Chapter 6: EARTH HERITAGE CONSERVATION

- Threats to Earth heritage
  - Quarrying and Earth heritage conservation: threats and benefits
- The history of Earth heritage conservation in Britain
- Earth heritage site protection
- Earth heritage conservation in practice
  - Conservation strategy
  - Fossil and mineral collecting and conservation
  - Cave conservation
  - Advice on conservation of Earth Heritage sites

The need to take active measures to conserve our Earth heritage is, perhaps, less obvious than for biological sites which we need to ensure the survival of endangered animals, plants and habitats. Rocks are, after all, hard and durable, and some have existed for many millions of years. Similarly, some mature landscapes have remained almost unchanged for centuries. However, natural resources such as crushed rock, sand and gravel, are required to meet the demands of modern society and careful planning is required to ensure that any important geological feature is not destroyed in this process.

Threats to the Earth heritage
In modern society, there is an increasing need for waste disposal sites. Quarries, gravel pits, old mines and caves have all been used to fulfil this need and some historically important sites have been lost to science as a result.

Some engineering methods can also pose problems for Earth heritage sites. In protecting coastal cliffs from further erosion, rock exposures of value to science may be covered by engineering works. Such practice can also cut off the sediment supply which feed and maintain shingle bars, beaches, saltmarshes and mud flats causing them to become eroded by the action of the sea. Similarly, river engineering works have altered natural fluvial geomorphological features, and commercial and industrial developments have destroyed or covered sites. Even the shape of the land has been changed as features are levelled or exploited to extract materials for the construction industry, and the planting of coniferous trees in upland areas has damaged geomorphological features and obscured geological exposures. Development and the effective conservation of the Earth heritage are not mutually exclusive if properly co-ordinated.

Quarrying and Earth heritage conservation: threats and benefits
Rock exposures created by quarrying and related activities have played a key role in the interpretation of Britain’s geology and have proved vital to the development of the Earth sciences over the last 200 years. Although active quarrying and conservation of the Earth heritage may not appear to be compatible, since quarrying is essentially a destructive process, it has also revealed exposures of rock formations, mineral veins and fossil taxa than would otherwise have been known from natural exposures alone. Therefore, quarrying, and indeed road construction, can be both a threat and a potential benefit to our understanding of the Earth heritage. Co-operation between the extraction industry and conservation interests can strike a mutually beneficial balance.

Of course, even when a site has been selected for Earth heritage conservation, it can still be threatened by, for example, a change in use or natural degradation. Conservation is, therefore, not only a matter of site protection and countering potential threats, but also the active management for the long-term maintenance of the features of special interest.

The history of Earth heritage conservation in Britain
Earth heritage conservation in Britain dates back to the mid-nineteenth century. An early example of the concern to conserve important sites is the action taken to protect Fossil Grove in Glasgow where well-displayed Lepidodendron stumps from the Carboniferous were enclosed in 1887. They are still protected by the Glasgow City Council.

In 1912, the Society for the Protection of Nature Reserves was formed, and gradually there emerged a more systematic approach for identifying sites which merited conservation. In 1941 the Society convened a conference to consider the place of conservation in post-war Britain. The outcome was the establishment of the Nature Reserves Investigation Committee, in 1943. This committee identified no fewer than 390 geological sites in England and Wales. A further 60 sites were identified in a subsequent report on Scotland.
This early work prompted the Government to create the Wildlife Conservation Special Committee (England and Wales) to examine ways in which Government could further support the national nature protection effort. Their report, Conservation of Nature in England and Wales (Cmd 7122, 1947), laid the foundation of nature conservation and recognised a twin approach to nature conservation in which scientific activity developed in parallel with aesthetic and recreational concerns.

In 1949, the Nature Conservancy was created by Royal Charter. The Charter empowered the Nature Conservancy to establish National Nature Reserves for the purposes of nature conservation, including geological and ‘physiographical’ (geomorphological) conservation.

In the same year, Parliament passed the National Parks and Access to the Countryside Act 1949; a milestone in the development of conservation legislation. The Act led to the creation of the National Parks in England and Wales, conferred powers on local authorities to create local nature reserves and required the Nature Conservancy to notify local authorities of the location of Sites of Special Scientific Interest (SSSIs) by reason of their flora, fauna or geological or physiographical features. The prominence of Earth heritage considerations in the thinking of the Committee, and subsequently the Act, owes much to the foresight of Sir Julian Huxley and other members of the Committee. While the Act gave no direct protection to SSSIs, Town and Country Planning legislation provides the means of protecting sites from being destroyed by development.

During the 1950s, 1960s and 1970s, Earth science staff of the Nature Conservancy (1949–73) and then the Nature Conservancy Council (1973–1991) contributed to the development of the SSSI and National Nature Reserve (NNR) series. A significant development in wildlife conservation was the Nature Conservation Review (1977) which evaluated between 1966 and 1970 areas of national biological importance in Britain. The Geological Conservation Review commenced in 1977, to provide a parallel audit of the Earth heritage in Great Britain.

At the same time, much activity by the Nature Conservancy Council was devoted to the local and day-to-day concerns of protecting the sites. This was done largely by participating as consultees in the development control process of the Town and Country Planning Acts. Also during this period, voluntary conservation bodies, notably County Naturalists’ Trusts, established some Earth heritage sites as non-statutory reserves, while further sites were acquired by local authorities as Country Parks or statutory local nature reserves.

The next major step forward was the enactment of the Wildlife and Countryside Act 1981, which improved arrangements for the effective conservation of SSSIs. An additional Earth heritage aspect of the Act, with important implications for landscape conservation, was the provision for Orders to protect areas of limestone pavement.

The Environmental Protection Act 1990 and the Natural Heritage (Scotland) Act 1991 subdivided the Nature Conservancy Council into three country-based organisations – the Countryside Council for Wales, English Nature and Scottish Natural Heritage. This re-organisation reflected the desire to bring nature conservation closer to local people. It also afforded the opportunity for the three organisations to develop independent approaches to the subject. Where common concerns and issues arise, such as in setting common standards of practice, the agencies operate through the Joint Nature Conservation Committee (JNCC). The JNCC also has responsibility for research and advice on nature conservation at both United Kingdom and international levels.

Outside the SSSI network, the protection of Earth heritage sites is undertaken for the most part by voluntary and locally-based groups, often with support from national Earth science societies and institutions. The work of the Geologists’ Association and its regional groups is particularly important, and the GeoConservation Commission of the Geological Society of London is a forum that brings together organisations and groups concerned with Earth sciences and site conservation. Since 1990, voluntary local groups have been established to notify local authorities of Regionally Important Geological and Geomorphological Sites. These RIGS groups have grown rapidly and today exist in all English and Welsh counties. Such groups are also being established in Scotland and Northern Ireland. The work of RIGS groups often involves museums, county wildlife trusts, industry and local authorities, as well as local geologists.

Although RIGS have no statutory status, they can be protected in a most effective way through local initiatives. Local authorities respond positively to protect sites that attract local support and will often accommodate their protection within Local and Structure Plans.
The need to protect Earth heritage sites other than SSSIs reflects a number of factors, particularly the demand for educational sites arising from an increase of interest in the Earth sciences. Other Earth heritage sites, with strong aesthetic rather than scientific appeal, are not specifically protected as SSSIs, but are valuable as a stimulation to raising public awareness and appreciation of geology and geomorphology. If such sites are of local, rather than national, importance, they may be protected by RIGS schemes. Many geological sites are also of local interest and importance for their flora, fauna, archaeology, mining history or amenity value, and they too may be protected as RIGS.

The network of RIGS groups helps to ensure that RIGS are accessible and where appropriate protected, and the RIGS scheme nationwide is of great importance and complements the Geological Conservation Review.

Earth Heritage site protection

The Environmental Protection Act 1990, the Natural Heritage (Scotland) Act 1991, and the National Parks and Access to the Countryside Act 1949 enable the statutory conservation bodies and local authorities to establish and manage, respectively, national and local nature reserves, for the conservation of wildlife and Earth heritage features. Land can be bought or leased for the purpose, or contractual agreements can be reached with the owners and tenants of the land to ensure its protection and proper management. The 1949 Act also enables these bodies to make by-laws to protect the reserves from any type of damage. As a last resort, the statutory conservation bodies and local authorities have a power of compulsory purchase.

Over the years a number of Earth heritage nature reserves has been established, such as Wren’s Nest National Nature Reserve near Dudley, in the West Midlands, which was established as an NNR in 1956 (the first in the United Kingdom for geology). The establishment of the Reserve is in recognition of the exceptional, international importance of the site as a source of Silurian-age fossils. The site has yielded a great variety of fossils in a superb state of preservation, the best of which can be found in museums throughout the world.

However, the 1949 Act recognised that it would be a long time before all important wildlife and Earth heritage sites could be acquired as nature reserves, if ever, and it also contained a provision for the Nature Conservancy (and successors) to notify local planning authorities of important areas which were not yet managed as nature reserves, as Sites of Special Scientific Interest (SSSIs). Once a local authority is notified of an SSSI in its area, it is able to protect the site from adverse development under the controls provided by the Town and Country Planning Acts.

Individual planning decisions are guided by the Structure, Unitary and Local Plans relating to the area under consideration. Of particular relevance are mineral and waste disposal Local Plans.

As well as enabling applications detrimental to conservation interests to be turned down, the Planning Acts enable conditional consent to be granted. Such consents allow development to proceed on or near an SSSI with adequate safeguards to avoid damage to the wildlife or Earth heritage interest of the site.

Planning legislation (Town and Country Planning Act 1990, and the Town and Country Planning (Scotland) Act 1990) also enables local authorities to enter into agreements with developers about how their land should be managed when development has taken place. These agreements are often negotiated in parallel with the consideration of planning consent. An agreement could, for example, require the developer and any subsequent owner to provide access to a geological exposure for educational or research purposes. If access had previously been restricted, such an agreement could be very beneficial.

The Planning Acts, and their associated General Development Orders, require local authorities to consult with the statutory nature conservation bodies before consenting to a development proposal affecting SSSI. Various other statutes place a similar requirement on a range of statutory bodies and public utilities, including the water companies and the National Rivers Authority.

In addition, the Wildlife and Countryside Act strengthened the protection afforded to SSSIs very considerably. This Act requires the statutory nature conservation bodies to inform all the owners and occupiers of an SSSI about the nature of the special interest of the site and of the type of activities which could cause damage to that special interest. Before carrying out any of these activities, an owner or occupier must give the appropriate statutory nature conservation agency at least four months’ notice. This enables the conservation agency to advise the owner or occupier how, if possible, the operation might be carried out without damaging the special interest. If that is not possible a contractual agreement to protect the site may be negotiated. The financial provisions of such an agreement are calculated in accordance with national guidelines.
If an owner or occupier is determined to carry out a damaging activity, and this activity does not require planning consent, the Secretary of State may be asked to make a Nature Conservation Order which extends the period of notice. Such an Order also has the effect of making it an offence for a member of the public to damage the site.

The 1981 Act also contains a provision enabling a Local Authority to make a Limestone Pavement Order, on either landscape or nature conservation grounds, to prevent the removal of rock from limestone pavement areas.

Present legislation is proving to be legally effective. It is equally important, however, that all concerned work closely with owners and occupiers of important sites to promote effective conservation management.

**Earth heritage conservation in practice**

**Conservation strategy**

Once an Earth heritage site has been identified as worthy of special protection measures, a practical conservation management strategy needs to be developed and implemented. This strategy involves elements such as documenting the importance of the site, planning and implementing practical conservation and protection measures, site monitoring and site enhancement. Although developing site management strategies was not part of the Geological Conservation Review, such strategies are a necessary extension of it.

**Classification of site types**

There are two main types of site:

- **Integrity sites** contain finite deposits or landforms which are irreplaceable if destroyed. A typical situation is a glacial landform, of limited lateral extent, such as a kame terrace or esker. Other examples include presently active, and previously active, geomorphological sites caves and karst, unique mineral, fossil or geological feature sites, and some stratotypes.

- **Exposure sites** provide exposures of a rock which is extensive or also well developed below the ground surface. Exposure sites are numerically the more common type and may include exposures in disused and active quarries, cuttings and pits; exposures in coastal and river cliffs; foreshore exposures; mines and tunnels; inland outcrops and stream sections.

The broad conservation principles for these types of site are different. ‘Integrity’ sites are, by definition, finite and irreplaceable. To conserve them a more ‘protectionist’ approach must be adopted. In contrast, the broad conservation principle for exposure sites depends on the maintenance of an exposure, the precise location of which is not always critical. Quarrying may be welcomed under some circumstances because it creates a fresh exposure and progressively reveals new rock surfaces enabling a rock body to be analysed in three dimensions. Similarly, marine erosion is often vital in the creation of fresh rock faces at coastal sites, particularly in softer rock formations.

Conservation management of a geomorphological site depends on whether it is a relict landform or an active process site. Broadly, the requirements for the former will be similar to those for ‘integrity’ geological sites. Management of dynamic environments, however, is more complex, and requires an understanding of geomorphological sensitivity and the capacity of the system to absorb externally imposed stresses.

The consideration of the nature of the site as an ‘integrity’ or ‘exposure’ site helps a fundamental conservation principle to be developed: whether to protect the resource or maintain the exposure. Further general conservation principles can be added by considering the actual type of the site itself – whether it is an active quarry or coastal exposure, for example, where the likely threats, opportunities and problems are different. Finally, site conservation principles will need to take into account the precise location of the feature of special interest within the site. If the feature of interest lies at a cliff base in a quarry, conservation measures should ensure that the foot of the cliff is not obscured, but if the only feature is half-way up the cliff, access to it may actually be improved if sand, shingle or other materials were to be placed at the foot of the cliff.

Using this framework of integrity/exposure site, site-type, and location of the particular feature at a site, it is possible to draw up general conservation principles for different types of site, and provide guidance to conservationists as to the likely threats which may affect them. Building on this, a detailed series of guidelines, the Handbook of Earth Science Conservation Techniques, produced by the NCC (now available
from the Countryside Council for Wales, English Nature and Scottish Natural Heritage) describes conservation guidelines for over 50 site scenarios. However, in order to draw up site-specific conservation plans which detail the measures which are essential to maintain and conserve the interest of a site, and to identify the measures which would enhance it, detailed assessments need to be made at the site itself.

Practical conservation planning and practice involves the following elements:

1. Documenting the special interest of a site
   This may be done by reference to scientific literature, by discussion with experts and by direct observation at the site. For the Geological Conservation Review sites, the Review itself provides the firm foundation for the scientific credentials of a site, and site reports are ultimately documented in Geological Conservation Review volumes. Other documentation schemes are also in operation, such as the National Scheme for Geological Site Documentation, briefly described in The Record of the Rocks, which RIGS groups use as their data source for identifying RIGS sites, and provides a record of geology at sites which can be used for teaching purposes.

2. Preparing a site conservation plan
   Information is required about what activities and processes would impair the interest at the site, how it would deteriorate naturally without intervention, and what action would be desirable, or even essential, to maintain the feature(s) of interest. The general scheme of conservation principles (integrity/exposure, type of site and location of feature(s) at the site) can provide general guidance. This will lead naturally to consideration of what site-specific and practical Earth heritage conservation measures will be needed to ensure that the features of special interest are not obscured, destroyed or damaged, and also to indicate the recommended frequency of monitoring. The country conservation agencies are developing such plans for all Geological Conservation Review sites.

3. Safeguarding the site
   Site management involved:
   - periodic monitoring of the condition of a site in order to anticipate and identify the nature of degradation or damage, and
   - carrying out essential site safeguard measures, and desirable site enhancement operations, in response to the above, for example, site clearance or re-excavation should a feature become obscured.

In the examples below, potential threats at actual sites are described, and practical solutions to some of the problems sites may face are indicated.

**Fossil and mineral collecting and conservation**

The collecting of fossils and minerals is generally regarded as a benign activity which is an integral part of field work. Many specimens are more valuable to science when removed from the rock than they are in situ, provided that they are collected in a responsible manner (see below), properly housed, curated, and made available for use in a suitable museum. An example is an ‘exposure site’ such as a cliff face subject to erosion, where new fossils will be exposed continually as the cliff-line retreats. In this case, the overall fossil resource can be very large, and it is important to collect and record the fossils before they are lost to the sea. However, some rare fossil or mineral reserves are highly localised and have only a limited supply, such as an accumulation of fossil bones in a cave. At such ‘integrity sites’, irresponsible collecting can be very damaging. The conservation of such rare and irreplaceable sites in Britain is becoming increasingly important as they represent a finite, non-renewable resource. In many of these cases, conservation of the site will require that collecting is carefully managed to ensure that the maximum amount of information is gained and the site remains available for appropriate use in the future.

Palaeontological and mineralogical sites differ from many other Earth heritage sites in their management requirements, although they suffer the same potential threats as quarries, cliffs, mines or other outcrops. These threats may involve removal of the resource, or it being obscured by infill, afforestation, slope stabilisation or various constructions. There is also the need to ensure that potentially irreplaceable material collected for research is properly stored and conserved.
The following guidelines constitute good practice (see also JNCC fossil collection statement).

- Obtain permission before collecting on private land, and respect the owner’s wishes.
- Wear appropriate clothing and footwear. A helmet is essential if collecting near cliffs or quarry faces and protective goggles if a chisel or hammer is used. Avoid collecting in dangerous situations. If collecting at the coast, consider tide times prior to the visit. Leave details of the collecting site, and expected time of return, with a responsible person.
- Take only a few representative specimens, and if possible collect only from fallen blocks or loose stones – indiscriminate collecting will diminish the resource for future visitors.
- If removing a specimen from a rock face, make a careful note of its exact position in relation to surrounding rock; a photograph provides a useful reference. Label the specimen, giving details of where and when it was collected.
- If possible, remove a fossil complete with some of the surrounding rock, and protect it in paper or cloth for safe transport.
- Large fossils can be a problem for the individual collectors and could be left for others to see; otherwise seek advice from a local museum. Special equipment and lots of time may be required to excavate large specimens properly.
- Mineral collecting from old mines poses special problems – such as effects of stability of the old working or gas build up. Old workings should only be entered with an organised group with experienced leaders. Mine dumps can be visited with permission, however.

A leaflet published by the Geologists’ Association is available about general conduct and safety on fieldwork.

**Cave conservation**

Caves (and associated karst sites) can be regarded as ‘integrity’ sites, since the features of interest are often irreplaceable. The broad conservation approach is therefore based on protection. The inaccessibility of some of these caves protects them to some extent. However, some very good localities have been lost or damaged due to caving activities, quarrying or collection by amateurs or professional dealers. Other activities can also be highly damaging if unmodified, such as effluent disposal and dumping, and entrance closure. Damage from changes in agricultural practice, water abstraction from boreholes and recreational caving can usually be avoided if the work is sensitively planned and carried out. The use of specific cave conservation plans is one method of addressing the threats to cave sites.

As well as their importance for geology and geomorphology, caves are also of conservation importance for their archaeology and fauna and flora; for example, they provide important hibernacula and breeding sites for several species of bats. In developing conservation plans for caves, the requirements of each type of interest will need to be balanced.

Issues of safety will be of the utmost importance for geologists studying cave sites, and the National Caving Association code of conduct should be followed in this regard. The NCA has also published a National Cave Conservation policy (1995) in association with the statutory conservation agencies, and it describes in detail the issues concerning the conservation of caves.

**Advice on conservation of Earth Heritage sites**

For Geological Conservation Review sites and SSSIs, local planning authorities, statutory bodies, potential developers and owners and occupiers should seek the advice of the relevant statutory nature conservation body before authorising or carrying out a potentially harmful activity at the site, or when planning any improvement to the site.