GUIDELINES FOR SELECTION OF EARTH SCIENCE SSSIs

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GUIDELINES FOR SELECTION OF EARTH SCIENCE SSSIs

Part 1: INTRODUCTION

The purpose of this document is to summarise guidelines for the survey, evaluation and selection of earth science SSSIs, a process known as the Geological Conservation Review (GCR). The GCR offers a Great Britain-wide mechanism whereby the country councils may discharge their statutory duties, under the Wildlife and Countryside Act 1981, Environmental Protection Act 1990 and the Natural Heritage (Scotland) Act 1991, to notify any area of land which in their opinion is of special interest by reason of its earth science (geological and physiographic) interest.

Part 2 of this document is a rationale, setting out the objective, general principles and philosophy of the GCR; Part 3 deals with the criteria used in the evaluation and selection of GCR sites; and Part 4 compares the earth science guidelines with those for biological sites.

Part 2: RATIONALE

The standards for earth science conservation have evolved progressively with practice and precedent contributing to a considerable body of experience and knowledge up to the conclusion of the main phase of GCR site selection in 1990. Published guidance on site selection to date has focused on the way in which the GCR was driven by the nature of geological science. The present guidelines are a consolidation of the broader rationale.

2.1 Summary rationale

The rationale for the GCR can be encapsulated in four definitive statements, as follows:

A The objective of the earth science SSSI system is to identify and conserve a GB-wide series of Sites of Special Scientific Interest for their 'geology and physiography'.

B Each site within the series must have a special interest demonstrable at national or international level, either in its own right or by virtue of its contribution to a network of closely related sites.

C The special interest of the series is interpreted as the minimum number of sites needed to demonstrate our current understanding of the diversity and range of earth science features with regard to the following criteria:

* representativeness
* exceptional features
* international importance

D Sites are assessed against the above criteria on a network basis. Each network consists of a group of sites addressing a particular geological period of time,(for example, Kimmeridgian, covering the period from 140 to 135 million years ago), or subject area, (for example, fossil fish). The 97 networks are grouped into 5 sub-divisions covering the entire discipline of earth sciences. The resulting 3010 GCR sites are condensed into 2200 earth science SSSIs by virtue of the occurence of different geological features at the same site.

These statements are explained and amplified in the remainder of Part 2, except for the substantial issue of criteria which is the subject of Part 3.

2.2 The value of, and need for, earth science conservation

The justification for earth science conservation is most fully set out in Earth science conservation in Great Britain - a strategy (NCC, 1991 copy attached). In summary the values of earth science sites are strongly founded in their potential use by humankind. The main values are for:

- scientific research,
- education,
- training,
- economic use
- leisure
- aesthetic purposes

The earth sciences are also of fundamental importance to the conservation of wildlife as rock and soil form the substrate for valued habitats, and control their hydrological characteristics. In addition, understanding interactions such as that between coastal sediment movement and coastal defences, the way in which rock weathering moderates changes in atmospheric chemistry, or soils buffer the effects of acid rain, provide an essential underpinning for effective and sustainable land management, land interpretation, and environmental policies.

In spite of a widespread perception of robustness, earth science features are subject to a wide range of threats involving loss of exposure and damage to their integrity. At the same time, some changes offer benefits. The pattern of threat and opportunities is also set out in the above document and, in summary, they are:

- coastal defences
- quarry infill
- instability and flooding of excavations
- river engineering
- general and specific deterioration of landscape quality
- road and urban construction
- over-collecting of minerals and fossils
- afforestation
- erosion and deposition
- broad changes in land use

2.3 The concept of 'special interest'

Statement A above incorporates the concept of 'special interest', the origins of which have been reviewed in Guidelines for selection of biological SSSIs (NCC, 1989). In essence a country agency, in exercising its "opinion" that an area of land has "special interest", is expressing a value judgement based on "best informed judgement rather than rigid application of objectives rules". This opinion may attempt to define the scientific (or nature conservation) importance of the site by reference to a series of instrumental values (eg importance to scientific research, importance in history of science, educational importance etc). As noted above in 2.2 these same "instrumental" values apply strongly to earth science conservation. The major consequence of employing instrumental values in this way is that representativeness should figure highly in the criteria used in assessing 'special interest'.

Another consequence is that 'special interest' is not fixed in time, and that the relative value of a site will, for instance, reflect the changing values of society or the advancement of science. In the case of earth science the development of new theories, such as plate tectonics in the 1960s and displaced terrains in the 1980s, as well as the location of new exposures, has meant that change in the fundamental thinking and practice of earth science has been at least as rapid as that in the biological sciences over recent decades. It follows that any series of sites so chosen is inherently dynamic and must be subject to addition or removal of sites if it is to retain its conservation relevance. In practice such review has resulted in only modest, but important, changes at the margins of the coverage, mainly because the use of representativeness as a major criterion leads to a general purpose, robust coverage, able to encompass fresh approaches.

2.4 National or international interest

Statement B, above, requires that each site must be of at least national - ie Great Britain - importance, without regard to geographical constraints or administrative boundaries (eg by country or by county). Assessment and selection on a British basis means that all sites selected are of at least national importance, having been assessed against all other comparable candidate sites in Britain. This approach matches the continuity of geological structures and features across Great Britain. It provides in the process a common currency of site status and value between England, Scotland and Wales and facilitates comparison with systems employed in other countries, by recognising that some sites are of international importance.

Statement B adds the caveat that a site may achieve this national standard either in its own right in isolation, or by virtue of its importance as a link in a chain of closely-related sites. This concept of a network of sites is explained in Section 3.3.

Internationally important sites are of major importance in the GCR coverage and this is amplified in Section 3.5.

The requirement of national importance precludes from the GCR series many sites of high regional or local importance - indeed the bulk of exposures of geological or geomorphological features in Britain. The conservation needs of this vast and

important wider earth science resource are better addressed by a non-statutory, locally-based approach which can embrace a wider range of values including local amenity. Such an approach is at the centre of the Regionally Important Geological/Geomorphological Sites (RIGS) schemes which operate at county level.

Part 3: CRITERIA

Statement C of the rationale states that the special interest of the site series is interpreted as the minimum number of sites needed to demonstrate our current understanding of the diversity and range of earth science features with regard to criteria of:

* representativeness
* exceptional features
* international importance

The following sections amplify this statement.

3.1 The concept of 'minimum numbers' of sites

Statement C requires that the GCR coverage should be composed of the minimum number of sites necessary to demonstrate the diversity and range of GB earth science features. The aim is to ensure that GCR site status is kept at a national level and, accordingly there is no equivalent to the biological concept of a 'critical standard' or threshold above which all candidate sites automatically qualify for inclusion.

No numerical limit to the total number of earth science SSSIs is prescribed, as the series of sites is dynamic and accordingly the numerical total may be expected to change as sites are added or removed over time. In practice, the coverage has proved very stable, although changes which have occurred have been important in maintaining its quality.

Implicit in the concept of minimum numbers is the concept of a minimum area for sites: that is, the least area to adequately encompass the interest. This area varies according to the type of site - for example a large folded structure or a volcanic centre may require many sites close together, or large sites, whilst a specific fossil horizon may only require one small site.

3.2 The concept of 'current understanding'

Statement C refers to our 'current understanding' of the earth science resource, thereby acknowledging that our understanding of it is incomplete, due to insufficient or outdated information. The emphasis in Statement C on demonstrating the diversity of the earth science heritage flows from this awareness, recognising that the GCR coverage is a selective sample of a much wider, and not fully documented or understood, resource. This reinforces the need for the site series to be as representative as possible of the known resource.

A second implication is that judgements on the selection of sites will have to be very well informed if they are to be credible and defensible. This is reflected in the logistics of selection, not described in detail in this paper, which is based on reaching a consensus of the widest possible range of available expert opinion. The vast majority of this opinion has been sought from outside the conservation agencies.

3.3 Representativeness

Representative sites are selected to adequately demonstrate (or represent) the diversity and range of the geological and geomorphological history of Britain.

The richness and complexity of our geological heritage is such that selection of sites characteristic of it can only be effected by means of a thematically-based methodology. As outlined in Statement D, the GCR provides such a framework by recognising five main subject areas which correspond broadly to established sub-disciplines recognised within earth science:

- Precambrian, metamorphic and structural geology
- Igneous petrology and mineralogy
- Stratigraphy
- Palaeontology
- Quaternary geology and geomorphology

Within each of the five subject areas, individual themes - based on 97 sub-divisions of geological time (eg Llandovery, from 438 to 428 million years ago) or subject areas (eg caves, fossil reptiles) - are recognised. Each theme provides the focus for the assessment and selection of a network of sites which best represent the features of its geology. It follows that the GCR coverage of sites is composed of sites grouped into networks, of which there are also 97. Within each GCR network, a core of sites must be chosen that are excellent examples, representative of the geology or geomorphology of that network.

Sites selected in this way each contribute to the theme addressed by that particular network and thereby demonstrate our current understanding of it. This means that the value of a representative site, although perhaps considerable in its own right, can only really be fully evaluated and appreciated when it is seen as a indispensable/integral component of the full network to which it belongs.

3.4 Exceptional features

Many sites have spectacular, rare or remarkable features which, by definition, are unrepresentative, but which form a critical part of the resource. These sites with exceptional features are often of considerable research value, and their inclusion within the GCR ensures that the highlights of British geology and geomorphology complement the coverage afforded by representative sites.

The term 'exceptional features' also refers to text-book examples of geological or geomorphological features (eg sites showing rare preservational states) or remarkably abundant accumulations of material (eg fossils, mineral or cave formations) and

classic landforms. Many such features are fragile in nature and often irreplaceable if lost or damaged.

These 'spectacular, rare or remarkable' sites are often those which are best able to capture the imagination of the general public (eg deformed rock strata at Durdle Door, the spectacular gravel ridge at Chesil Beach, unusual fossil assemblages at East Kirkton). Their conservation is essential if earth science conservation is to reflect the full range of instrumental values used in the GCR. For example, aesthetic value obviously plays an important role in selecting spectacular sites (eg the Cairngorms; the striking rock folding at Millok Haven; the lake beaches that form the Parallel Roads of Glen Roy; Cheddar Gorge etc) and educational value has an equal role in selecting certain 'text-book' sites (eg Chesil Beach, Raised Beaches of Jura).

3.5 International importance

The third criterion for GCR site selection ensures that sites with a commonly acknowledged importance to the international earth science community are included within the site coverage. Sites so selected have international recognition as standard or reference localities and are immensely important for the earth sciences. They are the keys to the establishment of the geological record set against an absolute time scale, and are analogous to the physical reference standards used in other sciences. This recognition may be formal (eg stratotypes officially recognised by the International Union of Geological Sciences or IUGS, such as Dobs Linn which is the international reference site for the boundary between the Ordovician and Silurian systems) or informal (eg localities where phenomena were first identified).

Great Britain is to the forefront in promoting earth science conservation at international level. In return Britain can be said to attract at least a moral responsibility to conserve internationally-important sites within its borders as part of a global heritage. Access to such reference sites is needed to test and retest theories in the light of scientific advances, and without them earth scientists both in Britain and internationally would be seriously disadvantaged.

Internationally-important sites tend to have a strong research value and may include:

- time interval or boundary stratotypes approved by the IUGS;
- stratotypes in recent usage as a standard;
- type localities for biozones, chronozones etc;
- internationally significant type localities for particular rock-types, mineral or fossil species, and landforms;
- historic type sections, localities or areas where rock or time units were first described or characterised, localities where geological or geomorphological phenomena were first recognised and described, or where a principle or concept was first conceived or demonstrated.

In addition to their research value, sites thus selected may also have considerable historic importance. For example, it is the historical aspect which gives much of the value to type areas (eg. Wenlock Edge), or localities where phenomena were first recognised (eg cauldron subsidence at Glencoe, unconformity at Siccar Point).

Most sites of this type can be assessed and selected in a straightforward manner, but a more selective evaluation of importance has to be employed when, for example, assessing the numerous type localities for fossils which exist, and only those with a clear rationale for international significance can justifiably be considered worthy of selection.

3.6 The complete GCR coverage

The three types of sites, generated by the three criteria outlined above, under thematic networks, together constitute the full GCR coverage of sites. The three types are not necessarily mutually exclusive. A small core of sites are simultaneously representative and have exceptional features of international importance, and many more sites qualify for two criteria. The bulk of the GCR coverage, however, is made up of sites selected according to a single criterion, that of representativeness.

3.7 Operational criteria and preferential weightings

The main operational criteria, based upon common-sense considerations, is that it should be feasible in the longer term to conserve any site selected. This would exclude sites where conservation was not ultimately feasible, such as collapsed mineworkings, but not, for example, sites where access was temporarily impossible, or sites part of whose interest would inevitably be lost over time.

Application of the three conceptual criteria described above (representativeness, exceptional features and international importance) does not inevitably lead to straightforward options as to whether to include or exclude a site. The practice of site selection can be complicated by having a number of sites which qualify according to the criteria but which demonstrate very similar features. This problem is more likely to occur in the case of representative sites rather than with internationally-important and 'exceptional features' sites, since both the latter tend to be more obvious candidates.

The preferential weightings for choosing between otherwise identical sites employed are as follows:

* Preference should be given to sites with an assemblage of several different geological interests, or representation of different sub-disciplines.

* Preference should be given to sites which show an extended, or relatively complete record of the feature of interest. In the case of landforms they should be intact.

* Preference should be given to sites which have been studied in detail and that have a long history of research and re-interpretation.

* Sites which have potential for future study and interpretation should be preferred. Such potential might be manifested by, for example, extensive *in situ* deposits with continuing interest or sites which otherwise lend themselves to further work.

* Preference should be given to sites that have yielded results that assist placing them in a wider context. eg radiometric dates, palaeomagnetic or geochemical data, pollen dating.

Part 4: THE EARTH SCIENCE AND BIOLOGICAL GUIDELINES FOR SITE SELECTION - A COMPARISON

In this section the guidelines for site selection for earth science and biological sites are briefly compared.

The principal criteria used in the earth science guidelines are representativeness, exceptional features and international importance. The biological criteria are size, diversity, naturalness, rarity, fragility and typicalness (NCC, 1989). The two sets have much in common with a high degree of shared concepts. Both take as their starting points the preservation of diversity of features, with range of variation as a recognised component. Both systems include rarity, fragility and size as criteria, albeit with different weightings of importance. The earth science concept of representativeness had much in common with the biological criteria of diversity and typicalness, and, in the geomorphological field at least, the earth science preferential weightings include naturalness.

At the 'rationale' level many concepts are shared. Both sets of guidelines attach importance to the following:

* principle of a GB-wide series
* dynamism of the series
* subjective nature of 'special interest' opinion

It is at the level of operational approach that a major divergence between the earth and biological sciences emerges. There is no earth science principle directly equivalent to the biological notion of a 'critical standard' or threshold above which all examples qualify for key site status. That notion reflects an inclusive approach, based upon numerous 'areas of search', and contrasts with the nearest equivalent GCR critical standard - namely that each GCR site must be of GB-level importance - which is more exclusive in character. These differences in approach correspond clearly with the contrasting biological and earth science administrative approaches to site selection, the former being county-based and the latter being GB-based.

It is concluded that at the level of guiding principles and criteria the two sets of guidelines could be integrated. Divergences at lower levels are marked however and integration as regards operational approaches would pose insuperable difficulties.

REFERENCES

Nature Conservancy Council (1989). Guidelines for selection of biological SSSIs.

Nature Conservancy Council (1991). Earth science conservation in Great Britain - a strategy.