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## Appendix 2 Geodiversity Guidance for LBAPS

Local Biodiversity Action Plans in Scotland

Sector Guidance Note 1

Geodiversity

Summary

This guidance note explains the link between the physical components of the natural heritage represented by rocks, soils, landforms and active physical processes, and the biological components of the natural heritage represented by biodiversity and biological processes. Landscape and soils are the bridges that link the physical to the biological world. This note focuses on the relationships between:

- features and processes of the physical Earth, and its species and habitats;
- the physical Earth, biodiversity and sustainable development.

Introduction

The geological story of Scotland is all around us in our rocks, soils, landforms, landscapes and active processes. These physical components of the natural heritage, the geodiversity, are closely linked to biological components of the natural heritage, biodiversity, through the relationship between rocks, soils, habitats and species. The relationship is fundamental - most habitats cannot exist without the supporting medium of soils, and soil cannot form without weathering processes acting on the underlying subsoils and rocks.

Rocks, soils and landforms are resources that provide essentials for life. These include water, raw materials for manufacturing and construction, soil for agriculture, land for recreation, and coal, oil and gas for energy. They also support habitats and species, and so are vital for the Earth's biodiversity.

Geodiversity is a dynamic subject - not just old rocks. Animals and plants that are growing today, plants decaying to form peat bogs, and soil washed off the fields during storms are parts of the processes of creating rocks of the future. These processes of rocks first supporting soil development then plant and animal growth, which then decay and become part of the soil and rock formation cycle, are parts of the biodiversity cycle of life. Habitats and species (both now and in the future) cannot exist without this cycle.

Maintaining geodiversity is as important as maintaining biodiversity, since both are fundamentally linked.

Scotland's geological history

Scotland is made up of rocks which have formed over millions of years. Some of the oldest rocks in the Highlands were formed about 3 billion years ago when Scotland sat near the South Pole. Over time, the Scottish landmass drifted north towards the equator. Our coal reserves formed around 300 million years ago. At this time Scotland was sitting at the equator, covered in forests and enjoying a tropical climate. It must have seemed like a greenhouse: the atmosphere at this time contained nearly twice as much carbon dioxide than it does today. As Scotland 'drifted' northwards, red sandstone rocks formed whilst we passed through the northern desert belt.

The dynamic earth forces that drove Scotland north across the globe produced heat and pressure and caused earthquakes and volcanoes. These forces folded, faulted, cooked and stewed our rocks and produced volcanoes such as Edinburgh's Arthur's Seat. Many of the rocks altered or produced by these forces are hard and resistant to erosion. They thus have a strong influence on our landscape.

The rocks that underlie the surface are sometimes exposed on hillsides, in coastal cliffs, in river banks and in artificial excavations such as quarries and road cuttings. Rocks can also be seen in building stones, giving areas their own local architectural distinctiveness. The effects of past land-uses such as mining or quarrying can seem an eyesore, but may provide excellent habitats especially for pioneer species, and have good restoration potential. Quarries also provide excellent locations for recreation and earth heritage interpretation. Some locally distinctive habitats such as the orchids, lycopodium and staghorn mosses on North Addiewell bing in West Lothian, are directly related to mineral extraction.

### Landscape, glacial landforms and associated sediments

Scotland has been covered by thick ice many times in its history. Moving ice rounded the hills and scratched and polished the rocks. It also created the wide straths and glens that today have small 'misfit' streams within them. As ice shaped the existing rocks, it left behind the eroded material (i.e. 'subsoils') as heaps of sand and gravel on the floodplains. These deposits often have distinctive terraced or mound shapes and can be very important for habitat. They are also an important economic resource. However, because the processes that formed them are no longer active, they are a finite resource that cannot be re-created. In the coastal zone, the melting ice left sea levels up to 45 m higher than present. This has left old shorelines inland, well above the current coast.

### Active processes

The surface of our land is constantly changing. Slopes move, rivers erode and waves reshape the coastline. Sudden events like flooding can create problems for land managers. However, they are an important part of the natural cycle and are vital for the formation of some habitats. These include pools in rivers for adult Atlantic salmon and gravel bottomed shallows for spawning and young.

Species that have evolved in dynamic environments are able to withstand the habitat changes caused by sudden events. Fresh water pearl mussels for example, bury themselves deeper into the riverbed when water levels start to rise.

### Soils

Soils are the interface between the physical Earth, habitats, species and biodiversity. Soils are a vital part of our ecosystem that directly influence what kind of plants and animals will live and grow in a given place. Soil distribution dictates vegetation cover and habitats for terrestrial ecosystems.

Soils have been developing since the last ice age ended on a range of materials, including those left by the glaciers. Distinctive geology often leads to particular soils, habitats and species. For example, the acid alpine soils of the Cairngorms and the serpentine soil on Shetland support unusual flora and fauna.

Soil properties such as texture and acidity, dictate what plants will grow. Some soils do not hold moisture well so plants growing in them have to be drought tolerant. Extreme soil conditions such as high calcium carbonate or high organic matter contents, create the unique flora of the Western Isles machair and the extensive peat bogs found throughout Scotland. Peat is a significant long-term store of the greenhouse gas carbon dioxide, so its disturbance and exploitation could have wider impacts.

### Conservation

The physical Earth heritage resource holds information about the history and development of Scotland and the Earth. It also holds information about the development and distribution of native habitats and species. Geo-conservation sites of national and international importance were identified through the Geological Conservation Review process and are known as GCR sites. This review was undertaken over a twenty year period by leading scientists working across the British Isles. Many of the GCR sites they identified are protected as Sites of Special Scientific Interest (SSSIs). Some sites may receive limited protection through the non-statutory designation of a Regionally Important Geological and Geomorphological Site (RIGS).

It is important to remember that our Earth heritage does not just occur within designated sites and that habitats and species can rarely be conserved successfully without reference to the physical Earth heritage.

In order to plan for effective conservation of biodiversity, and understand its variety and mosaic, it is vital to understand the local geodiversity, and include it within the Local Biodiversity Action Plan (LBAP) process. The conservation of geodiversity is as important as that of the soil and what is living and growing on it. Examples of LBAPs where summary maps and accounts of geodiversity have been included are the West Lothian and recently published City of Edinburgh reports. An increased understanding and awareness of the links between biodiversity and geodiversity should lead to increased representation of Earth heritage in future LBAP studies.

## Conclusion

Our complex biodiversity and the magnificent landscape over which it is draped only exist because of the underlying geodiversity. Scotland has evolved through varied geological processes, some of which continue to operate today. The natural landscape change that occurs today is usually related to coastal erosion or river flooding. Whilst these processes are less dramatic than those seen in the past (e.g. when volcanoes were erupting and mountains forming) they are significant for biodiversity, planning and development.

The links between the physical Earth heritage and biodiversity must be understood to enable effective management of habitats and species. Protecting a vulnerable plant or insect community from erosion by the sea will be unsuccessful if it was the erosion processes that first created the habitat niche. An understanding of the earth heritage is also fundamental to the wider goal of sustainable development because Earth heritage features and processes have created many of our important finite resources.

## Earth heritage information

There are a number of organisations that can provide detailed information about the physical

Earth heritage resource in your local area.

- The British Geological Survey is the government agency charged with advancing the geoscientific knowledge of the UK landmass (and adjacent continental shelf) by systematic surveying, long term monitoring and data collection. Part of their mission is 'to meet the needs of the governmental and scientific communities of the UK'. Their 8 Scottish District Geologists are based in Edinburgh and can be contacted for advice and assistance (0131 667 1000).
- Scottish Natural Heritage has a group of Advisory staff also based in Edinburgh who have expertise in Earth Sciences. They can be approached through the local SNH offices.
- The Macaulay Land Use Research Institute in Aberdeen and the Scottish Agricultural College are able to provide information on soil distribution and the relationship between land use, land cover and underlying soil.
- Staff within the Geography, Geology or Earth Science departments of local universities and colleges may also be able to help, and there are also a number of well-qualified independent experts who could provide advice on this subject.

Local RIGS groups undertake some Earth heritage conservation. There are currently RIGS groups in Fife, Lothian and Borders, Highland and Tayside. A Scottish national RIGS association is currently being set up although the UK RIGS Geoconservation Association already exists. Conservation bodies such as Scottish Wildlife Trust and the Royal Society for Nature Conservation have an active interest in geodiversity.

## Further Reading

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