Natural England Commissioned Report NECR051

Geodiversity Action Plans: The use of indicators in progress reporting

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Foreword

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Background

Natural England works to conserve and enhance the natural environment for its intrinsic value, the wellbeing and enjoyment of people and the economic prosperity it brings. Geodiversity is a fundamental part of the natural environment. Natural England has a key role to play in supporting the development of mechanisms through which the conservation, management and promotion of geodiversity can be co-ordinated.

This report forms part of the output from the research project: *Geodiversity Action Plans – Contributions and Measures of Success*. Commissioned research into the progress of Local Geodiversity Action Plans (LGAPs) was undertaken in 2008 which highlighted the need to establishing a consistent approach to LGAP monitoring to both measure progress and demonstrate the success and challenges faced by LGAPs. The UK Geodiversity Action Plan (UKGAP), currently in development, also requires a mechanism for measuring progress against its objectives. This report addresses these needs by:

- reviewing different action planning processes in the UK;
- reviewing monitoring methods used in established LGAPs;
- examining the use of indicators as a way of measuring positive progress for the natural environment; and
- recommending indicators that could be used to measure the progress of both LGAPs and the UK Geodiversity Action Plan.

Since this report was commissioned (in 2009) the new Government has instigated a move away from national indicators and also a move away from regional structures (and indicators) towards a more localised approach. This means that the regional level indicators suggested within the report will now need to be considered within this new context. The introduction of Coalition's vision of a *Big Society* confirms this move towards greater localism and also towards greater voluntary sector involvement. This places increased emphasises on local initiatives such Local Geodiversity Action Plans, giving them greater importance in the future of geoconservation and in the promotion of geology in general.

Natural England is an advocate of LGAPs and is often involved in LGAP partnerships at a local level. Natural England is a member of the UKGAP Group (which steers the development of the UKGAP) and through its work to conserve, manage and promote geodiversity will contribute to the delivery of the UKGAP.

This report forms part of Natural England's contribution to the UKGAP and will be used by the UKGAP Group to inform discussions on measuring the progress of the UKGAP. It will also be used to inform revisions to Natural England's guidance for producing and monitoring the progress of LGAPs.

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Further information

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Summary

Introduction

This report forms part of the output from the research project: *Geodiversity Action Plans – Contributions and Measures of Success*. In 2008, research was undertaken into the progress of Local Geodiversity Action Plans (LGAPs) which highlighted the need to establish a consistent approach to LGAP monitoring to both measure progress and demonstrate the success and challenges faced by LGAPs. The UK Geodiversity Action Plan (UKGAP), currently in development, also requires a mechanism for measuring progress against its objectives.

This report addresses these needs by:

- reviewing different action planning processes in the UK;
- reviewing monitoring methods used in established LGAPs;
- examining the use of indicators as a way of measuring positive progress for the natural environment; and
- recommending indicators that could be used to measure the progress of both LGAPs and UKGAP.

The action planning process

There are over 40 LGAPs in England and these have raised the profile of our geodiversity resource. However, research shows there have been difficulties associated with LGAP implementation and in measuring and promoting their progress. In addition, the UKGAP does not currently have all the facets required to make it a working action plan, which measures success. There is a need to show how local action is contributing to the national recognition, conservation and use of our geodiversity resource and to identify a common monitoring approach for identifying success at both local and national levels.

Action planning is well developed for biodiversity work and is starting to have more prominence within landscape work. It is therefore important to identify overlaps and common areas between landscape, biodiversity and geodiversity action planning, so that activities and reporting are not duplicated. Of particular relevance, a web-based Biodiversity Action Reporting System (BARS) has been developed and the structure developed should be considered in the development of the UKGAP website.

Research has shown that policy recognition for the geodiversity action planning process is only found within England, but that recognition of the wider relevance of geodiversity is found throughout the UK. In order to ensure sustainable use of the geodiversity resource there is a need to build on this recognition. Making use of geodiversity action planning at national and local levels is one method by which this can be achieved.

Monitoring LGAPs

Whilst the layout and design vary within the many LGAPs that have been produced, there are many similarities. Objectives, actions and (in many cases) targets are generally clearly set, together with identified timescales and partners. However, as identified by Haffey (2008), most LGAPs are not truly measuring, reporting or promoting their progress. Only one LGAP shows evidence of an annual review.

The development of a method for identifying progress towards UKGAP objectives could help in encouraging LGAPs to report on their own progress in a similar way and could also demonstrate how they link to the national framework. The internet-based BARS database appears to be widely used within biodiversity action planning and the development of a similar website to disseminate information on successes and

achievements for geodiversity action planning, may also help to encourage progress reporting in this area.

Development of indicators

The current use of indicators at a national level and within relevant disciplines at a variety of levels has been explored. In order to consider the transferability of these existing indicators in relation to: assessing change in geodiversity attributes; policy responses; the progress made towards a UKGAP; and to identify successes and achievements within LGAPs.

An indicator refers to specific characteristics that can be monitored to provide a measurement of changes and trends, often towards a particular goal or target. An indicator quantifies and simplifies so that complex realities can be understood.

National Governments in the UK use performance indicators to assess the contributions to cross-cutting national outcomes or Public Service Agreements (PSAs) and strategic objectives. At a local government level, performance indicators are also used to encourage good management practices in delivering services that meet users' needs and are in accordance with national outcomes.

Indicators have long been employed to assess change in biodiversity (especially, in recent years, within Biodiversity Action Planning) and are now also used to support the UK Sustainable Development Strategy and within Sustainability Appraisals. Most recently, the use of indicators has been explored in relation to landscape studies, the Ecosystems Approach and in geodiversity. However, the development of targets and indicators for both landscape and geodiversity has lagged behind that of biodiversity.

The existing indicator that is most transferable for use within a UKGAP relates to condition assessments of designated sites. Data required for this already exists in Scotland and England and is in a partial form in Wales and Northern Ireland. There is also a commitment to continue to collect this data (and improve coverage in Wales and Northern Ireland) into the future.

Another indicator that includes positive management at local sites of importance for their geodiversity interest is NI 197 within CLG's set of *National Indicators for Local Authorities* in England. Whilst data is currently only collected within England, it may be possible to expand this, in the future, across the UK.

Whilst the selection of indicators will not be definitive until the development of the UKGAP is complete, an initial suggestion for 16 indicators has been made. These indicators are considered to be most useful in reflecting the range of themes covered by the UKGAP. They are, as follows:

- **Theme 1: Furthering the frontiers of geoscience**
    - 1.1) Recognition within Research: The number of refereed research papers relating to UK geodiversity.
- **Theme 2: Influencing planning, environmental policy and development design**
    - 2.1) National Policy Recognition: The number of national-level policy statements, plans and strategies, in which geodiversity issues (and issues relevant to similar disciplines) are formally recognised
    - 2.2) Regional Policy Recognition: The number of regional-scale policy documents, plans and strategies, in which geodiversity issues (and issues relevant to similar disciplines) are formally recognised.
    - 2.3) Local Policy Recognition: The total number of statutory Development Plans in which geodiversity issues (and issues relevant to similar disciplines) are formally recognised.

- 2.4) Organisational Policy Recognition: The number of organisations with a specific geodiversity policy or where geodiversity is recognised within other corporate plans or action plans.
- 2.5) Geodiversity Gain at new Development Sites and Restored Mineral Sites: The total number of sites where geodiversity has been considered within the final design or restoration scheme. This may include, for example: retention of an exposed quarry face, an interpretation board or artwork that links to the surrounding landscape.

- **Theme 3: Gathering and maintaining information on our geodiversity**
  - 3.1) Geological Mapping: The total number of published geological maps at 1:50 000 scale which have been revised (either completely or partially re-surveyed; refitted 1" to 1:50 000 topographic base map; or, where elements have been modelled into a 3-dimensional format).
  - 3.2) Geological Collections: The total number of geodiversity collections available to view by geoscientists and the public.
- **Theme 4: Conserving and managing our geodiversity**
  - 4.1) Designation and Protection of Local Geological Sites: The total number of Local Geological Sites (also known as Local Geodiversity Sites and Regionally Important Geodiversity Sites) formally designated and therefore recognised by local planning authorities as a material consideration to be taken into account in planning decisions.
  - 4.2) Condition of Geological and Geomorphological SSSIs/ASSSIs: The total number of SSSIs designated for their geological or geomorphological features and/or active processes, where the majority (or all) of the site is in favourable condition (Scotland and Wales) or favourable or favourable recovering condition (England and Northern Ireland).
  - 4.3) Positive Conservation Management at Local Geological Sites: The total number of Local Geological Sites (also known as Local Geodiversity Sites and Regionally Important Geodiversity Sites) in the local authority area where positive conservation management has taken place up to five years prior to the reporting date.
- **Theme 5: Inspiring people to value and care for our geodiversity**
  - 5.1) Recognition within Formal Education: The total number of students sitting Geology GCSE (England, Northern Ireland, and Wales) or Geology SG (Scotland) examinations.
  - 5.2) Visits to Sites of Geodiversity Interest: The total number of people visiting a selection of geodiversity places within each of the four UK countries.
- **Theme 6: Sustaining resources for our geodiversity**
  - 6.1) Active LGAPs in Operation: The total number of LGAPs that completed an annual progress report, identifying the actions completed or progressed and which targets and / or objectives were met.
  - 6.2) Funding used for Geodiversity Action Planning: Total funds devoted to geodiversity action planning from a selection of national funding organisations.
  - 6.3) Voluntary Involvement: The total number of people actively involved in a voluntary capacity in geodiversity initiatives within LGAP partnerships and local geoconservation groups.

Conclusions of the report

There is the potential to make use of indicators in reporting progress towards the UKGAP objectives. However, resources would need to be identified to be able to conduct the annual reporting. The use of indicators has precedent and is particularly evident in both National Performance Framework reporting and Biodiversity Action Planning. There are only a few existing indicators for geodiversity within the UK which can be directly used to support the UKGAP, but straight forward monitoring could be achieved by using the desirable indicators identified in this report. Some of these indicators might also be applied to LGAP reporting and help in encouraging progress and promotion of geodiversity action planning at the local level.

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1 Introduction

Introduction

This report forms part of the output from the research project: 'Geodiversity Action Plans – Contributions and Measures of Success'. The research was carried out by Capita Symonds Ltd for Natural England, between November 2009 and March 2010.

The overall purpose of the project is to demonstrate the contribution made by a range of organisations to the UK Geodiversity Action Plan (UKGAP) and to provide a means of consistently recording and monitoring action and achievement. The project will thus play a part in progressing the UKGAP from its current status of 'providing a shared context and direction for geodiversity action in the UK' (UKGAP Group, 2008) towards a 'living document' that celebrates success. Part of the approach will include the development of a UKGAP website to inform, disseminate and provide a forum for discussion.

The structure of this report

Chapter 2 reviews the action planning process and the recognition given in policy for LGAPs and for geodiversity within the wider environment. Chapter 3 provides a brief assessment of the current methods used within LGAPs to review progress and Chapter 4 provides a more extensive account of the use of indicators, including identifying existing indicators that may have relevance for geodiversity. Chapter 5 provides our recommendations for a selection of indicators to use in monitoring progress towards UKGAP objectives.

2 The action planning process

Introduction

This chapter provides a brief summary of the development of the action planning process for geodiversity. In doing so, reference is made to the earlier development of biodiversity action planning and the later development of action planning for landscape. Recognition given to Geodiversity Action Plans (GAPs) and the wider relevance of geodiversity within national policy is also identified.

To provide the background, some definitions of biodiversity, geodiversity and landscape are provided first, together with a brief summary of the Ecosystems Approach which provides an opportunity for a more 'joined-up' consideration of the contribution of the different disciplines.

Definitions of biodiversity, geodiversity and landscape

Biodiversity

The introduction of chapter 15 to Agenda 21 sums up the importance of biodiversity as follows: 'Our planet's essential goods and services depend on the variety and variability of genes, species, populations and ecosystems. Biological resources feed and clothe us and provide housing, medicines and spiritual nourishment. The natural ecosystems of forests, savannahs, pastures and rangelands, deserts, tundras, rivers, lakes and seas contain most of the Earth's biodiversity. Farmers' fields and gardens are also of great importance, while gene banks, botanical gardens, zoos and other germplasm repositories make a small but significant contribution. The current decline in biodiversity is largely the result of human activity and represents a serious threat to human development.'

Article 2 of the Convention on Biological Diversity (CBD) defines biological diversity to mean: 'The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.'

Three levels of biodiversity are apparent from this definition:

- diversity between and within ecosystems and habitats;
- diversity of species; and
- genetic variation within individual species.

Landscape

Landscape protection, management and planning have long been recognised in England as a key element of land use planning at all scales: from National Parks and Areas of Outstanding Natural Beauty (AONBs) to Heritage Coasts and local designations such as Areas of Great Landscape Value (AGLVs).

However, whilst the protection and enhancement (where appropriate) of such designated areas is important, there are also benefits to be gained from using a much broader appreciation of all landscapes (whether urban or rural and in any condition) to inform decision-making. That notion is reflected in the European Landscape Convention (ELC) (2000) which defines landscape simply as: 'an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors'.

Geodiversity

Geodiversity is commonly defined as: 'the natural range (diversity) of geological (rocks, minerals, fossils), geomorphological (landform and processes), and soil features. It

includes their assemblages, relationships, properties, interpretations and systems' (Gray, 2004).

The diversity of geological and geomorphological features provides an invaluable natural heritage – a resource that underpins many aspects of not only the natural environment, but also of society, the economy and where and how people live. Geodiversity is found beneath our feet and within the built environment, and it shapes the landscape around us. It contributed to our industrial past, underpins biodiversity and influences art and design.

In common with biodiversity and landscape, the wider services that geodiversity provides include: training, education and lifelong learning; a contribution to 'sense of place'; recreation and geotourism; aesthetic qualities and wellbeing.

Developing a good understanding of the services which geodiversity provides also contributes to the sustainable management of natural resources (such as mineral extraction) and to our understanding of the Earth's changing natural systems (such as responding to climate change). It also assists in planning for development and land management in a way that avoids or reduces damage to the geodiversity resource and, where appropriate, allows for geodiversity gain within final development design.

The Ecosystems Approach

An Ecosystems Approach provides a basis for a strategic and flexible approach to policy-making and delivery for natural environment ideals. The definition of the Ecosystems Approach under the Convention for Biological Diversity (CBD) is '…a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.' Adopting an ecosystems approach means looking at whole ecosystems during decision-making and valuing the ecosystem services they provide.

An ecosystem, in this context, is described as '…a natural unit of living things (animals, including humans, plants and micro-organisms) and their physical environment. The living and non-living elements function together as an interdependent system' (Defra, 2007).

Within the Ecosystems Approach, 'ecosystem services' are described as the aspects of an ecosystem that have value to people. These extend far beyond 'ecological issues' to include both landscape and geodiversity services. The United Nations Millennium Ecosystem Assessment (MA) groups the services that an ecosystem provides into four main categories:

- **Supporting services (or natural capital)**: services that are necessary for the production of all other ecosystem services, for example, nutrient cycling, soil formation and primary production;
- **Provisioning services**: products that can be obtained from ecosystems, for example, food, fresh water, wood and fibre, fuel and aggregates;
- **Regulating services**: benefits obtained from the regulation of natural processes, for example, climate regulation, flood regulation, disease regulation and water purification; and
- **Cultural services**: non-material benefits, for example, aesthetic, educational, recreational and spiritual.

It is becoming recognised that ecosystem services have often been regarded as 'free goods', which can lead to over-exploitation and subsequently act as a barrier to achieving sustainable development. The Ecosystems Approach can be used as a tool in policy- and decision-making to meet the guiding principle of 'Living within Environmental Limits' - one of five complementary principles which form the basis of the UK Government Sustainable Development Strategy, 2005.

Development of the action planning process

The concept of 'Action Plans' originated in business planning. An action plan breaks down large complex initiatives into an aim, objectives and targets. Within the context of GAPs, this means activities that are going to support understanding, conserving and sustainably using the geodiversity resource.

Biodiversity Action Plans (BAPs)

The use of action plans in relation to environmental conservation first achieved prominence at the Convention on Biological Diversity (CBD) in 1992 to which the UK was one of the many signatories. The UK Government subsequently launched a UK Biodiversity Action Plan (UKBAP) which was seen as establishing a framework dependent on local action. Alongside Habitat Action Plans (HAPs), many Local Biodiversity Action Plans (LBAPS) now exist to guide and promote conservation activity at the local level. The BAP process thus advanced through a 'top-down' approach – with international ratification and a subsequent national framework driving local action.

The overall goal, the underlying principles and the objectives for conserving biodiversity as set out in the UKBAP are shown in Table 1 below.

A web-based database, the Biodiversity Action Reporting System (BARS) was developed in 2005 to support the planning, monitoring and reporting requirements of the UK Biodiversity Action Plan and helps assess progress towards the UK's 2010 biodiversity targets. It enables everyone involved in BAP implementation, including LBAP partnerships and Lead Partner organisations to enter action plans and record progress towards targets and actions. BARS uses drop-down lists and quantitative fields to provide a standardised structure so that individual organisations work can be set in the wider context including improved integration and communication between local and national action plans. Within the database, it is possible to access information on species / habitat targets, status, trends, losses, and threats both at national and local levels.

Table 1 UKBAP goal, principles and objectives

Overall goal
To conserve and enhance biological diversity within the UK and to contribute to the conservation of global biodiversity through all appropriate mechanisms.
Underlying principles
1. Where biological resources are used, such use should be sustainable. 2. Wise use should be ensured for non-renewable resources. 3. The conservation of biodiversity requires the care and involvement of individuals and communities as well as Governmental processes. 4. Conservation of biodiversity should be an integral part of Government programmes, policy and action. 5. Conservation practice and policy should be based upon a sound knowledge base. 6. The precautionary principle should guide decisions.
Objectives for conserving biodiversity
1. To conserve and where practicable to enhance: a. the overall populations and natural ranges of native species and the quality and range of wildlife habitats and ecosystems; b. internationally important and threatened species, habitats and ecosystems; c. species, habitats and natural and managed ecosystems that are characteristic of local areas; d. the biodiversity of natural and semi-natural habitats where this has been diminished over recent past decades. 2. To increase public awareness of, and involvement in, conserving biodiversity. 3. To contribute to the conservation of biodiversity on a European and global scale.

Action planning for landscape

The European Landscape Convention (ELC) held in 2000 produced the first international agreement on landscape, devoted to the protection, management and planning for all landscapes in Europe and became binding in the UK from March 2007. Whilst the Government considered that the UK was already compliant with the requirements of the ELC, it was thought that further actions were needed to raise awareness of existing measures and to make the statutory and regulatory framework fully effective.

In England, a Framework for Implementation of the ELC (Natural England and others, 2009) has since been published and agreed between Defra, English Heritage and Natural England. This framework identified a number of headings or themes (shown in Table 2 below) within which the key measures and actions for ELC implementation can be captured. The need for organisational Action Plans to be initiated was identified and Natural England, English Heritage and the National Forest Company have each produced their first ELC Action Plans. It is intended that these plans should stand as models and encouragement for other organisations.

A 'top-down' approach is therefore also emerging within landscape action planning, although local landscape action plans are currently not being developed. However, landscape work used at the local level includes: the development of Character Areas (CAs); Landscape Character Assessment (LCA) which helps to identify the environmental and cultural features which give an area its 'sense of place' and local distinctiveness; and, for example, the Condition and Quality of England's Landscapes (cQuEL) to identify and develop monitoring of landscape change.

Table 2 ELC framework headings

ELC Framework England - Headings (or Themes)
• Improving Performance within the current legal and regulatory frame • Influencing future legislation, regulation and advice, including contributing to gap analysis • Improving the understanding of landscape character and dynamics, and the monitoring of change and trends • Engaging people through comprehensive and accessible awareness and understanding activities as well as through promotion, education and training • Sharing experiences and best practice

Local Geodiversity Action Plans (LGAPs)

In contrast to the 'top-down' action planning for landscape and biodiversity, the GAP process advanced through a 'bottom-up' approach with the development of many LGAPs and the publication of guidance on company GAPs (cGAPs) from 2003 onwards, prior to the development of a national framework. An English Nature research report (Burek & Potter, 2004a) provided the rationale, drawing on the experience of LBAPs and suggesting models for LGAP development. An English Nature workshop (Burek & Potter, 2004b) to review the progress made by early LGAPs helped to identify some principles of good practice and a guidance note (English Nature, 2004) was subsequently produced.

The guidance note identified that the key components of LGAP development should include:

- an identified geographical boundary;
- partnership working;
- aims and objectives, together with corresponding measurable targets and actions;
- consultation;
- funding; and
- measurement of achievement.

However, a review of LGAP progress commissioned by Natural England (Haffey, 2008) found that, although many LGAPs had been produced and were successful in raising the profile of geoconservation, there were often difficulties associated with their implementation and in measuring and promoting their progress. Those involved in LGAP work cited lack of funding and time constraints as the key issues, particularly as there is a heavy reliance on the voluntary sector. In addition it was noted that, in some areas, there was a lack of commitment from local authorities and other public sector bodies. One of the recommendations of that report, directly relevant to this research, was to establish 'a consistent approach to LGAP monitoring to clearly measure progress. This is critical to demonstrating both the success and challenges faced by LGAPs and how they are making a difference.'

Regional Geodiversity Partnerships

In general, partnership working (including an identified lead partner) has been highlighted as a key component of action plan delivery. Within the field of geodiversity, Regional Geodiversity Partnerships have been established within England to assist partnership working. Regional Geodiversity Partnerships seek to share good geodiversity practice, influence regional policy and establish cross-regional working for geodiversity. Whilst the Geodiversity Partnerships are all at different stages of development and finding their own ways of working, they do have a number of common functions which are:

- to provide a regional network for organisations, groups and individuals involved in geodiversity;
- to provide a regional voice and profile for geodiversity;
- to influence planning, policy development and practice at national, regional or local levels;
- to share good practice; and
- to work to find opportunities for cross-regional activities.

UK Geodiversity Action Plan

In the absence of a European or International 'top-down' driver, for geodiversity, a UK Geodiversity Action Plan (UKGAP) is developing and in its current format provides a 'shared context and direction for geodiversity action' at the national level. It is geared towards supporting, promoting and representing the diverse views and objectives of those who have been involved in local initiatives. Consultation has been extensive and dialogue has occurred across England, Scotland, Wales and Northern Ireland. Natural England took a lead in the development of the UKGAP, alongside a number of other organisations (the UKGAP Group).

The current version of the UKGAP includes an aim, themes (identified at a meeting held on 11 February 2010, those present comprised: Jonathan Larwood and Hannah Townley, Natural England; Jane Poole and Jenny Higgs, Capita Symonds; Graham Worton, Dudley Museum and Art Gallery; and Chris Woodley-Stewart, North Pennines AONB and European Geopark.), objectives and targets. These themes and the associated objectives are still under development but, for the purposes of this report, especially in relation to identifying suitable indicators (see Chapter 4), the themes and anticipated focus of the revised objectives are shown in Table 3 below.

Table 3 Revised themes and objectives for the UKGAP

Themes	Objectives
1. Furthering the frontiers of geoscience	• To foster UK-based pure and applied geoscience research in order to better understand our geodiversity and its role in understanding and managing our natural environment.
2. Influencing planning and environmental policy and development design	• To increase recognition of our geodiversity in international, national, regional and local environmental and planning development policies. • To demonstrate the relevance and benefit of including geodiversity across our work in relation to the natural and built environment and the role that geodiversity plays in sustainable development. • To advocate and support development design and restoration that incorporates and enhances our geodiversity.
3. Gathering and maintaining information on our geodiversity	• To audit and document our geodiversity including sites, archives and collections.
4. Conserving and managing our geodiversity	• To protect our geodiversity through appropriate designation at international, national and local levels. • To maintain and enhance our geodiversity through the management of sites and wider landscapes. • To share experience of conserving our geodiversity through the provision of good practice guidance.
5. Inspiring people to value and care for our geodiversity	• To interpret our geodiversity for a range of audiences and communities, making geodiversity relevant to where we live and the places we visit. • To use the arts to explore and make links between geodiversity and our cultures, involving people in geodiversity in new and innovative ways. • To develop and provide resources that interpret, utilise and widen understanding of our geodiversity as part of formal and informal learning.
6. Sustaining resources for our geodiversity	• To increase the number of people involved in conserving and advocating the value of our geodiversity. • To increase the financial resource that supports action for geodiversity. • To support initiatives that encourage working together for our geodiversity.

Recognition for LGAPs and geodiversity in the wider environment

It is important to note that, whilst the geodiversity action planning process may have advanced through a 'bottom-up' approach, it does have some formal recognition in national policy, particularly within England.

England

Planning Policy Statement 9 (ODPM, 2005), currently being revised, notes that appropriate weight should be attached (by planners) to 'geological interests in the wider environment' as well as to 'designated sites of international, national and local importance' and that opportunities for the incorporation of beneficial geological features within the design of development should be promoted, together with those for biodiversity. The accompanying Guide to Good Practice (ODPM, 2006) explains how this can be delivered through Regional Spatial Strategies (RSS), Local Development Frameworks (LDFs) and through development control procedures. An opportunity therefore exists to include baseline geodiversity indicators in the Sustainability Appraisal process which is part of the LDF process. Local Geodiversity Action Plans are recognised as a 'framework upon which to audit, conserve, manage and promote characteristic geological, geomorphological and soils resources within a particular region or local authority area'.

Significantly, guidance on local sites (Defra, 2006) gives the same weighting to geological and geomorphological sites as it does to wildlife (species and habitats) sites and states that 'LGAPs have also been prepared in some areas and these aim to set local objectives to deliver and promote geological conservation based on knowledge of the existing network of nationally important geological SSSIs (Sites of Special Scientific Interest), RIGS (Regionally Important Geological Sites) and geology in the wider environment.'

In 2009, the Department of Communities and Local Government published a set of *National Indicators for Local Authorities* (CLG, 2009). These include NI 197 (Improved Local Biodiversity – proportion of Local Sites where positive conservation management has been or is being implemented). Whilst not explicitly included in the title, this indicator does include the identification of positive management at Local Geological Sites and recognises that this management may be defined within a GAP.

Wales

In Planning Policy Wales (Welsh Assembly Government, 2002) the following statement clearly makes the link between geology, biodiversity, landform and landscape: 'The natural heritage of Wales includes its geology, land forms and biodiversity and its natural beauty and amenity. It embraces the relationships between landform and landscape, habitat and wildlife, and their capacity to sustain economic activity and to provide enjoyment and inspiration. The natural heritage is not confined to statutory designated sites but extends across all of Wales – to urban areas, the countryside and the coast.' The associated Technical Advice Note (TAN) (Welsh Assembly Government, 2009a) expands on this, directly using the term 'geodiversity' within such statements as: 'Biodiversity and geodiversity add to the quality of life and local distinctiveness' and 'The enjoyment of wildlife and geology provides opportunities for lifelong learning, recreation and tourism'.

Within the TAN, geodiversity within the wider environment is recognised through statements such as: 'The planning system in Wales should help to ensure that development does not damage, or restrict access to, or the study of, geological sites and features or impede the evolution of natural processes and systems especially on rivers and the coast' and 'Development policies and, where appropriate, supplementary planning guidance, should promote opportunities for the incorporation of wildlife and geological features within the design of development and green infrastructure'.

LGAPs are not specifically stated as a mechanism for implementing action concerning the geodiversity resource, although reference is made to examples from the English Guide to Good Practice.

There is also a reference in the TAN to the need to develop indicators, both to identify change in the geodiversity resource ('In developing the overall strategy of a plan, local planning authorities should seek to: ensure that the environmental information base is up to date and is linked to indicators for change in wildlife, habitats and geological features') and in relation to the effectiveness of policy ('the indicators will need to concentrate on the influence of the plan in planning decisions, and the decisions themselves').

Scotland

In Scotland, within the newly reformed planning system, the National Planning Framework (Scottish Government, 2009) recognises, within a section on Landscape and Cultural Heritage, that 'Natural and historic environments help create a sense of place, contribute to the quality of life and are a rich resource for tourism and leisure, our creative industries, education, and national and regional marketing. They can also provide a focus for regeneration. The Scottish Government is committed to protecting, promoting and supporting the sustainable management of these key assets.' Within this section, specific reference is made to European Geoparks, coastal landscapes and seascapes.

The Scottish Planning Policy (Scottish Government, 2010), again within a section on Landscape and Cultural Heritage, includes a footnote which states: 'the natural heritage of Scotland includes flora, fauna, geological and physiographical features, its natural beauty and its amenity (Natural Heritage (Scotland) Act 1991)'. Although the LGAP process is again not explicitly mentioned, it is stated that 'Planning authorities should therefore support opportunities for enjoyment and understanding of the natural heritage'.

The following recognition for local sites, as well as statutorily protected sites is given: 'Local nature conservation sites designated for their geodiversity should be selected for their value for scientific study and education, their historical significance and other cultural and aesthetic value, particularly for their potential for promoting public awareness and enjoyment'. It is also recognised that green space consists of 'any vegetated land or structure, water or geological feature within and on the edges of settlements'.

Northern Ireland

Reference to geodiversity within Northern Ireland planning documents is limited. PPS1 (DoENI, 1998) makes the following statement, which whilst including landscape and soils, excludes geodiversity: 'In working towards sustainable development, the Department will aim to: conserve both the archaeological and built heritage and natural resources (including wildlife, landscape, water, soil and air quality), taking particular care to safeguard designations of national and international importance'.

However, within PPS2 (DoENI, 1997) the geodiversity resource is recognised through statements such as: 'Survival of the entire range of Northern Ireland's wildlife and the maintenance of the full diversity of its geological and physiographical features cannot be achieved solely by site protection but will require the wise management of the total land resource.'

No reference is made to the LGAP process, although these documents were published in the late 1990s (prior to the advance of geodiversity action planning) and planning reform is currently underway in Northern Ireland.

Conclusions

Many LGAPs are in existence and have raised the profile of the geodiversity resource. However, there have been difficulties associated with LGAP implementation and in measuring and promoting their progress. In addition, the UKGAP as it currently stands does not celebrate success or form a working action plan. There is a need to show how local action is contributing to the national recognition, conservation and use of our geodiversity resource and to identify a common monitoring approach for identifying success at both local and national levels.

Action planning is well developed for biodiversity work and is starting to have more prominence within landscape work. It is therefore important to identify overlaps and common areas between landscape, biodiversity and geodiversity action planning, so that activities and reporting are not duplicated. In particular, a web-based Biodiversity Action Reporting System (BARS) has been developed and the structure developed should be considered in the development of the UKGAP website.

Whilst policy recognition for the GAP process is only found within England, recognition of the wider relevance of geodiversity is found throughout the four UK countries. There is a need to build on this recognition and to ensure the sustainable use of the geodiversity resource. Making use of geodiversity action planning at national and local levels is one method by which this can be achieved.

3 Monitoring methods used in LGAPs

Introduction

This chapter considers the range of monitoring methods that have been employed within LGAPs to review progress and to report on success. A number of LGAPs (see Appendix I) where some monitoring and / or updates had been completed were selected for review and a summary of the findings is shown in Table 4.

Monitoring progress within LGAPs

The detailed action plan pages of most LGAPs reviewed use tables to present information. However, the Black Country GAP, Herefordshire and Worcestershire GAP and London GAP all make use of more visually interesting flowcharts.

All the LGAPs reviewed make use of objectives. However, the Dorset GAP uses a number of separate 'mini' GAPs to deal with different work areas and uses objectives only within the context of monitoring (see below). The Black Country GAP also identifies priority work areas. The London GAP Consultation Draft, which was initiated after development on the UKGAP had commenced, aligns the GAP objectives for London with those of the consultation draft UKGAP in order to make the reporting of local geodiversity contributions to the national framework more straightforward.

All LGAPs identify actions and most of these, with the exception of the Black Country GAP, are shown within the main LGAP. Six of the eight LGAPs also made use of targets.

Only two LGAPs indicate a timeframe for the full plan – the North Pennines AONB and European Geopark GAP and the London GAP. However, all LGAPs indicate the partners involved and a timescale for the identified individual actions. The Black Country GAP and London GAP use supporting tables to record this information and similar details are being uploaded to BARS for the Herefordshire and Worcestershire GAPs. Whilst BARS is a way of assisting in progress reporting, it is primarily designed for the BAP process and relates to UKBAP targets and actions. More generally, it would be preferable for progress on GAPs to be reported separately, rather than being subsumed within a BAP.

The Black Country GAP, London GAP and Herefordshire and Worcestershire GAPs also report on 'action status' – whether the task is completed or is underway for example.

The Cornwall and Isles of Scilly GAP has a separate chapter dedicated to 'Monitoring and Evaluation' and is the only GAP that lists indicators against objectives. The Monitoring and Evaluation Plan also identifies a possible mechanism or source of data for using the suggested indictors.

The only complete reporting exercise which is readily available via the internet appears to be the Annual Review of the Dorset LGAP, completed in February 2006. This review provides some detailed text on the actions that were completed within the review period and identifies which LGAP target was met and to which objective this contributed. The review only reported on actions which had progressed, but showed how some activities completed differed from those initially set out in the plan and identified next steps.

Conclusions

Many LGAPs have been produced and whilst layout and design vary, there are many similarities. Objectives, actions and in many cases targets are generally clearly set, together with identified timescales and partners. However, as already identified by Haffey (2008), most LGAPs are not truly measuring, reporting or promoting their progress. In the case of Cornwall and the Isles of Scilly GAP, a thorough monitoring and evaluation plan is suggested (including the use of indicators). However, it has not been implemented due to a lack of resources. To date, only the Dorset GAP shows evidence of an annual review.

The development of a method for identifying progress towards UKGAP objectives could also help in encouraging LGAPs to report on their own progress in a similar way – and could also demonstrate how they are supporting the national framework. The internet-based BARS database appears to be widely used within biodiversity action planning and the development of a similar website to disseminate information on successes and achievements for geodiversity action planning, may also help to encourage progress reporting in this area.

Table 4 LGAP presentation and progress reporting

Plan name	Initial pub. pate	Plan review date(s)	Second pub. date	Main GAP layout	Supporting tables to report on progress	Proposed and actual methods used to monitor progress
Cheshire Region LGAP	Sept 2003	N/A	Aug 2004	• Objective • Target • Action • Potential Partners • Timescale	N/A	It is understood that the LGAP is currently subject to a 'major review' to include more detailed information on the geodiversity of Cheshire and to present the LGAP using 'themes with community actions' rather than 'objectives'. Progress in relation to the initial plan does not appear to be published.
North Pennines AONB and European Geopark GAP	2004	N/A	2010	• Objective • Action • Partners • Timescale • Supports AONB management plan objective	N/A	A period for the initial plan was identified as 2004 – 2009 and for the second Consultation Draft as 2010-1015. Whilst a comprehensive review has been undertaken, progress in relation to the initial plan does not appear to be published.
Dorset LGAP	Feb 2005	Feb 2006	N/A	• Objective • Target • Action • Potential Partners • Timescale • Potential Funding	One annual review was published showing: • Text describing the actions progressed • Objective contributed • Target achieved	The annual Review of the LGAP lists actions completed within the review period and identifies which LGAP target was met and to which objective this contributed. The review only reported on actions progressed. The LGAP has since largely stalled due to lack of resources.

Plan name	Initial pub. pate	Plan review date(s)	Second pub. date	Main GAP layout	Supporting tables to report on progress	Proposed and actual methods used to monitor progress
Black Country GAP	2006	N/A	N/A	• Priority Work Area • Objective • Flowcharts showing ongoing work colour coded according to progress (routine ongoing work, task yet to begin, task underway, task complete)	Separate 'Action Plan' tables are used by the GAP Partnership and show: • Priority • Reasoning • Generic Action • Specific Tasks • Lead Person or Partner Organisation • Other Partners • Timescale • Resources Required	A period for the plan is identified as 2006/2007 with broad priority work areas for 2007/2008 also shown. The plan has not been formally reviewed although it is understood the Action Plan tables are updated each year.
GAP: Cornwall and Isles of Scilly	2005	N/A	N/A	A number of different 'Action Plans' are used rather than Objectives with the following: • Target(s) • Action(s) • Potential Partners/Contacts • Timescale • Priority • Cost Indication	There is a separate chapter in the report showing 'Monitoring and Evaluation' tables which include: • GAP Objective • Indicators • Mechanism / Source of Data • 'Action Plans' monitored	Measureable indicators that can be applied to the GAP objectives and a broad indication of the mechanisms that could be used to collect data are set out in the 'Monitoring and Evaluation' tables. Although it is suggested that the indicators should be measured annually, to date no recording of progress appears to be available.

Plan name	Initial pub. pate	Plan review date(s)	Second pub. date	Main GAP layout	Supporting tables to report on progress	Proposed and actual methods used to monitor progress
GAP: Herefordshire and GAP: Worcestershire	2009	N/A	N/A	The GAP has a loose leaf sheet for each objective showing: • Objective • Action • Action Status (ongoing, underway, to be undertaken)	It is intended that the Biodiversity Action Reporting System (BARS) will be used to report on: • Actions against annual Targets • Start Date and End Date Partners • Priority Rating • Action Status	An Action under Objective 7 is to 'ensure that the GAP is entered onto Biodiversity Action Reporting System (BARS) in order to record progress and encourage the integration of the BAP and GAP.' This action has started although as yet limited information exists. Targets are used within BARS. Under Objective 8, a 5-yearly review of the GAP is suggested and another action identified is to 'create a regular reporting procedure for the GAP'.
Consultation Draft London GAP	2010	N/A	N/A	Flowcharts showing: • Objective • Targets • Actions • Priority (completed, high (by end 2010), medium (by 2011-2012), lower (by 2013))	It is intended that the separate 'Action Plan' tables will be used by the GAP Partnership and show: • Target • Action • Lead London Geodiversity Partner Member • Other London Geodiversity Partner Members • Other Partners • Deadline • Date of Progress • Next Steps	A period for the plan is identified as 2009 to 2013. An annual report is suggested using the underlying Action Plan Tables to demonstrate progress with a full GAP review every 5 years. Action 5.5a states 'Develop an annual reporting procedure for the London GAP (making use of the Action Plan Tables) and a mechanism for a 5-yearly review.'

4 The development of indicators

Introduction

This chapter explores the current use of indicators at a national level, by Government and within relevant disciplines, at a variety of levels. It considers the transferability of these existing indicators in relation to: assessing change in geodiversity attributes; policy responses; the progress made towards a UKGAP; and use within LGAPs to identify successes and achievements.

An indicator refers to specific characteristics that are being monitored to measure changes and trends, often towards a particular goal or target. An indicator quantifies and simplifies and thereby helps in understanding more complex realities.

National Governments in the UK use performance indicators to assess the contributions to cross-cutting national outcomes or Public Service Agreements (PSAs) and strategic objectives. At a local government level, performance indicators are also used to encourage good management practices in delivering services that meet users' needs and are in accordance with national outcomes.

Indicators have long been employed to assess change in biodiversity (especially, in recent years, within Biodiversity Action Planning) and are now also used to support the UK Sustainable Development Strategy and within Sustainability Appraisals. Most recently, the use of indicators has been explored in relation to landscape studies, the Ecosystems Approach and in geodiversity.

A desk-based review of indicators was undertaken as part of this study, and the main sources consulted are listed in Appendix II. Indicators used at a national level (within the sustainable development framework, to monitor progress towards Government strategic outcomes and within the conservation agencies' corporate plans) are first identified, followed by the identification of relevant 'best value' indicators at the local level. The final section considers indicators used to measure change in the natural environment, concentrating on the disciplines of biodiversity, landscape and geodiversity and within the Ecosystems Approach.

Sustainable Development Strategy Framework indicators

There are 20 UK Sustainable Development Strategy Framework indicators which highlight priority areas shared across the UK. However, whilst many indicators include geodiversity considerations (such as: Indicator 2, 'Resource Use' and Indicator 7, 'River Quality'), data directly relating to geodiversity is not specifically gathered.

The shared UK principles for sustainable development should, however, be borne in mind in the development of the UKGAP. These are as follows:

- 'Living Within Environmental Limits: Respecting the limits of the planet's environment, resources and biodiversity – to improve our environment and ensure that the natural resources needed for life are unimpaired and remain so for future generations.
- Ensuring a Strong, Healthy and Just Society: Meeting the diverse needs of all people in existing and future communities, promoting personal wellbeing, social cohesion and inclusion, and creating equal opportunity for all.
- Achieving a Sustainable Economy: Building a strong, stable and sustainable economy which provides prosperity and opportunities for all, and in which environmental and social costs fall on those who impose them (Polluter Pays), and efficient resource use is incentivised.

- Promoting Good Governance: Actively promoting effective, participative systems of governance in all levels of society – engaging people's creativity, energy, and diversity.
- Using Sound Science Responsibly: Ensuring policy is developed and implemented on the basis of strong scientific evidence, whilst taking into account scientific uncertainty (through the Precautionary Principle) as well as public attitudes and values.'

Based on these principles, the priority areas for action that also need to be considered in the development of the UKGAP are: sustainable consumption and production; climate change and energy; natural resource protection and environmental enhancement; and, Sustainable Communities.

National Performance Indicators

England

Within the National Performance Framework there is now one overarching objective and 30 PSAs. PSA 28 '*Secure a healthy natural environment for today and the future*' is being led by Defra and is most relevant to work on geodiversity. However, the 5 key indicators used to measure progress towards delivering PSA 28 do not include reference to geodiversity or even the wider theme of landscape.

A PSA target for SSSIs was set in 2000: '*to bring into favourable or recovering condition (known as 'target condition') 95% of the area of Sites of Special Scientific Interest (SSSIs) in England by December 2010*'. Whilst this is no longer one of the national PSAs, it will still be taken into account, as part of tracking progress on the new cross-Government Natural Environment PSA 28 and remains one of Defra's and Natural England's strategic targets.

Natural England (then English Nature) completed the first round of its condition assessment programme in 2003 to create a baseline for the 95% target. This showed that 56.9% of the total area covered by SSSIs was in target condition at that time. From this baseline, progress milestones have been set and these are reported against annually. Good progress has been made since 2003, with 88.4% of SSSI area in target condition at the end of March 2009 (see Table 5 below). Natural England has indicated that it is possible to interrogate the data to establish a separate figure for geological SSSIs only.

Table 5 Progress towards SSSI Target, England: March 04 to March 09 (Taken from: http://www.defra.gov.uk/rural/protected/sssi/psa.htm [last checked 24 May 2010])

Date	Trajectory Milestone (Percentage of SSSIs in Target Condition)	Actual end of year figure (Percentage of SSSIs in Target Condition)
01 March 2004	62	62.9
31 March 2005	67	67.4
31 March 2006	72	72.3
31 March 2007	78	75.4
31 March 2008	83	82.7
31 March 2009	89	88.4
31 March 2010	93	
31 December 2010	95	

Scotland

The Scottish Government's National Performance Framework has 5 objectives, 15 national outcomes and 45 national indicators. One of the national outcomes has particular relevance to geodiversity:

- 'We value and enjoy our built and natural environment and protect it and enhance it for future generations'.

Four of the 45 national indicators are also relevant. These comprise:

- 'Increase to 95%, the proportion of protected nature sites in favourable condition';
- 'Improve the state of Scotland's Historic Buildings, monuments and environment';
- 'Increase the proportion of adults making one or more visits to the outdoors per week'; and
- 'Improve people's perceptions, attitudes and awareness of Scotland's reputation'.

The first cycle of site condition monitoring was undertaken from 1st April 1999 to 31st March 2005. At the end of the first cycle, 71.5% of natural features were found to be in favourable condition. By the end of March 2009, 78.4% of natural features were assessed as being in a favourable condition, compared to 77.5% at the end of March 2008. Figure 4.1 below shows this trend. SNH has also indicated that it is possible the data to establish a separate figure for geological SSSIs only.

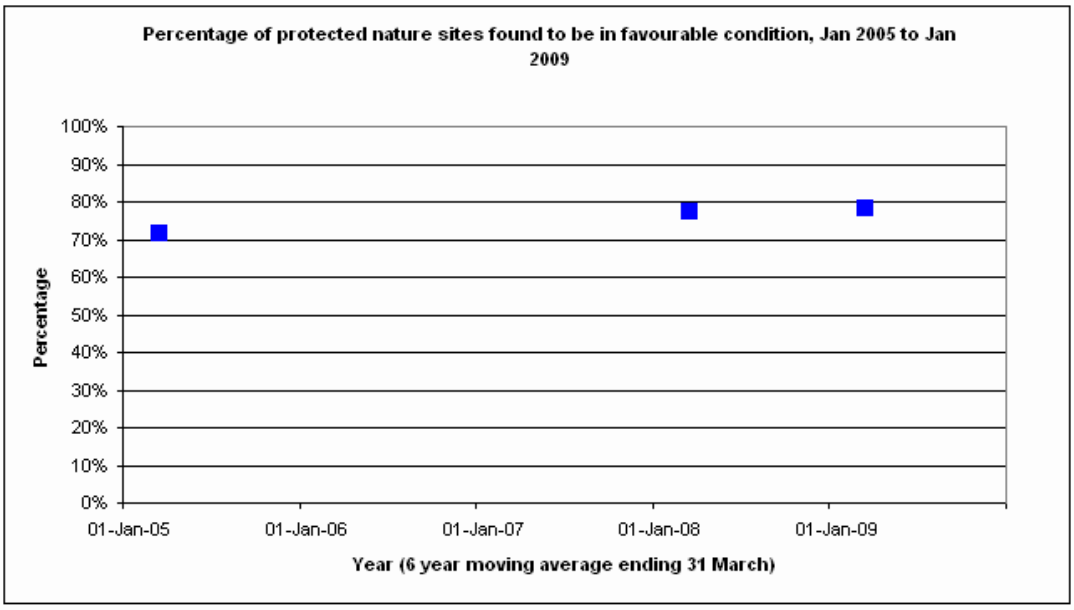

Figure 1 Progress towards Protected Sites Target, Scotland: Jan 05 to Jan 09 (Taken from: http://www.scotland.gov.uk/About/scotPerforms/indicators/natureSites [last checked 24 May 2010])

Wales

The Welsh Assembly Government has recently published a paper (Welsh Assembly Government, 2009b) expanding on 7 areas for action including the development of 19 national outcomes. Currently, information on outcomes and PSAs in Wales appears to be limited. Site condition monitoring in Wales is also incomplete and, to date, has been based on a 'rapid review' of a selection of sites (Countryside Council for Wales, 2006). The target that appears to be used by the Countryside Council for Wales (CCW) is 'sites in favourable condition', with data on geological sites being reported separately.

Northern Ireland

The Government in Northern Ireland has 5 key strategic priorities and 23 PSAs. Two PSAs have particular relevance to geodiversity: The first of these is PSA 22: 'Protecting our Environment and reducing our carbon footprint' with an Aim to: 'Improve the quality of our natural and built environment and heritage and reduce our carbon footprint'. The second is PSA 23: 'Managing the risk of flooding from rivers and the sea' with an Aim: 'To manage flood risk to encourage and support the social, economic and environmental development of Northern Ireland'.

Indicators are not used to measure progress towards these PSAs. Instead, numerous different targets are used, but none of these specifically relates to geodiversity.

Nevertheless, the Sustainable Development Implementation Plan (The office of the first minister and deputy first minister, 2006) puts a commitment on the Northern Ireland Department of Environment to ensure that '95% of the features underlying the designation of internationally important wildlife sites and Areas of Special Scientific Interest (ASSIs) are in, or approaching, favourable conservation condition by 2016.' Published data collected to date (Northern Ireland Environment Agency, 2008) does distinguish between geological and biological ASSIs. However, a full condition assessment has yet to be completed.

Site condition assessment on geological sites is carried out across the four countries using common standards monitoring (Williams, 2006). This provides a direct indicator of one of Scotland's national outcomes and is closely related to the national outcomes in both England and Northern Ireland. All four countries are in the process of gathering data relating to site condition, although coverage is incomplete in Wales and Northern Ireland. However, there are differences in how the data are presented, according to the different national targets and / or indicators. In England and Northern Ireland, data are collected according to 'favourable or recovering condition' for SSSIs only. In Scotland and Wales, data are collected according to 'favourable condition' for a wider range of protected sites. There are also differences in the categories of geological and geomorphological sites used, although it is possible to obtain a separate indicator of condition for all geological SSSIs assessed within each country.

National conservation agencies corporate plans

Each of the national conservation agencies has a corporate plan that expands upon their responsibilities to meet Government outcomes and their remit to promote the care, enjoyment and sustainable use of the natural heritage. Whilst indicators are not proposed to monitor success, some of the common themes running through the corporate outcomes or targets that are relevant to the development of a UKGAP include:

- improving the condition of special sites;
- people having a direct experience of the outdoors;
- protection for marine areas;
- the development of river basin management plans;
- dealing with climate change;
- consideration of the way landscapes integrate people, places and nature; and
- the use of Agri-Environment Schemes.

CCW specifically includes a section entitled 'biodiversity and geodiversity' and states that 'we will support the continued development and implementation of Local Geodiversity Action Plans in Wales.' CCW also promises to deliver from 2008 to 2012 the following: 'Implement a programme of activity to raise awareness within local government of biodiversity and geodiversity issues and responsibilities and to help promote biodiversity into all relevant aspects of local authority business.'

Natural England has two targets specifically relating to landscape and geodiversity. These are Target 1.1.1: 'An understanding of landscape and geodiversity is embedded in more policies and practice affecting England's natural environment at national, regional and local levels and is inspiring increased public engagement' and Target 1.1.2: 'Nationally important landscapes and areas of importance for their geodiversity are conserved and enhanced both through our direct intervention and through our support for partnerships and key stakeholders'.

Scottish Natural Heritage (SNH) has statements referencing the need to promote greater care and make information available on the geological heritage as contributions to corporate outcomes. SNH also refers to European Geoparks in its remit to work with people, places and landscapes.

No direct reference to geological heritage or geodiversity is made within the Northern Ireland Department of Environment's corporate strategy.

Local government best value indicators

As already mentioned in section 2.5.1, CLG's set of *National Indicators for Local Authorities in England* includes NI 197 (Improved Local Biodiversity – proportion of Local Sites where positive conservation management has been or is being implemented). This was the only 'best value' indicator identified for use at the local level that does include recognition of geodiversity.

The rationale behind this indicator is to measure the performance of local authorities by assessing the implementation of positive conservation management of Local Sites. Performance is calculated as a percentage of all Local Sites in the local authority area where positive conservation management has taken place up to five years prior to the reporting date (31 March each year). Good performance is indicated by an increase in the percentage of sites under positive conservation management year on year. The data are expected to be obtained from local records such as those held by the Local Wildlife Trust, the local authority or the Local Records Centre and owned by the Local Sites Partnership. Where a site is designated primarily for its geological features, the recommended activity may be defined within a Geodiversity Action Plan.

Indicators used to measure change in the natural environment

Attributes, criteria and presentation

The Pressure-State-Response (PSR) Model developed by the Organisation for Economic Co-operation and Development (OECD) has gained international prominence and is often used in the development and structure of indicators. The PSR model considers what might be called a number of 'aspects' or 'attributes' of the environment that can be measured by indicators. The model suggests that human activities exert 'pressures' on the environment (such as pollution) that affect its 'state' - as reflected in the quality and the quantity of natural resources (such as variety of species). Society then responds to these changes through the development of policies, and through changes in awareness and behaviour or activities (societal response). Indicators are most commonly used to measure the state of the environment, but can also be used to measure both pressure and response.

The PSR framework is continuing to evolve. An important requirement is the need to clearly differentiate between pressure and state indicators, and the need to expand the framework to deal more specifically with the needs for describing sustainable development. It has been adapted by the European Environment Agency to include two other factors in what is known as the Driver-Pressure-State-Impact and Response Model (DPSIR). 'Driving Forces' are the social, demographic and economic developments in societies and the corresponding changes in lifestyles, levels of consumption and production patterns. 'Impacts' are the result of the change in state of the environment.

It is also important to note that in other parts of the world approaches may also include the use of 'Data Coverage Indicators': the status of knowledge of the natural environment, which governs our ability to ensure the successful conservation of it. For example see Resource Planning and Development Commission (2003) *State of the Environment Tasmania*,kid34ewe see the Geodiversity and Geo-Conservation pages at: http://soer.justice.tas.gov.au/2003/lan/2/issue/77/index.php [last checked 24 May 2010]),

Some of the important criteria identified in literature for selecting indicators are:

- Indicators are important to support claims for causality, such as the links between pressures and environmental conditions.
- Indicators help evaluate performance if a basis for comparison is clearly identified, for example when a target is specified in policy processes.
- Performance measures imply that targets or objectives need to be set (ie something against which performance can be compared).
- Without good data, that is based on sound science and regular monitoring, it is not possible to develop reliable indicators.
- Indicators should be capable of revealing trends and, where possible, permit distinction between human-induced and natural changes.
- Thresholds are perhaps the most important basis of assessment. In general, crossing a clearly defined sustainability threshold should send an obvious message to policy-makers and to society in general.
- Sets of indicators evolve over time and are seldom, if ever, complete.
- Sets of indicators should be representative, small in number and integrate with other reporting requirements to assist in communicating effectively with policy makers and the public.
- Measurement of indicators tends to reduce uncertainty, but do not eliminate it.

In the UK, the trends shown by indicators are presented using the following categories:

- Performance Improving;
- Little or no overall Change / Performance Maintaining / Performance Fluctuating;
- Performance Deteriorating / Worsening; and
- Insufficient or no comparable data or Performance Data currently being collected.

The trend is usually shown by means of a percentage change and displayed in a graph.

Ecosystems Approach

The report: *Reviewing Existing Targets and Indicators for the Ecosystem Approach* (2008), a Defra funded project, made a recommendation for a framework which monitored four different aspects that are not too dissimilar from the PSR model described above. These aspects were as follows:

- The state of different ecosystem types as a proxy for their overall functioning.
- The ecosystem services that are a product of the ecosystem state.
- The pressures acting on ecosystems that cause deterioration in the state, and consequently, the services derived from it.
- Indicators of the interaction between society, the environment and the economy.

It was considered that whilst the currently used suite of indicators in England does provide a good overview of the state of the environment, greater clarity in the definition of ecosystem services would allow for finalisation of recommended indicators.

The assessment also concluded that there are gaps in the data relating to pressures on ecosystems. Additionally, it was identified that targets are not usually based on ecosystem limits - either because of a lack of scientific understanding or because targets are set at pragmatic steps.

Biodiversity Indicators

Within the field of biodiversity, Defra's publication: *UK Biodiversity Indicators in your Pocket* (2009) groups 18 indicators under 6 focal areas aligned to those used by the Convention on Biological Diversity. The 6 focal areas are as follows:

- Status and trends in components of biodiversity;
- Sustainable use;
- Threats to biodiversity;
- Ecosystem integrity and ecosystem goods and services;
- Status of resource transfers and use; and
- Public awareness and participation.

The Scottish Government's publication: *Biodiversity Indicators* (2007) has 17 indicators that describe the state of Scotland's biodiversity and 5 indicators to describe the engagement or response of people to its protection and enhancement. Indicators that deal with pressures on biodiversity are maintained within the Scottish Government's indicator set.

It would appear that, to date, only the indicators relating to trends in UKBAP priority species and habitats are reported within the UK's Biodiversity Action Reporting System (BARS).

'Improved Site Condition' is one of the indicators commonly used in Biodiversity monitoring, providing an overlap with indicators used to measure progress towards national PSAs and the national conservation agency corporate targets. It is important to note that some targets relating to particular habitats, such as lowland raised bog and limestone pavement, also have relevance for geodiversity.

The indicators used to monitor public awareness and the engagement or response of people also have transferability to geodiversity. These include for the UK: 'Volunteer time spent in biodiversity conservation in selected charities' and for Scotland: 'Attitudes to biodiversity'; 'Percentage of total settlement areas covered by Green space policies'; 'Proportion of adult population making visits to the outdoors'; 'Participation in natural heritage volunteering'; and, 'Membership of biodiversity organisations'.

Landscape and geodiversity

A report for the Land Use Policy Group (the Great Britain statutory conservation, countryside and environment agencies): *The Development of Rural Targets and Indicators* (2001) grouped considerations under the following headings, which include assessments of both the state and the response:

- Biodiversity;
- Landscape;
- Basic Resources;
- Earth Heritage;
- Recreation, Access and Amenity;
- Rural Economy;
- Farming and Forestry; and
- Policy Process / Awareness.

The report identified a lack of targets and suitable indicators for both landscape and earth heritage.

In relation to earth heritage, English Nature at that time suggested developing targets that dealt with favourable condition for geological SSSIs, long-term positive management at sites, improved access to sites and improved awareness of the earth heritage resource.

Since publication of the report, whilst there has been development in each of the four countries in relation to assessing change in the landscape, progress in relation to identified national targets or key indicators for landscape has been more limited.

As identified earlier (see section 3.2) the *Geodiversity Action Plan for Cornwall and Isles of Scilly* (2005) includes a suggested monitoring and evaluation plan, which identifies indicators that can be used to monitor progress towards the objectives of the GAP. Some of the indicators identified are really targets (ie they don't constitute specific characteristics that can be monitored to measure trends, but instead relate to the accomplishment of a particular task). However, true geodiversity indicators that were included in the plan, together with actual or suggested mechanisms to collect suitable data, are as follows:

- Increase in number of designated geodiversity sites (Natural England, Cornwall RIGS Group data and local planning authority records).
- Increase in number of SSSIs meeting 'favourable condition' (Natural England).
- Increase in number of County Geological Sites meeting 'favourable management' status or similar (Cornwall RIGS Group data).
- Improved recognition / awareness of geodiversity (From survey data and questionnaires).
- Increase in attendance at geoconservation training events (training course records).
- Decrease in the number of sites lost to development (local planning authority records).
- Increase in the number of conservation volunteers (geodiversity officer records, feedback from other organisations).

A Scottish Natural Heritage commissioned research report (Birch and others, 2009) specifically identified geodiversity themes, attributes and indicators that would be compatible with existing monitoring of the natural heritage in Scotland. The identified themes, attributes and indicators are presented in Table 6 below.

Table 6 Identified Geodiversity Themes, Attributes and Indicators for Scotland

Themes	Attributes	Indicators
State (intrinsic quality, degree of protection and economic value of geodiversity assets in Scotland)	1) PROTECTION	The total number of SSSIs, for which the citation includes geological or geomorphological features; the total number of sites listed as un-notified GCR sites; the total number of RIGS; and the total number of marine protected areas, for which the designation is based upon geological or geomorphological features of interest.
	2a) CONDITION – Geological and Geomorphological Features and Processes	The total number of SSSIs in Scotland designated for their geological or geomorphological features and/or active processes, where the majority (or all) of the site is in favourable condition.
	2b) CONDITION - Coastline	The length of Scottish coastline covered by a coastal or shoreline management plan.
	3) DIVERSITY OF GEODIVERSITY PROVISIONING ECOSYSTEM SERVICES	The diversity (number of different) economically exploited geological commodities from Scottish land based and offshore extractive industry sites.
	4) PERCEIVED QUALITY	The number of visitors to National Parks, National Nature Reserves etc per year whose main reason for visiting was related to landscape or geodiversity qualities.
Engagement (social benefits deriving from geodiversity assets in Scotland)	5) ACCESSIBILITY	The number of designated statutory and non-statutory sites with a geodiversity component that are formally identified in Development Plans and are located partially or wholly within ‘urban areas’.
	6) EDUCATION	The number of students of all ages currently enrolled in Earth Science courses at Scottish schools, colleges and universities.
	7) ACTION	The number of Geodiversity Action Plans currently in force.
	8) VOLUNTARY INVOLVEMENT	The number of people actively involved in geodiversity initiatives in Scotland.
	9) PROFESSIONAL INVOLVEMENT	The number of Scottish-based geological professionals.
Policy Recognition (references in formal policies, plans and strategies which acknowledge the need to protect or otherwise take account of geodiversity assets)	10) NATIONAL POLICY RECOGNITION	The number of national-level policy statements, plans and strategies in Scotland, in which geodiversity issues (and issues relevant to similar disciplines) are formally recognised.
	11) REGIONAL POLICY RECOGNITION	The number of regional-scale policy documents, plans and strategies in Scotland, in which geodiversity issues (and issues relevant to similar disciplines) are formally recognised.
	12) LOCAL POLICY RECOGNITION	The number of statutory Development Plans in Scotland, in which geodiversity issues (and issues relevant to similar disciplines) are formally recognised.

Themes	Attributes	Indicators
Knowledge (the level of shared (ie published) information regarding Scotland's geology, geomorphology and geodiversity initiatives)	13) GEOLOGICAL MAPPING	The percentage coverage of published geological maps at 1:50,000 scale which have been revised within 50 years of the date of assessment and the volume of subsurface geology that has been modelled into 3D format.
	14) AVAILABLE PUBLISHED RESEARCH	The annual number of publications within peer- reviewed scientific journals, which relate to the geology or geomorphology of sites within Scotland.
	15) AVAILABLE PUBLISHED BOOKS & GUIDES	The number of different non-academic books and guides on geology, geomorphology and geodiversity available within Scottish Libraries and bookshops.
Pressures (the extent to which geodiversity is under threat from natural or human causes)	16) DEVELOPMENT PRESSURES	These may include mineral extraction and restoration; landfill; reclamation of contaminated land; commercial and industrial developments; river management and engineering; afforestation and agriculture.
	17) RECREATIONAL PRESSURES	These may include: tourism; outdoor leisure facilities and activities; development and use of footpaths and bridleways.
	18) CLIMATE CHANGE PRESSURES	These may include coastal squeeze and sea-level change; coastal management; changes to active geological or geomorphological processes and changes in the nature and frequency of climatic events.

From the list shown in Table 6, seven priority geodiversity attributes and their indicators were recommended as a sensible selection that reflected the key values of geodiversity. In making this selection, consideration was given to ensuring:

- there was a reasonable spread of attributes across the different themes; and
- the associated indicators for each attribute were measurable either using or modifying existing monitoring tools, or establishing what were considered to be fairly straightforward new monitoring tools.

Attributes were not selected from the 'pressures' theme as methods and tools for assessing the extent to which the geodiversity is under threat at the wider landscape scale are limited. It was considered that further research relating to this theme is required.

The priority attributes and indicators recommended with a summary of the justification for their selection is quoted in full below as many of these indicators, are, with some modifications, directly suitable for identifying progress towards the objectives of the UKGAP.

- **PROTECTION:** The total number of SSSIs, for which the citation includes geological or geomorphological features; the total number of sites listed as un-notified Geological Conservation Review (GCR) sites; the total number of Regionally Important Geological or Geomorphological Sites (RIGS); and the total number of marine protected areas, for which the designation is based upon geological or geomorphological features of interest.
  Reasoning: this indicator is similar to that for 'Condition – Geological and Geomorphological Features and Processes', but looks at the broader scale of statutory and non-statutory designations and sites and is not restricted to SSSIs,

thus giving an appreciation of the wider context of geodiversity. Results will provide information on the degree of action taking place at a range of spatial scales depending on the level of importance of the designation; and data should be relatively easy to collate and interpret.

- **2a) CONDITION:** Geological and Geomorphological Features and Processes: The total number of geological SSSIs in Scotland designated for their geological or geomorphological features and/or active processes, where the majority (or all) of the site is in favourable condition.
  Reasoning: data for this indicator should be relatively easy to collate as part of the existing monitoring framework for the condition of SSSI. The indicator is comparable to the existing equivalent national indicator for biodiversity under the SNHi Trends and Indicators Plan; and a high percentage of sites in 'favourable condition' will be an indicator in itself of successful management planning and practices on the ground.

- **4) PERCEIVED QUALITY:** The number of visitors to National Parks, National Nature Reserves etc. per year whose main reason for visiting was related to landscape or geodiversity qualities.
  Reasoning: this indicator is comparable to the existing equivalent national indicator for biodiversity under the SNHi Trends and Indicators Plan. The existing Scottish Recreational Survey is committed to continue until 2013. The questions in the survey could be given a geodiversity 'spin' to collate the necessary data for this indicator; and there are considerable policy links for promoting and increasing visits to the outdoors, as described in Table 1. It is thought unlikely that there will be significant cost implications for modifying or adding questions to the Recreational Survey. Indeed, it could be considered as a time and cost saving to have the surveys combined in this way.

- **12) LOCAL POLICY RECOGNITION:** The number of statutory Development Plans in Scotland, in which geodiversity issues (and issues relevant to similar disciplines) are formally recognised.
  Reasoning: although this attribute and indicator follow the same principle as the candidate indicators for national and regional policy recognition, success at a local level would suggest success at higher levels in terms of geodiversity objectives filtering down through the hierarchy.

- **6) EDUCATION:** The number of students of all ages currently enrolled in Earth Science courses at Scottish schools, colleges and universities.
  Reasoning: the measurement technique that is eventually used to monitor this attribute has the potential to be applied to any subject or discipline. Data should be easy to collate from such potential sources as the Scottish examination boards and individual Scottish university academic registrars. Positive results from the monitoring of this attribute could encourage greater numbers of field visits (increasing trips to the outdoors and maximising learning opportunities from the natural heritage) whereas more negative results would hopefully raise issues within the education system and look at ways to increase the number of students studying Earth Science courses.

- **8) VOLUNTARY INVOLVEMENT:** The number of people actively involved in geodiversity initiatives in Scotland.
  Reasoning: this indicator is comparable to the existing equivalent national indicator for biodiversity and could be a versatile indicator for other geo-related disciplines. Monitoring data for the attribute would give an indication of the popularity, public interest and publicity of geodiversity; and could highlight the scope and resources available for carrying out or introducing new future initiatives or achieving geodiversity targets, for example, improving the condition of geological and geomorphological SSSIs and increasing the number of visitors to the outdoors.

- **13) GEOLOGICAL MAPPING:** The percentage coverage of published geological maps at 1:50 000 scale which have been revised (either completely or partially re-surveyed; or refitted 1" to 1:50 000 topographic base map) within 50 years of the date of assessment.
  Reasoning: this indicator is a measure of the effort and investment put into furthering geological knowledge. The collation of data to measure the state and trends in the attribute would be simple to undertake from existing BGS records, with the potential to differentiate within the results between bedrock and superficial mapping, for example. There is also scope for geomorphological mapping to be incorporated within the indicator in the future. Negative results from the monitoring and assessment of this attribute could encourage greater investment and funding for the BGS to further improve the geological knowledge base that would support the development of a national policy framework for geodiversity.

Conclusions

The development of targets and indicators for both landscape and geodiversity has lagged behind that of biodiversity.

The existing indicator that has most transferability for use within a UKGAP is that relating to condition assessments at designated sites. The data already exists in Scotland and England and in a partial form in Wales and Northern Ireland. There is also a commitment to continue to collect this data (and improve coverage in Wales and Northern Ireland) into the future.

Another indicator that does include positive management at local sites of importance for their geodiversity interest is NI 197 within CLG's set of *National Indicators for Local Authorities* in England. Whilst data is currently only collected within England, it may be possible to expand this, in future, to the other 3 UK countries.

The work already completed for SNH (Birch *et al*, 2009) is the most comprehensive in its consideration of geodiversity indicators. Whilst this work related specifically to the development of a framework for the strategic assessment of the value and state of Scotland's geodiversity, many of the indicators suggested would also be transferable to the monitoring of progress towards the UKGAP. The *GAP for Cornwall and the Isles of Scilly* (2005) also suggested some suitable indicators that directly relate to geodiversity, and these have overlaps with those identified by Birch *et al* (2009).

The next chapter makes specific recommendations for the use of indicators to monitor progress towards the UKGAP, particularly bearing in mind the principles set out in section 4.6.1 above.

5 Conclusions and recommendations

Introduction

This chapter presents our recommendations for a series of indicators that could be used to measure progress under the themes and objectives of the UKGAP. In making these recommendations, we have identified national indicators that already record successes for the geodiversity resource – thereby making use of existing datasets. We have also identified where suggested geodiversity indicators from existing reports could have relevance to the UKGAP. This particularly includes the assessment completed by Birch *et al* (2009) for SNH and the GAP for Cornwall and the Isles of Scilly. Finally, where new indicators are suggested, we have selected those where it is considered that reasonably straightforward monitoring tools can be used.

It is important to note that the suggested indicators will not only be reporting on the influence of the UKGAP in contributing to the successful conservation, management and use of the geodiversity resource. Other factors too are likely to influence the outcomes, such as the effectiveness of policy; and national and local incentives, including funding.

The indicators are described in terms of 'total numbers' as this is a concept more easily grasped by the majority of people. We suggest that the data are collected annually. However, for consistency between the four national countries (and for consistency with other national indicators) the annual trends in the data would use percentages. An example of the presentation style that could be used to report on the indicators, using imaginary data, is shown in Appendix III.

Table 7 below shows our suggested indicators for each of the themes of the UKGAP that are currently under development (see section 2.4.5 above).

Our recommendations and conclusions follow Table 7. Whilst the definitive selection of indicators cannot be chosen until the detail of the UKGAP is finalised, we have made an initial suggestion for 16 indicators that are considered to be most useful in reflecting the range of themes covered by the UKGAP. The reasoning for selecting these indicators is shown.

Table 7 Recommended indicators for measuring progress towards the objectives of the UKGAP

Themes (Together with the ATTRIBUTES being measured)	Draft objectives	Suggested Indicators	Existing or Desirable Indicator?	Possible Datasets
1. Furthering the frontiers of geoscience (KNOWLEDGE, PRESSURES)	To foster UK-based pure and applied geoscience research in order to better understand our geodiversity and its role in understanding and managing our natural environment.	1.1) RECOGNITION WITHIN RESEARCH: The number of refereed research papers relating to UK geodiversity.	DESIRABLE	The data are expected to be available through the use of academic search engines such as the Science Citation Index and Web of Knowledge.
2. Influencing planning, environmental policy and development design (RESPONSE)	To increase recognition of our geodiversity in international, national, regional and local environmental and planning development policies. To demonstrate the relevance and benefit of including geodiversity across our work in relation to the natural and built environment and the role that geodiversity plays in sustainable development. To advocate and support development design and restoration that incorporates and enhances our geodiversity.	2.1) NATIONAL POLICY RECOGNITION: The number of national-level policy statements, plans and strategies, in which geodiversity issues (and issues relevant to similar disciplines) are formally recognised.	DESIRABLE	The data sources would include national government planning and environment policy documents.
		2.2) REGIONAL POLICY RECOGNITION: The number of regional-scale policy documents, plans and strategies, in which geodiversity issues (and issues relevant to similar disciplines) are formally recognised.	DESIRABLE	The data sources would include: Regional Spatial Strategies and other development plans at the regional level; regional aggregates supply and waste management policies; River Basin Management Plans; and, Shoreline Management Plans.
		2.3) LOCAL POLICY RECOGNITION: The total number of statutory Development Plans in which geodiversity issues (and issues relevant to similar disciplines) are formally recognised.	DESIRABLE	A review of the content of statutory Development Plans at the local level would be required. The data are expected to be held by Local Planning Authorities in each of the four countries.
		2.4) ORGANISATIONAL POLICY RECOGNITION: The number of organisations with a specific geodiversity policy or where geodiversity is recognised within other corporate plans or action plans.	DESIRABLE	A review of organisations and companies with land-holdings would be required, including for example: aggregate companies; The National Trust; and, the National Forestry Company.

Themes (Together with the ATTRIBUTES being measured)	Draft objectives	Suggested Indicators	Existing or Desirable Indicator?	Possible Datasets
		2.5) GEODIVERSITY GAIN AT DEVELOPMENT SITES AND RESTORED MINERAL SITES: The total number of sites where geodiversity has been included within the final design or restoration scheme. This may include, for example: retention of an exposed quarry face, an interpretation board or artwork that links to the surrounding landscape.	DESIRABLE	The data are expected to be held by Local Planning Authorities in each of the four countries. A review of individual planning permissions (including restoration and after-use conditions for mineral sites) would be required.
3. Gathering and maintaining information on our geodiversity (KNOWLEDGE)	To audit and document our geodiversity including sites, archives and collections.	3.1) GEOLOGICAL MAPPING: The total number of published geological maps at 1:50 000 scale which have been revised (either completely or partially re-surveyed; refitted 1" to 1:50 000 topographic base map; or, where elements have been modelled into a 3-dimensional format).	DESIRABLE	The data are expected to be obtained from the British Geological Survey (BGS) database of existing and emerging mapping.
		3.2) GEOLOGICAL COLLECTIONS: The total number of geodiversity collections available to view by geoscientists and the public.	DESIRABLE	The data for collections such as the UK National Building Stone collection and the BGS Mineralogy and Petrology collections are expected to be available from the BGS.
4. Conserving and managing our geodiversity (PROTECTION, STATE and IMPACTS)	To protect our geodiversity through appropriate designation at international, national and local levels. To maintain and enhance our geodiversity through the management of sites and wider landscapes. To share experience of conserving our geodiversity through the provision of good practice guidance.	4.1) DESIGNATION AND PROTECTION OF LOCAL GEOLOGICAL SITES (OR EQUIVALENT): The total number of Local Geological Sites (also known as Local Geodiversity Sites or Regionally Important Geodiversity Sites) formally designated and therefore recognised by local planning authorities as a material consideration to be taken into account in planning decisions.	DESIRABLE	The data are expected to be obtained from local records such as those held by local geoconservation groups, the Local Wildlife Trust, the local authority or the Local Records Centre and owned by the Local Sites Partnership.
		4.2) CONDITION OF GEOLOGICAL and GEOMORPHOLOGICAL SSSIs/ASSSIs: The total number of SSSIs designated for their geological or geomorphological features and/or active processes, where the majority (or all) of the site is in favourable condition (Scotland and Wales) or favourable or favourable recovering condition (England and Northern Ireland).	EXISTING	The data are gathered by and held within each of the four countries nature conservation agencies: Natural England, Scottish Natural Heritage, The Countryside Council for Wales and The Environment and Heritage Service, Department of Environment Northern Ireland.

Themes (Together with the ATTRIBUTES being measured)	Draft objectives	Suggested Indicators	Existing or Desirable Indicator?	Possible Datasets
		4.3) POSITIVE CONSERVATION MANAGEMENT AT LOCAL GEOLOGICAL SITES (OR EQUIVALENT): The total number of Local Geological Sites (also known as Local Geodiversity Sites or Regionally Important Geodiversity Sites) in the local authority area where positive conservation management has taken place up to five years prior to the reporting date (31 March each year).	EXISTING but in England only	The data are expected to be obtained from local records such as those held by the local planning authority (particularly in England where this is one of GLGs performance indicators) but also with local geoconservation groups, the Local Wildlife Trust, the local authority or the Local Records Centre and owned by the Local Sites Partnership. Where a site is designated primarily for its geological features, the recommended activity may be defined within a Geodiversity Action Plan.
		No indicators are currently identified that tackle the issue of the pressures and impacts on geodiversity within the wider landscape. It was identified in the Capita Symonds work for SNH that methods and tools for assessing the extent to which the geodiversity is under threat at the wider landscape scale are limited. It was considered that further research relating to this theme may be required, although ongoing work currently in progress to characterise UK landscapes (such as the Condition and Quality of England's Landscapes) may also develop methods relevant for geodiversity.		
5. Inspiring people to value and care for our geodiversity (RESPONSE)	To interpret our geodiversity for a range of audiences and communities, making geodiversity relevant to where we live and the places we visit. To use the arts to explore and make links between geodiversity and our cultures, involving people in geodiversity in new and innovative ways. To develop and provide resources that interpret,	5.1) RECOGNITION WITHIN FORMAL EDUCATION: The total number of students sitting Geology GCSE (England, Northern Ireland, and Wales) or Geology SG (Scotland) Examinations.	DESIRABLE	The data are expected to be obtained directly from the examination boards.
		5.2) VISITS TO SITES OF GEODIVERSITY INTEREST: The total number of people visiting a selection of geodiversity places within each of the four countries.	DESIRABLE	The participating places selected should ideally be those where visitor data is already directly gathered by site, centre or museum staff. It might be possible to interrogate the data to ascertain the types of visitor – school groups, overseas visitors, business trip etc.

Themes (Together with the ATTRIBUTES being measured)	Draft objectives	Suggested Indicators	Existing or Desirable Indicator?	Possible Datasets
	utilise and widen understanding of our geodiversity as part of formal and informal learning.			
6. Sustaining resources for our geodiversity (RESPONSE)	To increase the number of people involved in conserving and advocating the value of our geodiversity. To increase the financial resource that supports action for geodiversity. To support initiatives that encourage working together for our geodiversity.	6.1) ACTIVE LGAPS IN OPERATION: The number of LGAPs that completed an annual progress report, identifying the actions completed or progressed and which targets and / or objectives were met.	DESIRABLE	The data are expected to be obtained either directly from LGAP partnerships and local geoconservation groups or from a maintained central register held, for example, by GeoConservationUK.
		6.2) FUNDING USED FOR LOCAL GEODIVERSITY ACTION PLANNING: Total funds devoted to local geodiversity action planning from a selection of national funding organisations.	DESIRABLE	It is expected that the data could be obtained directly from the funding bodies.
		6.3) VOLUNTARY INVOLVEMENT: The total number of people actively involved in a voluntary capacity in geodiversity initiatives within LGAP partnerships and local geoconservation groups	DESIRABLE	The data are expected to be obtained directly from LGAP partnerships and local geoconservation groups or from a maintained central register held, for example, by GeoConservationUK.

Recommended indicators

From the longer list of indicators shown in Table 7 above, the suggested indicators for each UKGAP theme are presented below with a summary of the justification for their selection:

- Suggested Indicators for UKGAP Theme 1: Furthering the frontiers of geoscience
    - **1.1) Recognition within research:** The number of refereed research papers relating to UK geodiversity.
      Reasoning: The data should be relatively straightforward to collect from citation indexes or reference databases. It would show the importance of the UK's geodiversity for research purposes.

- Suggested Indicators for UKGAP Theme 2: Influencing planning, environmental policy and development design
    - **2.1) National policy recognition:** The number of national-level policy statements, plans and strategies, in which geodiversity issues (and issues relevant to similar disciplines) are formally recognised
      Reasoning: Success at a national level reflects greater support for geodiversity from national government
    - **2.2) Regional policy recognition:** The number of regional-scale policy documents, plans and strategies, in which geodiversity issues (and issues relevant to similar disciplines) are formally recognised.
      Reasoning: Recognition in regional scale documents and strategy reflects both transfer of national policy and a greater regional acceptance of the importance of geodiversity.
    - **2.3) Local policy recognition:** The total number of statutory Development Plans in which geodiversity issues (and issues relevant to similar disciplines) are formally recognised.
      Reasoning: Success at a local level would suggest success at higher levels in terms of geodiversity objectives filtering down through the hierarchy.
    - **2.4) Organisational policy recognition:** The number of organisations with a specific geodiversity policy or where geodiversity is recognised within other corporate plans or action plans.
      Reasoning: This would show the extent to which national policy and guidance is filtering down into individual organisations.
    - **2.5) Geodiversity gain at new development sites and restored mineral sites:** The total number of sites where geodiversity has been included within the final design or restoration scheme. This may include, for example: retention of an exposed quarry face, an interpretation board or artwork that links to the surrounding landscape.
      Reasoning: As for the Cornwall and Isles of Scilly GAP, an indicator could also be 'the number of geodiversity sites lost to development'. However the positive approach has value in demonstrating greater understanding and 'uptake' by planners and developers and also considers geodiversity more widely rather than limiting consideration to sites only.
- Suggested Indicators for UKGAP Theme 3: Gathering and maintaining information on our geodiversity
    - **3.1) Geological mapping:** The total number of published geological maps at 1:50 000 scale which have been revised (either completely or partially re-surveyed; refitted 1" to 1:50 000 topographic base map; or, where elements have been modelled into a 3-dimensional format).
      Reasoning: This indicator is a measure of the effort and investment put into

furthering geological knowledge. The collation of data to measure the state and trends in the attribute would be simple to undertake from existing BGS records, with the potential to differentiate within the results between bedrock and superficial mapping, for example. There is also scope for geomorphological mapping to be incorporated within the indicator in the future. Negative results from the monitoring and assessment of this attribute could encourage greater investment and funding for the BGS to further improve the geological knowledge base. (Audits are covered within Indicator 4.1 below, being a pre-requisite to the designation of local sites).

- **3.2) Geological Collections:** The total number of geodiversity collections available to view by Geoscientists and the public.
  Reasoning: Geological collections (whether comprising rocks, minerals, fossils, building stone, geological maps or site audit records) provide a key support to our formal education and life-long learning about Earth Science. The continued understanding which can be gained from these materials, about geological processes, products and sites, might be lost if the indicator reveals that collections are not being maintained and made accessible for people to use and learn from. In this way a negative result to this indicator might help to encourage wider promotion and support for these collections. Data about the number of important national and local collections could be made simply available, although it is not currently gathered,

- Suggested Indicators for UKGAP Theme 4: Conserving and managing our geodiversity
  - **4.1) Designation and protection of Local Geological Sites (Or Equivalent):** The total number of Local Geological Sites (also known as Local Geodiversity Sites or Regionally Important Geodiversity Sites) formally designated and therefore recognised by local planning authorities as a material consideration to be taken into account in planning decisions.
    Reasoning: Whilst LGAPs often include an audit of geodiversity sites, progressing to the next step of getting recognition for the local sites of geodiversity interest from the local planning authorities is not always completed. If local sites are not designated, indicator 4.3 below cannot be used. The designation process should include uploading data to a local records centre. Therefore data for this indicator should be readily available, even though it is not currently collected.
  - **4.2) Condition of geological and geomorphological SSSIs/ASSSIs:** The total number of SSSIs designated for their geological or geomorphological features and/or active processes, where the majority (or all) of the site is in favourable condition (Scotland and Wales) or favourable or favourable recovering condition (England and Northern Ireland).
    Reasoning: This indicator is already used in each of the four UK Countries. Therefore data should be relatively easy to collate as part of the existing monitoring framework for the condition of SSSIs / ASSIs. A high percentage of sites in 'favourable condition' will be an indicator in itself of successful management planning and practices on the ground.
  - **4.3) Positive conservation management at Local Geological Sites (Or Equivalent):** The total number of Local Geological Sites (also known as Local Geodiversity Sites or Regionally Important Geodiversity Sites) in the local authority area where positive conservation management has taken place up to five years prior to the reporting date (31 March each year).
    Reasoning: CLG's set of *National Indicators for Local Authorities* in England includes NI 197 ('Improved Local Biodiversity – proportion of Local Sites where positive conservation management has been or is being implemented) which whilst not explicit in the title includes management at Local Geological

Sites. Whilst the data is currently only collected within England, it is anticipated that similar data is held in local record centres or with the local planning authorities in Wales, Scotland and Northern Ireland and local authorities in these countries could still make use of the indicator in their best value performance measures.

- Suggested Indicators for UKGAP Theme 5: Inspiring people to value and care for our geodiversity
    - **5.1) Recognition within formal education**: The total number of students sitting Geology GCSE (England, Northern Ireland, and Wales) or SG (Scotland) Examinations.
      Reasoning: The data should be relatively straightforward to collect from the Examination Boards and shows recognition and enthusiasm for the Earth Sciences within the formal education system.
    - **5.2) Visits to sites of geodiversity interest:** The total number of people visiting a selection of geodiversity places within each of the four countries.
      Reasoning: Comparable to the Scottish biodiversity indicator 'Visits to the Outdoors' but directly specific to places with geodiversity interest. By limiting the dataset to a selection of places, it might be possible to make use of existing data already collected across the UK in relation to visitor numbers.
- Suggested Indicators for UKGAP Theme 6: Sustaining resources for our geodiversity
    - **6.1) Active LGAPs in operation:** The total number of LGAPs that completed an annual progress report, identifying the actions completed or progressed and which targets and / or objectives were met.
      Reasoning: As already identified by Haffey (2008), most LGAPs are not truly measuring, reporting or promoting their progress. This indicator may help to encourage wider promotion and recognition for the work which is being carried out. In addition, a progress report demonstrates that the LGAP is active and therefore must be receiving some financial support or at least identifies that there is a local 'people resource' willing to complete actions.
    - **6.2) Funding used for geodiversity action planning:** Total funds devoted to geodiversity action planning from a selection of national funding organisations.
      Reasoning: Whilst Indicator 6.1 is considered to, in part, identify financial and people resources available for geodiversity action planning, this indicator would more directly identify the support at a national level.
    - **6.3) Voluntary Involvement:** The total number of people actively involved in a voluntary capacity in geodiversity initiatives within LGAP partnerships and local geoconservation groups.
      Reasoning: This indicator is comparable to existing equivalent national indicators for biodiversity. The trends observed would give an indication of the popularity, public interest and publicity of geodiversity; and could highlight the scope and resources available for completing other geodiversity actions such as contributing to the management of local sites and increasing the number of visitors to the outdoors.

Conclusions

There is the potential to make use of indicators in reporting progress towards the UKGAP objectives. However, resources would need to be identified for the annual reporting process. The use of indicators has precedent, and is particularly evident in both National Performance Framework reporting and Biodiversity Action Planning. There are only a few existing indicators for geodiversity within the UK which can be included, but the desirable indicators that are suggested deliberately use straightforward monitoring methods.

6 References

Agenda 21. Available at: http://www.un.org/esa/dsd/susdevtopics/sdt_biodiversity.shtml [last checked 24 May 2010].

Biodiversity Action Reporting System (BARS). Available at: http://www.ukbap-reporting.org.uk/default.asp [last checked 24 May 2010].

Burek, C. & Potter, J. (2004a) *Local Geodiversity Action Plans: Setting the Context for Geological Conservation*, English Nature Research Report 560, ISSN 0967 876X.

Burek, C. & Potter, J. (2004b) *Local Geodiversity Action Plans: Sharing Good Practice Workshop*, Peterborough, 3 December 2003, English Nature Research Report 601, ISSN 0967 876X.

CLG (2009) *National Indicators for Local Authorities and Local Authority Partnerships: Updated National Indicator Definitions.*

Convention on Biological Diversity (CBD) Available at: http://www.cbd.int/convention/convention.shtml [last checked 24 May 2010].

Countryside Council for Wales (2006) *SSSIs in Wales: Current State of Knowledge: Report for April 2005 - March 2006.*

Defra (2006) *Local Sites Guidance on their Identification, Selection and Management.*

Defra (2007) *Securing a healthy natural environment: An action plan for embedding an ecosystems approach.*

DoENI (1997) (The Planning Service, the Department of the Environment Northern Ireland) Planning Policy Statement 2: Planning and Nature Conservation.

DoENI (1998) (The Planning Service, the Department of the Environment Northern Ireland) Planning Policy Statement 1: General Principles.

ELC Action Plans. Available at: http://www.landscapecharacter.org.uk/elc/actionplans [last checked 24 May 2010].

English Nature (2004) *LGAPs: Sharing Good Practice*, ISSN 1 85716 839 9. Available at: www.mineralsandnature.org.uk/downloads/localgeodiversity.pdf [last checked 24 May 2010].

European Landscape Convention (ELC) Available at: http://conventions.coe.int/Treaty/en/Treaties/Html/176.htm [last checked 24 May 2010].

Gray, M. (2004) *Geodiversity: Valuing and Conserving Abiotic Nature*, Wiley & Sons.

Haffey, D. (2008) *Local Geodiversity Action Plans: A review of progress in England*, Natural England Research Reports 027, ISSN 1754 1956.

Natural England, Defra and English Heritage (2009) *European Landscape Convention - A Framework for Implementation in England*. Available at: http://www.landscapecharacter.org.uk/elc/framework [last checked 24 May 2010].

Northern Ireland Environment Agency (2008) *The condition of Northern Ireland's Areas of Special Scientific Interest: the Results of the First Condition Assessment Monitoring Cycle 2002-2008* Research and Development Series No. 08/10.

ODPM (2005) Planning Policy Statement 9 (PPS9): Biodiversity and Geological Conservation, HMSO.

ODPM (2006) Planning for Biodiversity and Geological Conservation: A Guide to Good Practice, HMSO.

Scottish Government (2009) National Planning Framework for Scotland 2, ISBN 978-0-7559-8023-9.

Scottish Government (2010) Scotland Planning Policy, ISSN 1741 1203.

The office of the first minister and deputy first minister (2006) *A positive step: Northern Ireland - A sustainable development implementation plan.*

UK Government (1994) Biodiversity: The UK Action Plan HMSO ISBN 0 10 124282 4.

UK Government (2005) Sustainable Development Strategy, HMSO.

UKGAP Group (2008) *Draft UK Geodiversity Action Plan - a framework for action*. Available at: www.geoconservation.com/GCCdocs/UKGAP/UKGAP1Oct08.doc [last checked 24 May 2010].

United Nations Millennium Ecosystem Assessment (MA). Available at: www.maweb.org [last checked 24 May 2010].

Welsh Assembly Government (2002) Planning Policy Wales, ISBN 0 7504 2854 6.

Welsh Assembly Government (2009a) Technical Advice Note 5: Nature Conservation and Planning, ISBN 978 0 7504 5430 8.

Welsh Assembly Government (2009b) *Better Outcomes for Tougher Times: The Next Phase of Public Service Improvement.*

Williams, J.M. (ed. 2006) *Common Standards Monitoring for Designated Sites: First Six Year Report - Geology*. Peterborough, JNCC.

Appendix 1: Sources used in the review of LGAPs (Chapter 3)

Cheshire Region LGAP (August 2004): Available at: www.crlgap.org.uk [last checked 24 May 2010].

North Pennines AONB and European Geopark GAP 2010-1015 (2010): Available at: http://www.northpennines.org.uk/index.cfm?articleid=5137 [last checked 24 May 2010].

The Dorset LGAP, including the Dorset and Devon World Heritage Site (2005) and *The 1st Annual review of the Dorset LGAP* (February 2006): Available at: http://www.dorsetforyou.com/index.jsp?articleid=328525 [last checked 24 May 2010].

Black Country GAP (2006): Available at: http://www.dudley.gov.uk/environment--planning/countryside/countryside-action-plans [last checked 24 May 2010].

GAP: Cornwall and the Isles of Scilly (2005): Available at: http://www.cornwallwildlifetrust.org.uk/geology/Geodiversity_action_plan [last checked 24 May 2010].

GAP: Herefordshire (2009) and *GAP: Worcestershire* (2009). Available at: http://www.earthheritagetrust.org/blog/LocalGAPs [last checked 24 May 2010].

Poole, J.S., Higgs, J., Harris, K. E. & Birch, J. L. (February 2010) *London's Geodiversity Action Plan 2009 – 2013*. Consultation Draft. Co-ordinated by Capita Symonds with assistance from the London Geodiversity Partnership.

Appendix 2: Sources used in the review of indicators (Chapter 4)

National Performance Indicators

UK Government Sustainable Development Indicators: Defra (2009) *Sustainable Development Indicators in your Pocket*: An update of the UK Government Strategy Indicators. Available at: http://www.defra.gov.uk/sustainable/government/progress/data-resources/national.htm [last checked 24 May 2010].

UK Government Sustainable Development Framework Indicators: Defra (2005) *One Future – Different Paths*, The UK's Shared Framework for Sustainable Development. Available at: http://www.defra.gov.uk/sustainable/government/progress/national/framework.htm [last checked 24 May 2010].

English Government: Public Service Agreements including Indicators. Available at: http://www.hm-treasury.gov.uk/pbr_csr07_psaindex.htm [last checked 24 May 2010].

English Government: 197 National Indicators for Local Authorities: CLG (2009) *National Indicators for Local Authorities and Local Authority Partnerships*: Updated National Indicator Definitions. Available at: http://www.communities.gov.uk/publications/localgovernment/updatednidefinitions [last checked 24 May 2010].

The Scottish Government National Performance Framework: 5 Strategic Objectives, 15 National Outcomes, 45 Indicators. Available at: http://www.scotland.gov.uk/About/purposestratobjs [last checked 24 May 2010].

Welsh Assembly Government: Local Government 20 Best Value Performance Indicators: *The Local Government (Best Value Performance Indicators) (Wales) Order* 2008 No. 503 (W44). Available at: http://www.england-legislation.hmso.gov.uk/legislation/wales/wsi2008/wsi_20080503_en_1 [last checked 24 May 2010].

Northern Ireland Government: Northern Ireland Executive Programme for Government 2008-2011 Annex One PSA Framework. Available at: http://www.pfgbudgetni.gov.uk/psaframework241007.pdf [last checked 24 May 2010].

National conservation agency's corporate plans

Natural England Corporate Plan 2009-2012: Available at: http://naturalengland.etraderstores.com/NaturalEnglandShop/NE188 [last checked 24 May 2010].

Scottish Natural Heritage Corporate Plan 2008/2011: Available at: http://www.snh.org.uk/strategy/pd00.asp [last checked 24 May 2010].

Living within Environmental Limits - The Countryside Council for Wales Corporate Plan 2008-1012: Available at: http://www.ccw.gov.uk/publications--research/corporate-information/corporate-plan-2008-12.aspx [last checked 24 May 2010].

Department of the Environment Northern Ireland Corporate Plan 2008-2011: Available at: http://www.doeni.gov.uk/index/information/foi/recent-releases/publications-details.htm?docid=6958 [last checked 24 May 2010].

Ecosystems Approach indicators

Linstead, C et al (2008) *Reviewing Targets and Indicators for the Ecosystem Approach*, Final Report, Defra Project Code NR0119 Available at: http://randd.defra.gov.uk/Document.aspx?Document=NR0119_7420_FRA.pdf [last checked 24 May 2010].

Biodiversity indicators

United Nations Environment Programme: Bubb, P., Jenkins, J. & Kapos, V. (2005) *Biodiversity Indicators for National Use: Experience and Guidance*, UNEP WCMC Cambridge, UK. Available at: http://www.unep-wcmc.org/information_services/publications/BINU/Experience_and_Guidance.pdf [last checked 24 May 2010].

European Environment Agency: Set of Biodiversity Indicators: European Environment Agency (2007) *Halting the loss of Biodiversity by 2010: Proposal for a first set of Indicators to Monitor Progress in Europe*, EEA Technical Report No 11/2007 ISBN 978-92-9167-931-7 Available at: http://www.eea.europa.eu/publications/technical_report_2007_11 [last checked 24 May 2010].

European Environment Agency (2009) *Progress towards the European 2010 Biodiversity Target*, EEA Technical Report No 4 /2009 ISBN 978-92-9167-993-5 Available at: http://www.eea.europa.eu/publications/progress-towards-the-european-2010-biodiversity-target [last checked 24 May 2010].

UKBAP Action Reporting System (BARS). Available at: http://www.ukbap-reporting.org.uk/ [last checked 24 May 2010].

UK Government: Defra on behalf of the UK Biodiversity Partnership (2007) *Biodiversity Indicators in your pocket.* Available at: http://www.jncc.gov.uk/page-4229 [last checked 24 May 2010].

The Scottish Government (2007) *Scotland's Biodiversity Indicators*, ISBN: 978 0 7559 1600. Available at: http://www.scotland.gov.uk/Publications/2007/10/08091435/0 [last checked 24 May 2010].

Scotland: Scottish Natural Heritage Trends and Indicators. Available at: http://gateway.snh.gov.uk/pls/htmldb_cagdb1/snhlive.tai_disp_template_pkg.display_topic_page?p_cat_id=2 [last checked 24 May 2010].

Rural Indicators including landscape and geodiversity

Land Use Policy Group for the Great Britain Statutory Conservation Agencies: Dwyer, J et al (2001) *The Development of Rural Targets and Indicators*, A report for the Land Use Policy Group by The Institute for European Environmental Policy. Available at: http://www.ukbap.org.uk/library/BIGPapers/RuralIndicatorsPaper.pdf [last checked 24 May 2010].

Landscape Character Network and Landscape Character Assessment Guidance Swanick, C & Land Use Consultants (2002) *Landscape Character Assessment Guidance for England and Scotland*, Countryside Agency and Scottish Natural Heritage publication

Available at: http://www.landscapecharacter.org.uk [last checked 24 May 2010].

The use of indicators for geodiversity

GAP: Cornwall and the Isles of Scilly (2005). Available at: http://www.cornwallwildlifetrust.org.uk/geology/Geodiversity_action_plan [last checked 24 May 2010].

Birch, J., Poole, J.S., Thompson, A & Higgs, J. (2009) *Strategic Assessment of the Value and State of Scotland's Geodiversity: Development of an Attribute Framework for Monitoring and Surveillance*, Scottish Natural Heritage, ROAME No. 4066.

Appendix 3: Fictitious example presentation of indicator trends

Example indicator: Condition of geological and geomorphological SSSIs / ASSIs

The total number of SSSIs/ASSIs designated for their geological or geomorphological features and/or active processes, where the majority (or all) of the site is in 'favourable condition' (Scotland and Wales) or 'favourable or favourable recovering' condition (England and Northern Ireland). NB: numbers used are fictitious values.

	ENGLAND	**WALES**	**SCOTLAND**	**NORTHERN IRELAND**	**UK Total**
Total no. of SSSIs/ASSIs designated for their geological or geomorphological features and/or active processes	700	70	400	400	1,570
Year	No. of designated sites found to be in "favourable" or "favourable recovering" condition				
1995	500	30	250	220	1000
2000	600	45	200	250	1095
2005	550	50	250	275	1125
2010	550	42	300	300	1192
2011	…	…	…	…	…