our natural assets represent our Critical Natural Capital. This is not tradable.

The replaceable / tradable components represent our Constant Natural Assets.

The overall levels of our CNA must not decline - in some cases they must increase.

The Critical Capital of our natural assets are irreplaceable and should therefore be afforded the strictest protection.

CNC is NOT the level to which detrimental development and land use change can proceed.

3. THE CHARACTER OF THE NATURE CONSERVATION RESOURCE

This section briefly sets the context of the UK's terrestrial environment. It is important to realise that the natural assets of the terrestrial environment are highly fragmented with isolated environmental features. This has important implications for our appreciation of the nature of what we define as CNC or CNA; as well as the relationship between the two (see Appendix 1).

Despite extensive habitat reduction and fragmentation, particularly in lowland areas, the United Kingdom supports a diverse nature conservation resource comprising a wide range of geological types, geomorphological features, and habitats that support characteristic species assemblages.

The geological resource is diverse and complex and represents most periods of geological history (Nature Conservancy Council, 1990). The underlying rocks have been moulded over the centuries to create the principal land forms of today through processes of weathering and repeated episodes of glaciation. These land forms, rock types and the soils that have developed on them and the variation in climate across the country strongly influence the nature of the natural vegetation of the UK. However, whilst the climate and geology provide the basis for the range of habitats and species present in the UK, humans have become the prime regulators of biological diversity (HM Government, 1994a). The impact of human influence has been most keenly felt in this century with a rapid intensification of land use and the subsequent decline in habitats and species.

The UK is one of the most studied countries in the world and there is a large volume of work that describes and characterises its habitats, vegetation and species assemblages (Shirt, 1987, Batten *et al* 1990, Rodwell, 1991a, 1991b & 1992). The principal habitats are described in the UK Biodiversity Action Plan as woodlands, heathlands, lowland grasslands, coastal areas (cliffs, estuaries, saltmarshes, sand dunes and shingle shorelines), marine, freshwater habitats (lakes and ponds, rivers and streams, canals and grazing marsh ditches), peatlands, uplands, farmland and urban areas. Very few of these habitats can be described as entirely natural and none are unaffected by human activity.

Unlike the marine environment and large wilderness areas, the majority of natural and semi-natural terrestrial habitats of the UK generally exist as fragments of what was previously a more widely occurring and common resource. Today approximately 30% of the UK consists of semi-natural habitats, the bulk of which is located in upland areas (NCC, 1989). The remaining 70% is intensively used land which has considerable wildlife interest, but it is thinly dispersed and fragmented. Semi-natural habitats are not evenly distributed throughout the country with large expanses of blanket bog and other habitats covering the uplands or areas such as the New Forest and numerous small fragments of semi-natural habitat remaining in the intensively managed lowlands.

The decline in the nature conservation resource has occurred in terms of both area and quality. For example, the area of heathland in Nottinghamshire has been reduced by 90% since the 1920s (Nottinghamshire County Council, 1993) and it is estimated that 97% of agriculturally unimproved lowland grassland was lost between 1932 and 1984 (HM Government, 1994a). As a consequence habitats and landscapes have been reduced in their complexity, area and connectivity resulting in the contraction in population size and range of many species within the UK eventually leading to local and even national and international extinction.

Box 2

There have been huge losses in habitats and declines in species numbers, as well as species extinctions.

Much of lowland England supports a habitat resource that is highly fragmented.

Ecological theory suggests that highly fragmented habitats support less biological diversity.

Our existing total stock of natural assets (CNC + CNA) is the level below which we must not proceed with detrimental development and land use change.

4. CONCEPTS RELATING TO THE DEFINITION OF CNC

4.1 Evaluation and site designation systems and the selection of critical natural capital.

It has been suggested that CNC is independent of existing designations / notifications. In terms of approaching land use planning and environmental protection, we support this notion. For the present, there should be no link made between the designation of a site and the identification of environmental features as CNC. There is a risk that current designation systems may be undermined, unless widespread recognition is given to the fact that designation of sites under existing systems, and the identification of CNC, are undertaken for different purposes.

There may, over time, be an integration of CNC and the statutory and non- statutory designation systems, but at present CNC and the designation systems should complement each other. Identifying CNC is a step towards implementing environmental sustainability by ensuring the maintenance of biodiversity. Many designation systems are aimed at conserving a representative range of our biota and are not necessarily planned in such a way that they ensure sustained biodiversity maintenance. See Box 3.

There could, however, be a utilisation of the existing criteria used in the designation of sites, in the identification of CNC. As described below, replaceability is a central consideration in the identification of CNC and the replaceability of a habitat is, in most cases, a function of its ecological quality. An impoverished habitat, low in complexity and diversity of representative species, is, almost by definition, easier to move or recreate (given the aims of such schemes) than a pristine example of its type (see Section 4.5). The criteria used for designations provide a relatively well proven framework within which to assess quality of habitat, or to give an indication of the status of a species.

The fragility of a species and its populations is reflected in its status as defined in many of the local, national and international designation listings for species (see Appendix 2) and as a result the importance of a site, habitat or geographical range for the species is also reflected in the species' designation. A rarer, more fragile (less robust and adaptable) species will tend to have a narrower range of habitats upon and within which it can dwell during its daily, seasonal and life cycles. It will usually, therefore, be more difficult to safeguard against the loss of part of its niche, particularly if the lost habitat which formed part of its niche is complex and / or of high quality. The

designation systems provide one step towards assessing the "criticality" of a particular species and its niche.

Traditionally in the terrestrial environment sites of nature conservation interest have been identified and evaluated based on a series of criteria, a detailed database and the collective wisdom of scientists. The criteria and standards for evaluating sites have evolved over a period of almost 150 years (NCC, 1989). At a national level criteria for evaluating the nature conservation value of a site were published in the Nature Conservation Review (Ratcliffe, 1977). These have been refined over the years with and greater emphasis placed on some criteria than others which culminated in the publication of "Guidelines for Selection of Biological SSSIs" (NCC, 1989). The evaluation criteria described by Ratcliffe (1977) have also been extensively used to varying degrees to assess the nature conservation value of sites at the local level (e.g. County, District and City) (Collis & Tyldesley, 1993). The application of these standard evaluation criteria provides a measure of the quality of a site in terms of its ecological or geological value in a given context. A review of site designations and their potential overlap with the concept of CNC is contained in Appendix 2.

The ecological criteria upon which designations are based therefore provide a measure of environmental quality at given spatial levels. We do not advocate the notion that designated sites automatically form our CNC. Some sites exist which are of SSSI quality for instance, but for various reasons are not designated as such. Furthermore, the interest of some SSSIs and other designated sites may be re-creatable in which case these would not qualify as CNC; but this does not necessarily affect their value as identified by existing designation systems. The tried and tested ecological *criteria* employed in the designation of sites and species, however, do have a place in the process of identifying CNC, as described above. The criteria have been challenged on many occasions at public inquiries and are now widely accepted and used in planning and legislative processes.

BOX 3

There are different reasons for notification of environmental assets as CNC and notification of environmental assets as SINCs, SSSIs, SACs, etc. It is envisaged that many of these latter sites will also be identified as CNC, but the following should be borne in mind:

- **The aim of identifying CNC is the maintenance of biodiversity as a function of a healthy environment, which in turn contributes to the wider aims of sustainable development.**

- **The aims of site designation vary, but the principal reason is to conserve a representative range of the UK's plants, animals, habitats and geology. There is no pre-requisite for this to be done in such a way as to ensure the long-term maintenance of biodiversity but it may do so to a greater or lesser degree.**

4.2 Prioritisation of habitats and species

Since the Earth Summit and the promotion of the maintenance of biodiversity there has been an increasing shift towards prioritising habitats and species based on nature conservation importance and their rate of decline and rarity. These are features which are threatened or declining across Europe and therefore require special attention if biodiversity is to be maintained.

The Habitats Directive lists priority habitats and species, recovery programmes for protected species have been devised (Whitten, 1990) and priority habitats and species action plans are being developed as part of the implementation of the UK Biodiversity Action Plan.

The process of prioritising is based on our knowledge of the rarity, rate of decline, degree of threat and importance of habitats and species at a given scale. These characteristics are invariably included in site evaluation procedures and are reflected in site designations. They also give an indication of how we value these sites, habitats and species.

The priority that is attached to an environmental feature should be material in the consideration of whether that feature is critical or not. This is not to say that if a feature is not recognised as a priority habitat or species then it should not qualify as CNC. Rather, the presence of a priority habitat or species should be one of a number of factors considered in the determination of CNC.

If enough information exists, there is scope for the production of more local priority lists which will aid in the identification of CNC at these levels.

4.3 The Natural Areas concept and the selection of critical natural capital

There are many different spatial scales within which natural features can be considered and within the context of which different aspects of the environment can be classified.

Spatial levels that coincide with governmental administrative boundaries: local (district/borough); regional (planning regions/regional government office boundaries); national; and international, are useful because much environmental information is held on this basis. Natural Areas also provide a useful context within which to identify CNC, although some initial problems may be encountered here because many natural areas cross administrative boundaries. Inter-authority co-operation will be necessary in the development of a CNC system in Natural Areas.

English Nature's aim is to maintain and enhance the characteristic biological diversity and natural features of England across their ranges. The Natural Areas approach provides a potential framework for holding ecological information on not only the rare and special features of the country, but also the mosaic of habitats, species and land forms that contribute to the local distinctiveness of the countryside throughout England.

"Natural Area" is not a formal designation and will not conflict with existing designations such as National Parks or Areas of Outstanding Natural Beauty. The geographic framework provided by Natural Areas will enable English Nature and other users to take account of all aspects of land use that affect the wildlife resource rather than identify areas specifically for certain attributes be they scientific interest, beauty or historic importance.

The Natural Area approach is currently being refined and it will provide a framework and context within which ecological theories concerning population dynamics and

habitat fragmentation can be more easily applied, monitored and measured. In time this may help in the identification of critical population levels.

4.4 Scientific uncertainty and the precautionary principle

The current level of scientific uncertainty about biodiversity conservation and the application of ecological theories makes accurately predicting the effects of human activity very difficult. This in turn makes policy formulation and implementation equally uncertain and supports the adoption of a precautionary approach to the conservation of biodiversity, decision making and policy formulation in the UK.

It should also be recognised that many species may already exist at levels that are unsustainable in the long term. In recent years there have been several cases of species that have either become extinct in the UK or no longer exist as viable wild populations because population sizes have been greatly reduced (for example, large copper butterfly, Essex emerald moth). Replacement of lost habitat and the extension of species populations within their natural range, to the best of our current abilities, may be required.

We advocate an approach to CNC identification that employs the precautionary principle at every stage. While the best available knowledge should be drawn upon, whenever it is not clear whether the outcome of a proposed course of action will be damaging to the natural environment, or when it is unclear whether the damage resulting from a proposed course of action cannot be fully and directly compensated, then the action should not be allowed to proceed.

The Government defines the precautionary principle in the 1990 White Paper "This Common Inheritance" and the UK Biodiversity Action Plan, in the following terms:

"*Where there are significant risks of damage to the environment, the Government will be prepared to take precautionary action to limit the use of potentially dangerous materials or the spread of potentially dangerous pollutants, even where scientific knowledge is not conclusive, if the balance of likely costs and benefits justifies it*"

This definition makes no direct reference to damaging development or land use change proposals that may affect habitats and species, but "Sustainable Development the UK Strategy" (HM Government, 1994b) goes on to state that "...*the principle can be applicable to all forms of environmental damage that might arise...*" (para. 3.12). The definition above indicates a desire to evaluate the precautionary action in terms of

likely costs and benefits. This definition has a number of tangible and non-tangible factors such as financial costs, social benefits, health considerations and value of the environment. These can be interpreted to varying degrees and consequently the application of the precautionary principle will vary between decision making bodies. There will be those who will adopt a straight forward approach that will not accept potentially environmentally damaging proposals if any degree of uncertainty exists. Others will consider the degree of uncertainty and balance this against the cost of precautionary action and the likely environmental benefits that will accrue.

4.5 Replaceability

Habitat irreplaceability is recognised as a key concept in the identification of CNC in 'Sustainability in Practice' (EN, 1994) and as a key concept in the maintenance of biological diversity. In the UK Biodiversity Action Plan (HM Government, 1994a), the issue of habitat irreplaceability is described in the following way:

"While some simple habitats, particularly those populated by mobile species which are good colonisers, have some potential for re-creation, the majority of terrestrial habitats are the result of complex events spanning many centuries which defy re-creation over decades. Therefore, the priority must be to sustain the best examples of native habitats where they have survived rather than attempting to move or re-create them elsewhere when their present location is inconvenient because of immediate development proposals"

This recognises the importance of not allowing reduction in quantity and quality of critical assets.

The difficulty with the concept of irreplaceability is the uncertainty surrounding the extent to which the interest of an environmental asset can be replaced. At one end of the scale there are many habitats that are widely viewed as irreplaceable (for example ancient woodland, raised lowland mires and limestone pavement). For these habitats their interest and value has developed over thousands of years and the environmental conditions that moulded them cannot be technically or financially re-created within acceptable time scales. At the other end of the scale are a range of ephemeral (short - lived) communities which rely on regular disturbance for their continued existence.

The importance of historical longevity when considering replaceability is recognised in the UK Biodiversity Action Plan:

"The habitats of the UK have developed initially through colonisation from the rest of *Northwest Europe after the last glaciation, and then subsequently under the direction and influence of human land management activities. The results of these long historical processes, are not reproducible over short time scales, and indeed like individual species themselves, are a product of evolution combined with chance events which cannot be re-run the same a second time"*

Success in attempted replacement depends in large part on the objectives of the scheme and the way in which results are assessed. With a single species success, in theory, could be fairly accurately measured in terms of, for instance, number of individuals, number of sites, number of breeding pairs. On the other hand the objective of a habitat replacement scheme may be to replace a whole habitat in terms of its species assemblages, vegetation structure and ecological processes. The success of such a proposal is much harder to determine as long established habitats with a continuous history of appropriate management are complex and detailed systems.

Restoring physical conditions and basic vegetation structure of former habitats is sometimes achievable within acceptable time scales, but it is very difficult, if not impossible, to restore the full range of species as some are difficult to re-introduce and because often the full range of species originally present is not known. According to Spellerberg (1992) superficially similar habitats could be created, but it is impractical to re-create a habitat which includes precisely the same species composition, population structures and distribution of all taxonomic groups. Therefore the key question relates to which aspects of a natural feature need to be replaced to ensure the maintenance of environmental quality and biodiversity.

If we are to sustain our existing environmental resource we need to determine if threatened aspects of the resource can be replaced within an accepted time scale that ensures no long term or irreversible deterioration takes place. This does not necessarily mean that the habitat and species resource will not fluctuate in time and space as the countryside is an ever dynamic system. However, those assets that are so valuable or fragile that they cannot withstand the rate of change or are intrinsically irreplaceable once lost must be identified as critical natural capital.

The current low levels of certainty surrounding the question of habitat replaceability and species translocation mean that this decision tree cannot be presented in detail, and that it is unlikely that definitive answers will be derived.

A series of broad issues that should be consideration are discussed below. They offer some guidance on the factors that need to be addressed when determining replaceability. More often than not, it will be necessary to make a decision based on experience and availability of information. Wide consultation about the different factors involved in arriving at a decision about the feasibility of replaceability / translocation, should be encouraged. The science of habitat re-creation is still in its infancy and there is a need to provide data on past experience to help guide good decision making.

4.5.1 Considerations in determining replaceability

Similar considerations should be made when considering either re-creation or translocation.

A. Can the feature under consideration be replaced in the locality?
Before consideration of technical, financial and political feasibility, this question is aimed at focusing attention on to a number of much simpler factors:

there must be:

> **Room to re-create within the local landscape**
> Guidance will be required here from planners who will be most able to provide information on land availability and known and predicted changes in land use that may provide opportunities for re-creation

If there is room, the re-created feature:

> **Must not undermine the viability of other valuable environmental features**
> A replacement habitat / site etc. must not be offered in compensation for environmental damage if this will result in a net environmental loss. For instance, does the new site create new barriers to movement of species between habitat patches?

Once all the reasons for which a particular environmental feature is held to be of importance have been identified, then by asking the question about whether there is the opportunity to re-create within the locality, *regardless of technical success*, it is possible to avoid the more difficult questions (discussed below) about the technical feasibility of re-creation.

B. Is it technically feasible?

English Nature (1993) summarise many of the issues which should be considered when attempting to decide whether a proposed re-creation will be successful. These include:

- historical context and continuity;
- baseline edaphic conditions at the proposed new site;
- the importance of matching existing micro-variations in topography, etc;
- availability of suitable innoculum [also consider availability of local sources];
- complex inter- and intra-species relationships

The extent to which these features are in operation is likely to be a function of the quality of the asset under consideration. As also suggested by English Nature, higher value (higher quality) sites often exist in situations where each of the above factors will present the most complicated re-creation problems. It is likely, then, that higher quality sites will be the most difficult from which successful results can be obtained.

As discussed earlier, the ecological criteria used in the designation of statutory and non-statutory sites provide a well tested and generally accepted measure of the quality of environmental features. The application of such criteria provide a useful starting point in the identification of features of interest that may be considered when determining replaceability. Appendix 1 contains an overview of some of the ecological theories, concepts and principles relating to biodiversity conservation. These should form a baseline of thoughts when considering the impact of development on any natural feature and the wider environment, although it is unlikely that they will enable clear cut decisions to be made except for a few well studied species. Where outcomes are unclear, the precautionary principle should apply.

Historical continuity is a very important aspect as it relates to time scales. Those assets that require long time scales for a successful replacement to be created are more likely to be considered critical. This is not to say that recently created sites, such as former quarries and other post-industrial sites will be any easier to re-create. The processes that have produced the site conditions may have been reliant on processes which are no longer financially, politically or environmentally acceptable (for example certain industrial processes no longer exist). The colonisation of such sites are poorly understood, and there is very little or no historical information on the wider ecological context of the sites. The sources of seed and animals available in the general

countryside no longer exist in the same abundance or patterns as they did when such sites were developing their value, through natural colonisation.

Consideration must also be given to the long term viability of re-creation - the above issues are considerations of form (the appearance and physical characteristics of a site) - long-term viability is also very dependant on the functioning of a site. It is one thing to re-introduce plants to a new site in a manner that resembles their previous appearance (their physiognomy and aggregation characteristics) and then to introduce the animals that dwelt on such a site. It is quite another to be confident enough to say that the site thus created will function as the old site did, maintaining itself and its contribution to biodiversity.

Consideration of exactly what the aims of re-creation are should be made. For instance, a site may be essential in terms of biodiversity maintenance only with respect to the continued survival of a barn owl, because it is rank grassland supporting a population of small mammals that provide a food source. In this case, it may be decided that this is an achievable aim and that the grassland, for the barn owl, can be treated as CNA. If the aims require a much more demanding set of criteria to be met, however, then one would probably be much less convinced about the eventual success of such a scheme.

C. Time scales

Much debate surrounds the important issue of the most suitable time scale within which to assess the success of a re-creation / translocation scheme.

"This Common Inheritance" (HM Government, 1990) suggests that 25 years (a human generation span) is an appropriate time scale within which to judge environmental sustainability. When applied to determining the success of habitat re-creation 25 years may appear quite arbitrary. However, the aim of identifying CNC is to operationalise sustainable development: if we are unable to pass on to the next generation at least what we currently enjoy in environmental terms, then we are failing to achieve sustainable development.

Using a time scale of 25 years immediately places a limit to development on any old or very complex habitat: peatlands, ancient woodlands, ancient grasslands, for instance, would qualify by default as CNC, simply for the reason that they are not re-creatable within 25 years.

An alternative time scale that is related to the nature of the feature under consideration may be considered but will require future refinement and wide agreement. Its application should be treated very carefully : accepting longer time scales may not ensure the futurity that is demanded by sustainable development. Furthermore, if an attempt is made to replace a currently ancient habitat within (say) 500 years, even if the attempt is successful, in 500 years time the habitat would have been (say) 1000 years old, but will actually be only 500 years old. Historical continuity is lost in this way. The following sample of time scales are presented for discussion:

Ancient woodland	Centuries
Secondary woodland	Decades / Centuries
Ancient grassland	Centuries
Secondary grassland	Decades / Centuries
Ancient heathland	Decades / Centuries
Secondary heathland	Decades
Peat-forming systems	Centuries
Open water systems	Years / Decades
Other Wetland habitats	Years / Decades / Centuries
Pioneer plant communities	Years
Species introductions / relocations	X generations - dependant on species
Geological features	Immediate (?) / Years

The choice of time scale within which to work - the human generation turnover approach or a more habitat related time scale - will require wide consultation and eventual consensus in order for CNC to be applied effectively.

Further interest is generated in the matter of whether a development should proceed until a re-creation scheme, offered as compensation, has actually been shown to be successful. This has obvious implications in the application of planning conditions which could lead to very lengthy delays in development. This will not impact as seriously on certain industries (for example minerals operators who plan many years in advance) as on others (for example housing, which is much more opportunistic), but there are also potential problems in the possibility that developers from any industrial sector may be asked to finance compensation projects "up front".

4.6 Other considerations relating to CNC.

4.6.1 Rehabilitation versus re-creation

Despite the implication that lower quality habitats are easier to re-create than higher quality habitats, many habitats which exist in an impoverished state may still be considered as irreplaceable (for instance afforested heathland). They represent a part of a particular resource that has high potential to be restored and also supports some existing interest. The rehabilitation of such habitats should not be offered in compensation for the loss of similar habitats elsewhere. Trading the existing habitat against the chance of rehabilitating an impoverished version of it, will ultimately result in a net environmental loss, even if restoration is deemed to be successful.

This argument could be seen to be considering the potential value of a site, as opposed to the current value of a site. This, however, is not strictly true. The fully rehabilitated quality and functioning of the currently afforested heathland, for example, should be realised through other schemes and encouraged if for no other reason than because of the alarming rate of loss of heathland. The loss of the existing heathland should be compensated by the creation of more heathland where this is technically possible.

5. DECISION TREES FOR SELECTING CRITICAL NATURAL CAPITAL

The decision trees have been constructed based on a series of considerations that relate to quality, function and replaceability of assets within the environment. Each question in the decision tree should be answered yes or no. There will however undoubtedly be occasions when there is insufficient knowledge to confidently answer the questions in this manner. In this case a precautionary approach should be adopted. The considerations are in no particular order of priority. Consequently, a site or feature could qualify as CNC at any stage and for more than one reason.

The decision trees consider the natural environment under 4 broad headings. The justification for each broad heading is contained in the explanatory text for each tree, but they consider the quality and function of the environment. Replaceability is a key, common theme associated with each heading and it is considered separately in each tree. Further consideration of the concept of replaceability is given in Section 4.5.1. The broad headings covered by the decision trees are:

1. Rare, Threatened, Declining species
2. Typical/characteristic assemblages of species of habitats
3. Environmental Service Provision
4. Importance to Earth Sciences

A brief section on social value has also been included under Section 6. This aspect is complementary to ecological considerations and requires further consideration.

We have attempted in our approach to consider why a feature is critical. For example, a site may be intrinsically critical (for instance a very old and complex irreplaceable habitat that has developed under environmental conditions that no longer occur). Alternatively the site or the feature may be critical for the reason that it supports a rare, threatened or declining species. Other features may be critical despite having very little or no interest with respect to the maintenance of biodiversity, but may form an essential biological service for example, stabilisation of soil, assimilation of wastes and pollutants or supply of water to a critical wetland habitat.

DECISION TREES

The questions in the decision trees have been kept simple and broad to avoid over complication. In some cases, however, to answer each question a number of subsidiary considerations will need to be made and these along with the decision tree questions are presented below. The decision trees are bound as pull outs in order that they can be easily followed alongside the text below.

These decision trees should be applied to the full range of habitats and species within England in order that they can be refined.

General points about the decision trees

When using the decision trees, the spatial context within which you are working should be borne in mind. Different aspects of environmental features may be critical at different levels.

We have used the term "feature under consideration" throughout the decision trees. This includes species, habitat, community (faunal and floral), site, wider area, or any other feature.

The question of replaceability occurs in each decision tree. Refer to Section 4.5.1 for guidance.

The term "appropriate time scale" is included at present under considerations of replaceability. Further discussion and agreement on this concept is needed (see Section 4.5.1.c).

It is hoped that eventually the process of identifying CNC will be refined to an extent that it can be used by almost anyone. Planners are very important in the process because of their roles in development control and in forward planning. However, in most cases, until a perfect set of environmental information exists for all districts and all natural areas, the input of local ecologists will also be required. The decision making process should also be supported by the production of monitoring and review data on habitat re-creation.

5.1 Q1. Rare, threatened & declining species

The following considerations relate to ensuring that those species most at risk are maintained at a favourable conservation status within the environment (see Appendix 2). English Nature regard the maintenance of Biodiversity as a key objective of environmental sustainability. It is also recognised as a function of the natural environment. Rare, threatened and declining species often give an indication of the quality of a habitat in terms of habitat complexity and maturity. Consequently, if the environment is to fulfil its function of maintaining biodiversity these species should be given particular consideration.

5.1.1 *Does the feature under consideration support rare, threatened or declining species?*

This question identifies whether species present on a site, feature or area under consideration are rare, threatened or declining. There are numerous data sources from which lists of these species can be determined at several different spatial levels (see, for instance, BSBI[1] guidance). The level (for example. district, county, national, Natural Area) at which this question should be considered requires identification at the outset, but it could differ for different species.

Species which are not rare, threatened or declining, but characteristic of habitats and landscapes will be considered in the next decision tree.

5.1.2 *Will the loss of part or all of the feature under consideration result in the loss of the species?*

This question requires consideration of the niche requirements of a species which will vary from species to species. For some species the niche requirements may only be met on part of a site, feature or area under consideration and consequently, partial loss may not necessarily result in the loss of the species. For other species, particularly those that are highly mobile with wide ranges, the site or feature under consideration may only provide part of the niche requirements for the species at a particular moment in its life cycle.

[1] Botanical Society of the British Isles

5.1.3 *Is there a suitable alternative site on which a viable colony of the species could be established within an accepted time scale ?*

This question considers the opportunity to redress a threatened loss of a species from an area under consideration. Before consideration of technical, financial and political feasibility, this question is aimed at focusing attention on a number of much simpler factors: Is there room to re-create?. Is there opportunity to re-create, and assuming re-creation was successful *per. se.*, would the new feature serve the same function as the original feature in the local landscape? (see Section 4.5.1a). This question also considers whether re-establishment can be achieved within an accepted time scale. This could relate to a human generation time scale (see Section 4.5.1c)

5.1.4 *Can the alternative site be (re)-colonised from a neighbouring colony within an appropriate timescale?*

This question considers the likelihood of natural re-colonisation from other colonies of the species. This will be affected by the dispersal ability of the species in question, the ease with which suitable niche requirements can be re-established and maintained on the alternative site and the presence of any barriers to dispersal other than distance. Consideration should also be made, where possible, of the manner in which the population functions, and whether isolation from the nearby colony will affect the long term viability of the new colony. There will be little information to enable many of these considerations to be answered. In these circumstances a strong emphasis should be placed on the precautionary principle as the species under consideration are at risk.

5.1.5 *Can (re)-colonisation of the species be achieved by human intervention and a viable colony established within an appropriate timescale?*

This question considers whether it is technically, financially and politically feasible to artificially effect re-establishment of a colony of the species. If re-colonisation can be achieved then the likely long term effect of isolation of the new colony should be considered and compared to the state of isolation of the existing colony. Consideration should be given to how to remove or reduce the degree of isolation.

5.2 Q2. Habitats and species assemblages

Biodiversity is not just concerned with the conservation of rare species. It includes the full range of diversity between and within ecosystems and habitats, diversity of species and genetic variation within individual species (HM Government, 1994a). This tree considers the characteristic assemblages of species of semi-natural and natural habitats.

5.2.1 *Does the feature under consideration support characteristic assemblages of species of the habitat?*
This question considers those species that characterise the habitat under consideration. Each habitat can be recognised by a suite of consistently occurring species many of which form the basic structure of the vegetation and ensure that the habitat functions successfully. Lists of characteristic species could be identified from descriptions such as the National Vegetation Classification. Guidance on animal communities should be sought from English Nature.

5.2.2 *Is there an alternative site on which the characteristic assemblages of species can be established nearby without detriment to other features?*
If the quality and quantity of the habitat resource is to be maintained consideration should be made of the availability of land for habitat re-colonisation or re-creation. If there is no foreseeable opportunity to replace lost habitat at an alternative site then it is effectively irreplaceable at the time of consideration. This is especially true for rare, specialised and complex habitats for which there is restricted opportunity for natural development. Commoner less complex habitats such as rank tall neutral grassland and scrub may be constantly regenerating on abandoned land and consequently, there may be no need to identify a specific alternative site. See Sections 4.5.1a+c.

In determining whether this criterion is satisfied, bear in mind that the establishment of a new feature should not be allowed to damage other environmental features in such a way that a net environmental loss will ensue.

Guidance needs to be established on how close a new feature should be to an existing one. This will depend very much on the nature of the existing feature

5.2.3 *Can the alternative site be (re)-colonised naturally within an accepted time scale?*

If an alternative site is available consideration should be made if characteristic assemblages of species can re-colonise naturally within an accepted time scale. The speed of natural re-colonisation will be affected by the site conditions on the alternative site, the dispersal ability of individual species and the position of the alternative site within the landscape.

5.2.4 *Is it technically and financially feasible to establish viable populations of characteristic species assemblages through human intervention within an appropriate timescale?*

If it is uncertain that characteristic assemblages of species will naturally re-colonise the alternative site within an accepted time scale, consideration should be given to the feasibility of achieving re-colonisation through human intervention. The feasibility will be affected by the historical context of the habitat, the site conditions, availability of suitable sources of species innoculum and interspecific relationships.

5.3 Q3. Environmental service provision

These questions relate to those features in the environment which do not directly support critical, rare, threatened or declining species or critical characteristic assemblages of species but may, however, form an important indirect service to some other important feature. For instance, the wider hydrological catchment of a wetland may be crucial to the continued survival of the wetland and therefore, as an environmental feature, requires protection. Any threat of damage to the catchment needs as much consideration as a threat of damage directly to the wetland.

This consideration could be extended to include environmental engineering structures that protect property (such as flood banks), features that help reduce erosion (such as shelter belts or hedgerows), habitats that act as sinks for natural by-products (for example carbon dioxide), pollutants or wastes (such as reed bed filter systems, river deposits and peatlands).

5.3.1 *Does the feature under consideration provide an environmental service?*
These services contribute, often indirectly, to the health of the environment and its ability to support life and should be maintained. Those that cannot be substituted by human intervention should be protected as critical environmental assets.

5.3.2 *Is it technically and financially feasible to maintain the environmental service/benefit through human intervention?*
This question will determine the feasibility of replacing or substituting the environmental service which requires consideration of the technical and financial aspects of the loss of the environmental service and subsequently, replacing or substituting it.

5.4 Q4. Earth Science

Earth Science is an important constituent of the natural capital of England and in common with the biological natural capital parts of this resource are critically important if we are to ensure that future generations have an equal opportunity to study earth science.

5.4.1 *Does the site support land forms, exposures or deposits important for earth science?*

It is suggested that the presence of important features can be determined initially from statutory and non-statutory designation systems. For recently created features advice should be sought concerning the value of the site for earth science.

5.4.2 *Is the site a geological integrity site?*

Integrity sites are those sites whose scientific value arises from the fact that they are finite and limited deposits or land forms that are irreplaceable.

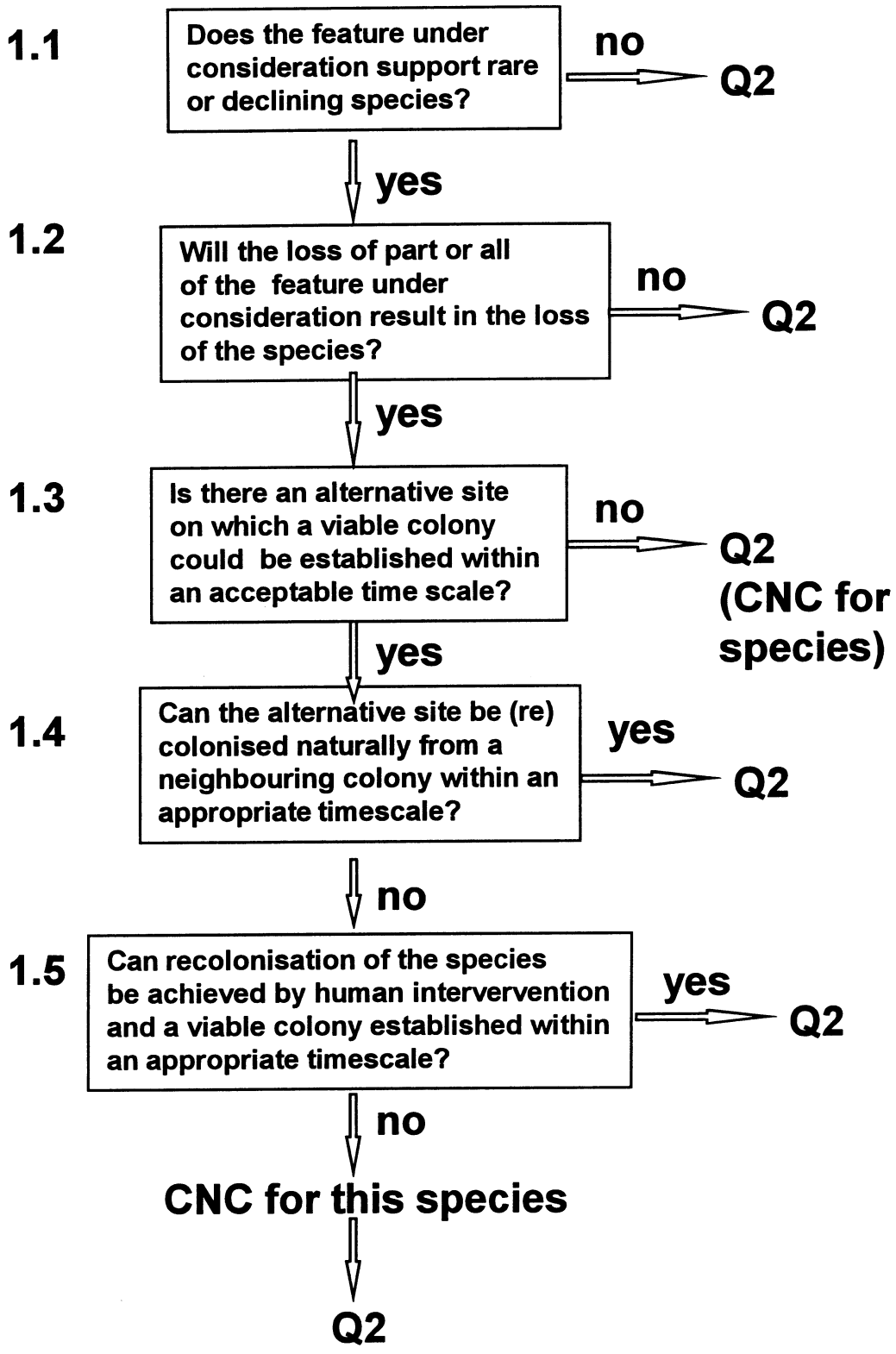
5.4.3 *Is there an opportunity to replace the feature of interest elsewhere within the natural area?*

If there are no apparent opportunities within the natural area to replace the scientific interest of a site then it should be treated as critical at the time of consideration.

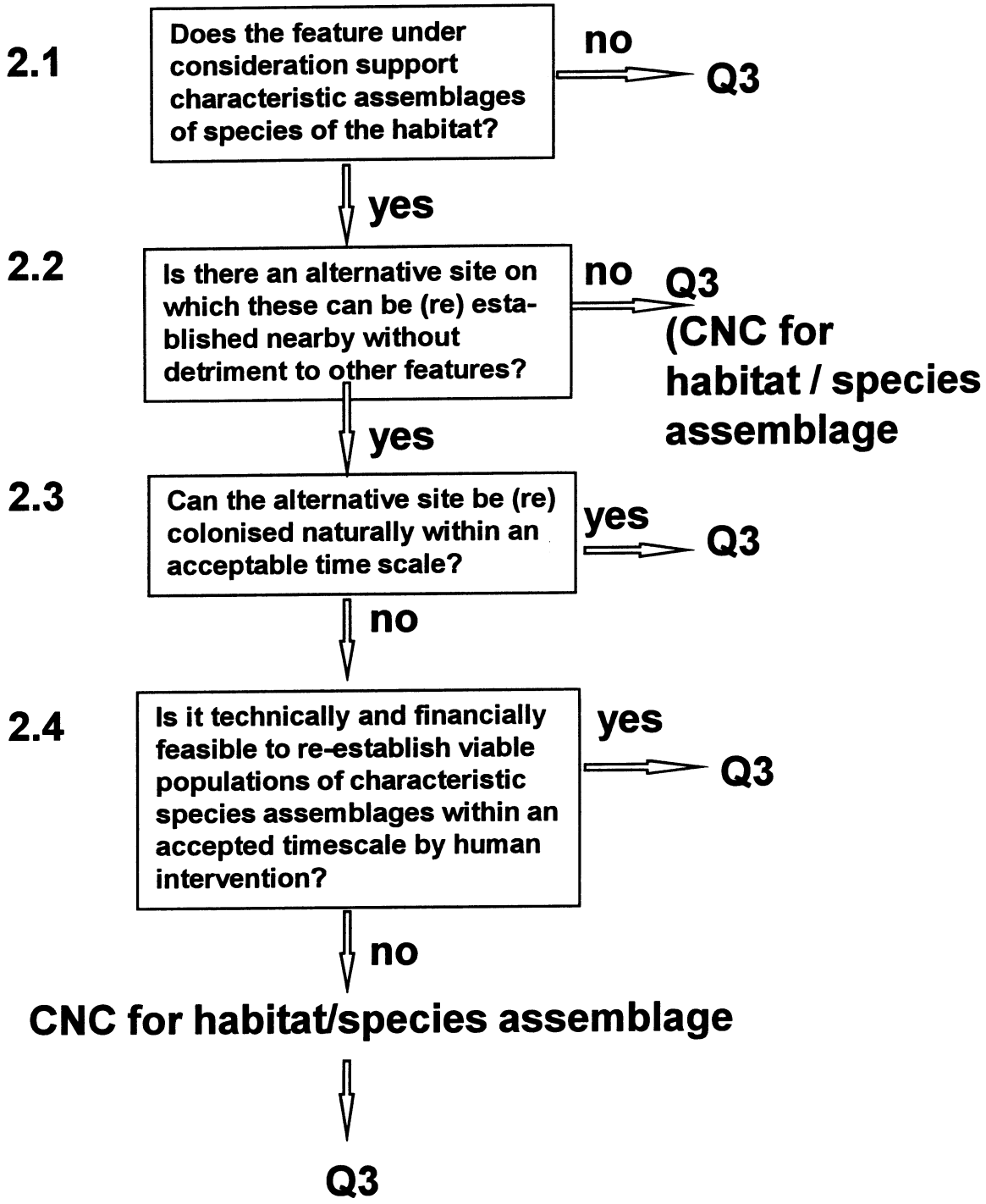
5.4.4 *Can the feature of interest be replaced technically and financially within an accepted time scale?*

If there is a suitable opportunity to replace the feature of interest within an accepted time scale and it can be technically achieved in a cost effective manner then it is not critical.

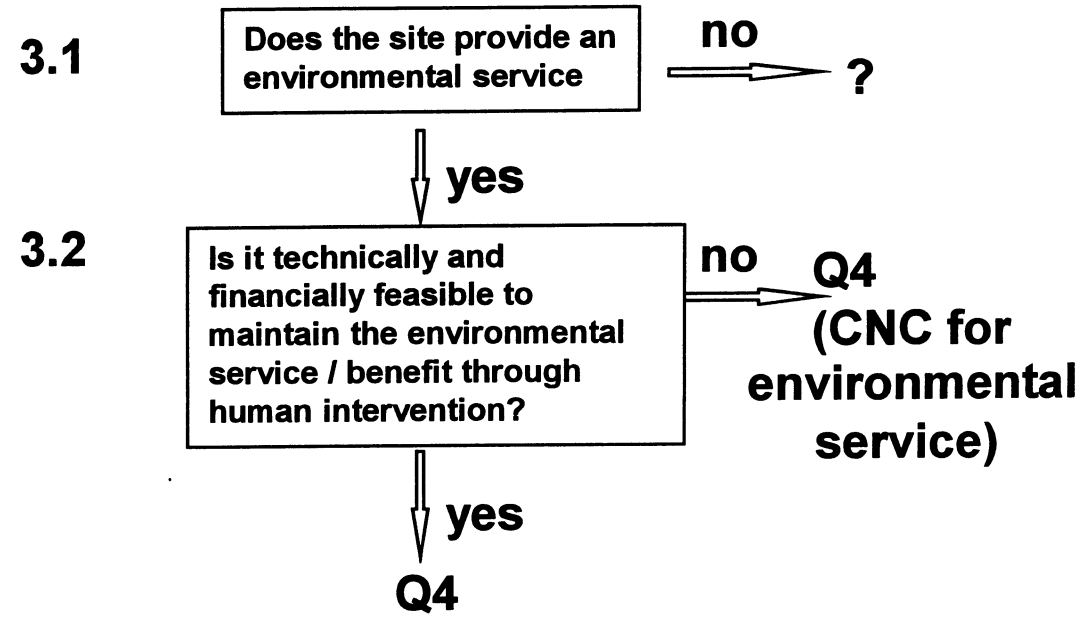
Q1 Rare, threatened and declining species



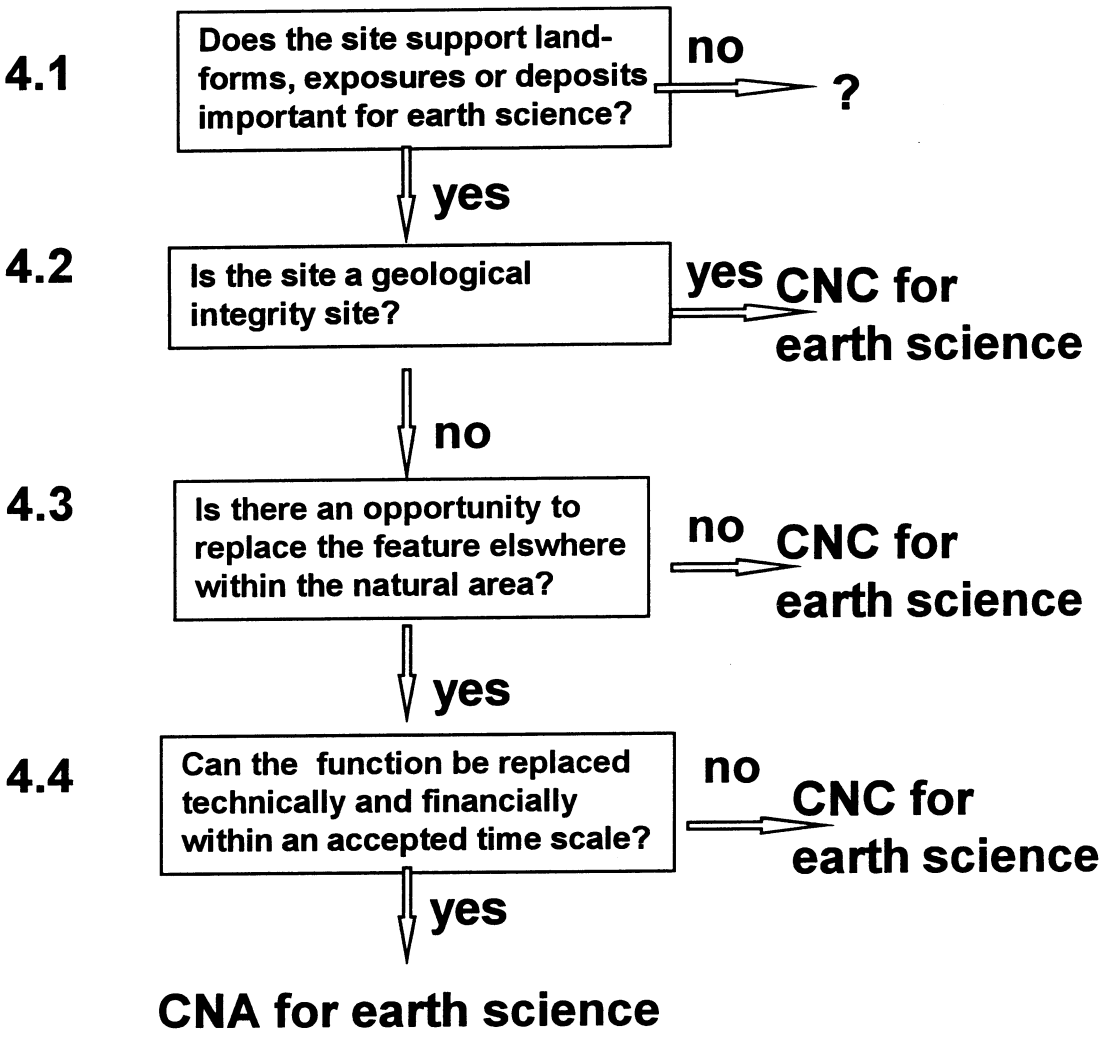
Q2 Habitats and species assemblages



Q3 Environmental service provision



Q4 Earth science



6. CRITICAL SOCIAL NATURAL CAPITAL

Critical Natural Capital is described in Sustainability in Practice (EN, 1994) as consisting of assets, stock levels or quality levels that are:

(a) highly valued; and either
(b) essential to human health, or
(c) essential to the functioning of life support systems, or
(d) irreplaceable or unsubstitutable for all practicable purposes (e.g. because of antiquity, complexity, specialisation, location)

The nature conservation resource includes geological exposures, geomorphological features, land forms, habitats and species. However, It has been argued that social criteria for designating *critical social natural capital* should also be used (EN, 1994).

English Nature is concerned that people benefit from nature conservation and supports the identification of critical social sites at the local level and that local authorities and community groups have an important role to play in the identification process.

Critical social natural capital is described as those assets that are of critical social value to a local community, rather than of high ecological or scientific value. However, ecological value and social value are not exclusive and it is likely that a great many sites identified as being ecologically important in a local context will also have a high or critical social value.

7. APPLICATION OF CNC

7.1 Implementation mechanisms and implementing bodies

Whilst the UK's planning system offers many opportunities for adaptation to take account the concept of CNC, as discussed in "Sustainability in Practice" (EN, 1994), CNC should by no means be promoted purely through planning.

Agriculture and forestry, which for many habitats and species can be more damaging to the natural environment than those activities governed by planning, are policy areas which should incorporate the concept of CNC. "Sustainable Forestry the UK Programme" (HM Government, 1994c) recognises the need to assess proposed woodland expansion in terms of its impact "*on other biodiversity interests*" (para. 3.65). Paragraph 3.70 states the government's policies for enhancing biodiversity through forestry, one of which is "*to identify suitable sites for new native woodlands*". These present opportunities for the integration of the concept of CNC. Policies for expansion of timber crops (para. 3.64), the expansion of woodlands for leisure (para. 3.86) and landscape (para.3.94) should also incorporate a consideration of CNC.

Local Authorities are well placed to promote, implement and develop the concept of CNC and, through Local Agenda 21 have the ideal vehicle for ensuring their contribution to sustainability. Many other land holding and land management organisations such as the National Rivers Authority and the public utilities, as well as central government bodies such as the Department of Transport, can all adapt the concept of CNC and further its application.

7.2 Reactive or proactive application ?

In land use planning and control, including forestry and agriculture, the concept of CNC could be applied in both a forward planning or in a more reactive manner in the determination of whether and where various land use changes should go ahead. The principal determinant will be financial resources, but used as a forward planning tool to identify features as tradable or non-tradable, the planning system would benefit by giving a clear indication of the location of development sites. By identifying precisely why certain features are critical or tradable, a defensible system will evolve.

7.3 Monitoring

Monitoring of the natural resource must be undertaken. It is likely that the nature of the component parts of our environmental capital will change over time and the classification of it as CNC or CNA will change accordingly. As new information about

our environmental capital comes to light, this will also change our classification. For instance, Wybunbury Moss National Nature Reserve in Cheshire (already likely to be CNC for many reasons) was recently found to support a spider previously recorded only in north west Europe. This illustrates that for many environmental features our knowledge of their interest and their contribution to biodiversity is far from complete. New records of this kind will inevitably occur and the classification of aspects of environmental features will change.

"Stock taking" or environmental auditing is very important if we are to be sure that we are doing the best we can to maintain a functioning environment and contributing to sustainable development. If decision makers do not know what the resource is, in terms of quantity and quality, they will not be able to judge whether environmental sustainability, and hence sustainable development is being achieved.

8. GLOSSARY

CNA	Constant Natural Assets. Those features in the environment which are not critical (irreplaceable) and whose loss should be fully and directly compensated in environmental terms.
CNC	Critical Natural Capital. Those features in the environment which are irreplaceable and whose loss or damage should not be allowed.
Edaphic conditions	Relates to soil conditions, includes micro-topography, chemical and hydrological status of soils.
Environmental service provision	In these terms, all services provided by environmental features which are of use to humans or to other environmental features. Features which provide environmental services may not have intrinsic nature conservation value themselves (for instance an impoverished water course or
Physiognomy	In these terms, the appearance of biological communities, which is often distinctive, for instance, the "look" of heather moorland or lowland hay meadows.
Rehabilitation	The treatment of impoverished habitats with the aim of regaining their former appearance, species composition and functioning. Differs from re-creation in that the starting point is further advanced in terms of the development of the habitat.
Translocation	The movement of species or habitats from one place to another with the aim that target habitats and species will remain viable at the receptor site.

APPENDICES

APPENDIX 1. ECOLOGICAL THEORIES, CONCEPTS AND PRINCIPLES RELATING TO THE CONSERVATION OF BIOLOGICAL DIVERSITY AND THE SELECTION OF CRITICAL NATURAL CAPITAL.

In recent years a variety of ecological theories have been developed to explain and investigate the impact of habitat reduction and fragmentation on the diversity and survival of species within the landscape. These theories and models provide a theoretical ecological basis for the conservation of biological diversity within a terrestrial landscape where habitats and hence species populations have been fragmented by human activities. They form the scientific basis of much of the current work in the relatively new discipline of landscape ecology (Bunce, 1992).

The concepts, theories and models that form the basis of landscape ecology and the conservation of biological diversity within a fragmented landscape do not operate independently of each other. For example, theories on habitat corridors and stepping stones relate to the effects on species populations of isolation and habitat fragmentation.

Whilst these ecological theories provide a basis for developing approaches to the conservation of biological diversity at a population and landscape scale, they are either general theories or have only been tested on specific examples. The lessons from such testing are difficult to apply generally as the requirements and behaviour of species is so varied. For example, some species are highly mobile and others are not; some species are highly adaptable and have a broad ecological tolerance whilst others are restricted to small areas and have very specific niche requirements.

However, they do provide a theoretical basis for land use planning and landscape ecology which is reflected in the promotion of general principles of reducing habitat fragmentation and isolation, maintaining large connected blocks of habitat and ensuring that species populations are maintained at a favourable conservation status, i.e. the population size and distribution is static or expanding. The current lack of information on species population dynamics in the UK means that there is little scope to determine exactly the critical thresholds for many species and habitats.

The limitation of basing site selection on ecological theories is referred to in "Guidelines for the Selection of Biological SSSIs" which recognises that natural

guiding principles are of rather limited use in the selection of the SSSI series and that selection needs to be based on a realistic perception of the values which concerned society places on these features of nature rather than the arcane concepts of theoretical ecology

Habitat fragmentation

In general terms a decrease in habitat area leads to a decrease in species richness, but there is no single explanation as to why larger patches of habitat tend to support more species than smaller patches. Habitat fragmentation can lead to isolation of populations, which in the long term are vulnerable to inbreeding depression and genetic drift. They are also more susceptible to "random events" that can result in species extinction from habitat patches. Fragmentation can also result in increased edge effects, reduced population sizes (which can also lead to local extinction) and immigration of species favoured by recently created edges which can result in changes in community composition.

Niche Concept

The niche concept is that any given species of animal or plant may survive in only a certain range of conditions at any one time and not outside this range. Species vary in the complexity, and specificity of their niche requirement. Factors that affect the conditions of a species niche include predation, disease, climate and physical and biological conditions. Some species have very broad and simple requirements and tend to be relatively common. Others have very specific and complex ecological requirements.

The niche of a species may not be restricted to one particular biotope patch (i.e. area of habitat as perceived by people). Some species need a habitat patch (i.e. patches in the sense of the species' niche) that comprise a mosaic of habitats and ecological conditions within a given area e.g. Barn owl. Consequently a species niche may be smaller or larger than a single area of a particular site of a habitat within the landscape (e.g. a block of grassland or a woodland in an arable agricultural landscape). Equally a species niche requirements may be fulfilled in only part of a site of a habitat within the landscape.

The niche concept has clear implications for the determination of the critical natural capital for a particular species within a given area. All the features of the niche of a species will need to be maintained if that species is to have the basic requirements to survive within the area under consideration.

Island Biogeography Theory

The theory of island biogeography was first proposed by MacArthur and Wilson (1967) to explain the relationship between the size of an area and species diversity (the area effect) and the relationship between the degree of isolation and species diversity (the distance effect).

The theory proposes a model that predicts that on any island the number of species it supports is determined by an equilibrium between extinction and immigration of species. MacArthur and Wilson recognised that island biogeography theory can be applied to plants as well as animals and could apply wherever patches of uniform habitat, not just islands in the oceanic sense could be recognised.

The theory has been widely applied, discussed and modified (Simberloff, 1976, Brown and Kodric-Brown, 1977, Williamson, 1981).

In the consideration of Critical Natural Capital, the island biogeographic theory is important. The relationship between species diversity, the size of uniform habitat patches and the isolation of habitat patches is theoretically important in determining the minimum area required to support a full and viable range of species populations of the habitat. This will also be affected by the number, size and juxtaposition of the fragments of the habitat which in turn will affect different species in different ways.

Metapopulation Theory

Metapopulation theories relate to partially isolated populations belonging to the same species. They have been developed to more accurately describe the real situation of populations dispersed within a fragmented habitat. The populations that comprise a metapopulation are able to exchange individuals and recolonise sites in which the species has recently become extinct.

This theory of population dynamics is particularly relevant to the survival and dispersal of species within a fragmented habitat resource. It is also important in the consideration of the relationship between Critical Natural Capital and Constant Natural Assets. For example a series of sites may be designated as CNC for a particular species that exists on those fragments at one moment in time. However, other fragments that may be considered as CNA potentially could become new sites for the species of interest.

Source and Sink Theory

The source and sink model allows for differences in quality between habitat patches that support a species with some patches being superior to others. Inferior habitat patches (sinks) require re-colonisation from superior habitat patches (sources) to maintain the presence of a species. Thus a source has been defined as a net exporter of individuals and a sink as a net importer (Pulliam, 1988).

This model has implications for conservation biology and a detailed knowledge of population dynamics is needed. If within a population only the sinks are protected and not the sources the long term survival of the population can not be guaranteed. If a source sink system is operating for a particular population of a species the sources could be considered critical to the survival of the species, but it is less clear what status the sinks have and it is likely that this will vary from species to species.

Minimum viable population size

Minimum viable population theories have been used in work on the conservation of threatened populations of species and are usually species-specific. When a population is reduced in size to a few individuals its chances of survival tend to decrease as the effects of inbreeding and genetic drift slow population growth, shorten longevity of the species and reduce the species ability to adapt to environmental change.

It could be argued that the critical natural capital in terms of the population size of a species is equivalent to the minimum population size. However, there are clearly inherent dangers in reducing species population sizes to a minimum level as it is unclear if in the long term the original calculation of the minimum population size accounted for long term change in the vitality of the population. In addition the minimum population size cannot be considered in isolation from the distribution of the population throughout a fragmented landscape and the ability of each fragment of the population to interact with others.

Corridors, stepping stones and connectivity

It has been suggested that the impact of fragmentation can be reduced by linking habitat patches with wildlife corridors, links and stepping stones. The potential value of corridors in maintaining biological diversity is referred to in the UK Biodiversity Action Plan (HM Government, 1994a).

"Duplicating habitats around existing sites of interest and linking isolated sites together through the maintenance of appropriate landscape features have much to recommend them as positive measures to sustain biodiversity."

However, the exact value and role of corridors as conduits for the movement of species and as habitat fragments in their own right remains unresolved (Dawson, 1994). Consequently, although wildlife corridors are likely to be of value for certain species they should be seen as only one method of protecting threatened species and habitats and that other measures, including the protection of existing habitats from further fragmentation and replacement of past losses may be more effective.

APPENDIX 2. DESIGNATIONS

International designations

(a) The Ramsar Convention on Wetlands of International Importance especially as waterfowl Habitat (1971) requires the conservation of wetlands, especially those listed by the convention. Article 2 paragraph 2 of the convention states;

'Wetlands should be selected for the list on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology. In the first instance wetlands of international importance to waterfowl at any season should be included'.

In Article 4 paragraph 1 the convention recognises the need to 'promote the conservation of wetlands and waterfowl by establishing nature reserves on wetlands, whether they are included on the List or not'. It could be argued that this is the equivalent of maintaining an overall stock of wetlands habitats or constant natural asset.

The convention recognises the right of each of the signatories, because of its urgent national interest, to delete or restrict of the boundaries of wetlands included in the list. However, in Article 4 paragraph 2 the convention urges that where a deletion takes place ' it should as a far as possible compensate for any loss of wetland resource, and in particular it should create additional nature reserves for water fowl and for the protection, either in the same area or elsewhere, of an adequate portion of the original habitat'. This requirement for the replacement as far as possible of lost habitat is in accordance with the replacement of CNA where loss of habitat cannot be avoided.

(b) EC Council Directive on the Conservation of Wild Birds: The Birds Directive.(1979) applies to birds, their eggs, nests and habitats. It provides for the protection management and control of all species of naturally occurring wild birds in the European territory of Member States.

Article 4 of the Directive requires that special measures be taken to conserve the habitat of the species listed in Annex I in order to ensure their survival and reproduction in their area of distribution

(c) EC Council Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora: The Habitats Directive (1992)

Article 1 of the directive defines conservation as a series of measures required to maintain or restore the natural habitats and the populations of species of wild fauna and flora at a favourable conservation status.

Favourable Conservation Status

The conservation status of a natural habitat will be taken as 'favourable' when:
(i) its natural range and areas it covers within that range are stable or increasing, and,
(ii) the species structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future and,
(iii) the conservation status of its typical species is favourable.

The conservation status of a species will be 'favourable' when:
(i) population dynamics data on the species concerned indicate that it is maintaining itself on a long term basis as a viable component of its natural habitats and,
(ii the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future and,
(iii) there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long term basis.

Article 3 paragraph 3 of the directive states
Where they consider it necessary, member states shall endeavour to improve the ecological coherence of Natura 200 by maintaining, and where appropriate developing, features of the landscape which are of major importance for the wild fauna and flora, as referred to in Article 10.

Article 10 states
Member states shall endeavour, where they consider it necessary in their land use planning and development policies and in particular with a view to improving the ecological coherence of the Natura 2000 network, to encourage the management of features of the landscape which are of major importance for wild flora and fauna.

Such features are those which, by virtue of their linear and continuous structure (such as rivers or traditional systems of marking field boundaries) or their function as stepping stones (such as small ponds or small woods) are essential for the migration, dispersal and genetic exchange of wild species

Articles 12, 13,14 and 15 refer to the protection of species listed in several Annexes. Article 16 provides for the derogation from the provisions in these Articles provided that there is no satisfactory alternative and that the derogation is not detrimental to the maintenance of the populations of the species concerned at a favourable conservation status in their natural range.

The provisions of the Habitats Directive described above have clear connections to the theories, concepts and models relating to the conservation of biological diversity. The concept of favourable conservation status is particularly valuable as it proposes a method by which the status of a species can be assessed albeit rather crudely and without a the need to determine the precise boundaries of a minimum viable population. Article 10 recognises the importance of habitat fragmentation and its potential effects on the maintenance species populations within a natural or semi-natural habitat fragmented by intensive human activity.

(d) Biogenetic Reserves

A number of sites designated as National Nature Reserves (NNR) and Sites of Special Scientific Interest (SSSI) have been identified as Biogenetic Reserves under a Council of Europe programme for the conservation of heathlands and dry grasslands. Consequently the designation of a site as a Biogenetic Reserve indicates it is of international significance.

National Site Designations.

Nature Conservation in Britain (NCC, 1984) states that the primary objective of nature conservation is to ensure that the national heritage of wild flora and fauna and geological and physiographic features remains as large and diverse as possible, so that society may use and appreciate its value to the fullest extent.

(a) National Nature Reserve (NNR)

National Nature Reserves (NNRs) are designated under section 19 of the National Parks and Access to the Countryside Act 1949 or section 35 of the Wildlife and Countryside Act.

(b) Site of Special Scientific Interest (SSSI)

Sites of Special Scientific Interest (SSSIs) are designated under section 28 of the Wildlife and Countryside Act, 1981. Biological SSSIs are identified based on guidelines produced by the Nature Conservancy Council. (NCC, 1989) which provide a consistent rationale for the evaluation and selection of biological SSSIs throughout the UK.

The SSSI series is intended to form a national network of areas representing in total those parts of Britain in which the features of nature and especially those of greatest value to wildlife conservation are most highly concentrated or of the highest quality (NCC, 1989).

Nature Conservation in Britain (NCC, 1984), states; 'collectively, the national total of protected areas should be large and varied enough to guarantee the survival of a necessary minimum of Britain's wildlife and physical features'. The Guidelines for the Selection of Biological SSSIs recognises that the total area of habitats and the total size of species populations identified as having special interest should correspond to the necessary minimum of the national nature conservation resource referred to in 'Nature conservation in Great Britain'.

The Guidelines for the Selection of Biological SSSIs outlines two approaches that have been used in the selection of sites for designation as SSSIs. The first is based on representation of the best examples of the full range of natural and semi-natural ecosystem types and their fauna and flora. The second is based on the identification of a critical standard of nature conservation importance above which all examples qualify for key site status.

Where an SSSI has international importance in terms of its habitats or species (e.g. plant communities and species with markedly Atlantic or Lusitanian distribution, blanket bog, endemic and island races, globally rare species, unusual biogeographic combinations of species) the Guidelines state that it is self-evident that it is of special interest in its total national occurrence and that in these cases it is necessary to select all sites above the critical standard. This can apply to extensive habitats and numerous species as well as habitats with a restricted distribution or rare species (NCC, 1989).

The identification of SSSIs within fragmented habitats is usually straight forward so long as the site meets the critical standards set out in the selection guidelines. However, for extensive and continuous habitats such as blanket bog, upland grassland,

coastal cliffs, determining the boundaries of the SSSI can be more problematic and the guidelines outline a series of principles on which to base such a decision.

(c) Geological designations

The Geological Conservation Review (GCR) was started in 1977 and was completed in 1989. This comprehensive review identified sites suitable for designation as SSSIs using a set of general and detailed criteria (NCC, 1990). The geological SSSIs are selected on the basis of their research importance and are considered to be of national or international importance.

The GCR considered 97 subject blocks corresponding to particular stratigraphic time periods or division of the subject within the fields of igneous, metamorphic and structural geology, palaeontology, mineralogy and geomorphology. Suitable sites from each block have been identified under the GCR.

There are two types of site, although they are not mutually exclusive.

(i) Exposure sites

These are sites where the scientific or educational value is provided by the exposure of a deposit which is extensive underground, but otherwise inaccessible, unless by remote sampling. Consequently, although widespread the interest of the site is not is not available for study other than at the site exposed. Exposure sites depend on preserving the face of the exposure. The actual material exposed does not need to remain so long as the material can be exposed at a face to form equally good or improved exposures. Exposure sites are no less important than integrity sites. Their high value lies in the huge costs and difficulty of creating similar sites to replace them if they were lost.

(ii) Integrity sites

These are sites whose scientific value arises from the fact that they are finite and limited deposits or land forms that are irreplaceable if developed.

(d) Limestone pavement orders

All limestone pavements are of physiographical and sometimes biological interest and are identified as a priority habitat in the Habitats Directive. The pavements of northern England are among the best examples in the world (PPG9) and it appears self-evident that they are of national and international importance.

Local Site Designations

(a) Local Nature Reserves (LNRs)

Local nature Reserves are designated by local authorities under section 21 of the National Parks and Access to the Countryside Act, 1949. They are considered in PPG9 to be of regional or local importance.

(b) Non-statutory designations (SINCs & RIGS)

Throughout the country planning authorities and nature conservation organisations recognise a series of non-statutory sites of importance for nature conservation (SINCs). The geological SINCs may also be referred to as Regionally Important Geological/Geomorphological Sites (RIGS).

Biological SINCs are generally selected using the same criteria as those for the selection of SSSIs although social criteria are commonly used (Collis and Tyldesley, 1993). The use of common criteria is valuable, but there are differences in the critical standards applied to identify a site of importance as selection is based on administrative boundaries and the range of quality of the nature conservation resource varies from one district, city or county to another. Consequently, a species-rich grassland SINC in a intensively arable county such as Nottinghamshire, may not qualify as a SINC in a county with a large grassland resource such as Devon. The SINC designations however, do identify the most valuable sites within the local nature conservation resource.

Regionally Important Geological/Geomorphological Sites (RIGS) were selected on the basis of their educational, research, historical and aesthetic importance.

A number of species are statutorily specially protected under various national and international obligations and legislation, including the Wildlife and Countryside Act (1981) and the measures described above. Official and local "Red Data Books" also give guidance on those species most rare or under threat of decline and such publications should be consulted whenever possible.

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