Dumfries and Galloway
Local Biodiversity Action Plan

Dumfries & Galloway Local Biodiversity Action Plan

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Photographs

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Additional photography: Laurie Campbell www.lauriecampbell.com, Paul Naylor www.marinephoto.org.uk, Steven Round www.stevenround-birdphotography.com, John Bridges www.northeastwildlife.co.uk .

Where possible, the photographs used in this publication have been taken in Dumfries & Galloway. All such photographs are captioned with the place and date that they were taken. Photographs not from Dumfries & Galloway are not captioned with place or date.

Endorsement by the Dumfries & Galloway Biodiversity Partnership

The Dumfries and Galloway Biodiversity Partnership comprises of around 80 local groups, businesses, voluntary organisations and statutory agencies. There is no formal membership or written constitution; any organisation or individual that contributes to achieving the aims and objectives of the Local Biodiversity Action Plan is automatically deemed to be a partner. All partners are committed to understanding, safeguarding, restoring and celebrating biodiversity within the Dumfries and Galloway Council area.

The Partnership is co-ordinated by a Steering Group consisting of around 15 key partners, though membership of the Steering Group is open to all partners. The purpose of the Steering Group is to provide guidance and support to the Biodiversity Partnership in order to make progress on the key strategic biodiversity issues in Dumfries and Galloway. It meets on a quarterly basis, is chaired by an elected chairperson and serviced by the Council's Biodiversity Officer. It has no budget of its own.

The Partnership convenes smaller Working Groups as necessary to address specific issues arising from the Dumfries and Galloway LBAP.

Our Aims

The aims of the Dumfries and Galloway Biodiversity Partnership are:

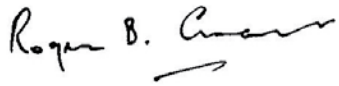
- To identify and address strategic and/or pan-Dumfries and Galloway biodiversity issues.
- To review and monitor biodiversity actions contained within the LBAP, with reference to the Scottish Biodiversity Strategy Implementation Plans.
- To provide a link between local groups and national biodiversity strategies, action plans and reporting procedures.
- To raise awareness and promote biodiversity by championing individual actions and biodiversity issues generally

Our Commitment

In recognition of the above, we the undersigned pledge our co-operation, commitment and support to the implementation of the Dumfries and Galloway Biodiversity Local Biodiversity Action Plan and undertake to use our best endeavours to:

- Take cognisance of the Dumfries and Galloway LBAP in the day-to-day business of our organisations.
- Identify sources of funding to deliver Dumfries and Galloway LBAP.
- Provide guidance and support to other biodiversity partners.
- Monitor and report on progress with the Dumfries and Galloway LBAP.

Dumfries & Galloway Council



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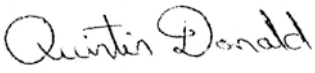

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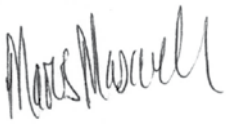

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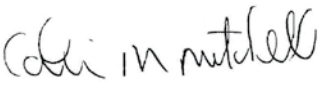

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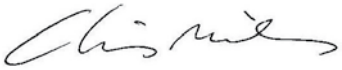

Chris Miles, Area Manager

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Foreword

Dumfries & Galloway has as great a range of biodiversity as you are likely to find anywhere in the UK. With two hundred miles of coastline lapped by the warming influence of the gulf stream, its central position in the British land mass and remarkably varied topography and habitats, the region holds the northernmost of some 'southern' species and the southernmost of some 'northern' species. This 'best of both worlds' bonus applies across a broad spectrum of flora and fauna, including plants, insects and birds. Moreover, this interest encompasses the whole year, with the region being particularly noted for its migrating and wintering waterfowl, including the entire world population of Svalbard barnacle geese, which spend the winter on the Solway - mainly in Dumfries & Galloway.

The term biodiversity was given special significance and prominence at the 1992 Rio `Earth Summit' where the UK and 150 other countries pledged, through the Convention on Biological Diversity, to take local action to look after wildlife and thereby ensure its global sustainability. The resulting publication in 1994 of the UK Biodiversity Action Plan stimulated a plethora of local action plans, including the Dumfries & Galloway Local Biodiversity Action Plan (LBAP). Launched by our partnership in 1999, this was the first comprehensive plan of its kind in Scotland, winning both national and UK awards, and setting a benchmark example for others to follow in the local conservation of biodiversity.

Other sectors and industries had had their plans and strategies for years, but here for the first time was a comprehensive initiative and action plan focusing on maintaining, enhancing and promoting our wonderful wildlife for its own sake, and for the benefit of local people and visitors alike, whilst at the same time contributing to this wider national and international effort as envisaged in Rio.

The achievements of the LBAP are many and varied, but include a superb Environmental Resource Centre, launched by Deputy Minister for Environment and Rural Development Allan Wilson in 2004. This truly first rate community resource receives hundreds of thousands of records and delivers high quality information, training and volunteering opportunities across the region. More than 45 Local Wildlife Sites have been designated and landowners given information and advice to incorporate into their decision making. There has been a significant increase in the restoration of native broadleaves, including riparian planting to benefit salmon. Habitat enhancement has also been undertaken for black grouse and nightjar, whilst there has been significant creation of reedbed and restoration of raised bog. A 'best practice project' has enabled local farmers to establish demonstration sites of good practice in managing for wildlife, whilst biodiversity has been integrated into roadside management by the local authority and the idea picked up nationally, too. Research has been undertaken on merse (saltmarsh) and sparling (a rare fish), whilst vendace, and red kites have been reintroduced into the region.

The LBAP has also benefited wildlife viewing and nature based tourism, with new facilities at Wigtown Bay and the establishment of an annual wildlife festival attracting over 2,000 participants per year. The Galloway Kite Trail was established in 2003 and has made a significant contribution to the local economy as well as encouraging people to enjoy the fantastic spectacle of kites around Loch Ken. These are just some of the achievements of the LBAP; there are many others.

The new LBAP builds on existing achievements and sets out a challenging programme of new actions, reflecting some changes in the national status and priority of species and habitats. For example, the number of priority species found in Dumfries & Galloway is now over 400, and whilst there are existing plans for some of these, naturally they can only be referred to in a document of this size, with more information being available on the web site. Biodiversity remains at considerable threat from land-use and climate changes, and a key challenge for this plan will be to optimise opportunities to maintain and link habitats in ecologically robust networks that can minimise adverse effects on our wildlife in the future.

One of the innovative and exciting aspects of this new plan is recognition that habitats are more than simply collections of species, but also include the physical aspects of the landscape, and what a varied landscape that is! From the grassy heather moors of Langholm and the whaleback hills of Moffatdale, to the shimmering sands of the Solway and increasingly rocky Stewartry coast, back-dropped by the famously rugged grandeur of the Galloway Hills, especially the granite massifs of Criffel, Cairnsmore and the Dungeon Hills. Beyond these to the west lie the magical Machars, Moors and Rhins of Wigtownshire, which have an almost Hebridean quality, bounded as they are by stunning lichened cliffs and shining seascapes. The new LBAP reflects the importance of these physical aspects in a new section on geodiversity, which it is hoped will help to protect and raise awareness of these physical riches upon which our wonderful biodiversity depends.

It is now a statutory duty upon all public bodies to have regard to the protection and enhancement of key biodiversity in the undertaking of their work, and various legislative instruments and processes require rigorous environmental assessment of proposed new developments to ensure this. However, it is local pressure and local action that will deliver the desired halt in biodiversity loss and generate habitat enhancement, and this can only be achieved by continually engaging communities and young people in the wonder and needs of their wildlife. This document plays a key role in this and should therefore be used by everyone, from individuals to large companies and other organisations, as a starting point in learning more about our biodiversity and as a guide in finding out what we can all do to protect and enhance it for future generations to enjoy.

Chris Rollie
RSPB Area Manager

INTRODUCTION

The first edition of the Dumfries & Galloway Local Biodiversity Action Plan (LBAP) was published in June 1999. It was one of the first LBAPs in Scotland and went on to win the Royal Town Planning Institute's Scottish Award for Quality in Planning and the Scottish Silver Green Apple Trophy for Environmental Best Practice.

Since 1999, more than 80 organisations have become part of the Dumfries & Galloway Biodiversity Partnership, and have taken positive action towards LBAP targets. Individuals, land managers, communities, businesses, voluntary environmental groups and statutory agencies have all contributed successful projects, large and small, that have helped protect and enhance the special biodiversity of Dumfries & Galloway.

But much has changed since 1999. This document updates the Dumfries & Galloway LBAP and provides new targets for the years ahead that will enable everyone to further the conservation of biodiversity in the region.

What is Biodiversity?

Biodiversity is short for biological diversity. It simply means the variety of life - the great richness of living things in the natural world, everything from the smallest insect to the largest whale, from tiny toadstools to huge ancient trees. Biodiversity is more than just a few rare animals and plants; it includes the huge array of species and habitats, the genetic variation contained within these, and it includes people.

Making best use of the Dumfries & Galloway Local Biodiversity Action Plan

The Dumfries & Galloway Local Biodiversity Action Plan is intended as a working document to be used by a wide cross section of people to take positive steps to conserve and enhance biodiversity. Different people will use it in different ways, and not all sections will be relevant to everyone. Rather it should be used as a tool to guide conservation action in those areas where the reader can make the greatest difference. For many people this might mean relatively small-scale improvements in the garden; for foresters, farmers, engineers and other land-managers biodiversity improvements will affect greater areas of land; whilst planners and decision-makers will be able to build biodiversity into wider strategic issues. In order to assist with this, the LBAP has been laid out with the following sections:

- **Key Issues** are large-scale issues that will exert a significant influence on biodiversity and its management throughout the lifetime of the plan.
- **Overall Aims** are the key outcomes that the LBAP aims to achieve.
- **Central Objectives** are overarching objectives that will, if implemented, result in significant benefits for all biodiversity across the whole of Dumfries & Galloway. These will be achieved by specific **Central Actions** and/or actions contained in Local Habitat Action Plans.
- **Local Habitat Action Plans** present detailed actions for individual habitats. Semi-natural habitats are classified largely by ecological criteria, whilst highly modified habitats are grouped primarily by different land-uses. However, this is not a scientific classification. Whilst all land in Dumfries & Galloway is covered by at least one action plan, relevant information for some types of habitat may be found in more than one plan. The plans are cross-referenced to facilitate this. Those habitats considered of greatest important for biodiversity are termed Local Priority Habitats.
- **Species Statements** provide an overview of the status, distribution, threats and opportunities for each of the species groups. Unlike the first edition of the LBAP, there are no new detailed Species Action Plans, as the majority of species actions are best achieved through habitat actions. However, the published Species Action Plans from the first edition are still available and will continue to be relevant for much of the lifetime of this second edition. Existing Species Action Plans will be updated and new Species Action Plans published in the future as necessary. Those species considered of greatest importance in the region are termed Local Priority Species.
- **Lead Partners** are identified next to all Central and Habitat Actions. The role of a lead partner is to co-ordinate implementation of an action, but it is expected that other partners will have a role to play in virtually all of the listed actions. As with all local biodiversity action plans, this document is not a statutory requirement and therefore takes a voluntary rather than compulsory approach. Lead partners have committed their support and co-operation to the plan, but uncertainty about future resources and other commitments means that they may not be able to complete all actions.



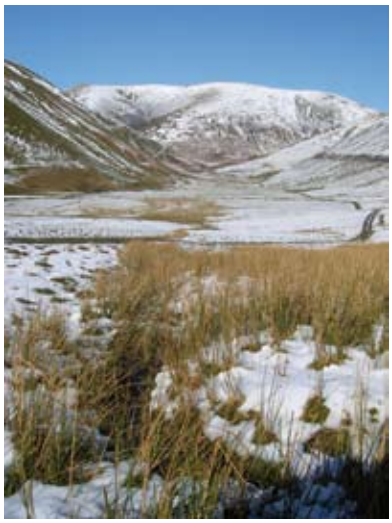

KEY ISSUES

Since the first edition of the Dumfries & Galloway Local Biodiversity Action Plan in 1999, a number of issues have increased in importance. Each will exert a significant influence on management for biodiversity during the lifetime of this LBAP, and probably well into the future.

Climate Change

1. Background

Climate change is undoubtedly a reality. Climate is the 'average weather', including variables such as temperature, rainfall and wind, over a period of time at a particular location. Climate change refers to a significant variation in the average climate, persisting over decades or more. Over the 20th century, global temperatures rose by around 0.7˚C and 1998 was the warmest year since records began in 1861, with 2005 almost as warm.



Snow may become a rare occurrence in future winters. Dalveen Pass March 2008 (Peter Norman)

Some climate change is the result of natural processes, but changes in global climate have also arisen due to human activities that have altered the gaseous composition of the earth's atmosphere. Gases such as water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and ozone (O_3) naturally trap the sun's heat in the earth's atmosphere. In doing so they warm the earth's surface by over 30˚C to a level at which humans and other living things can survive. This is known as the '**greenhouse effect'**. Evidence now points to climate change well in excess of natural trends resulting from increased concentrations of greenhouse gases in the atmosphere since the industrial revolution, primarily from the burning of coal, oil and gas.

The extent to which human and natural systems across the world will be affected will vary greatly from place to place. The government funded Climate Change Scenarios for the United Kingdom was published in 2002. In Scotland it is predicted that:

- Annual temperatures averaged across Scotland will rise. In the worst case scenarios this could be by as much as 3.5˚C in the summer and 2.5˚C in the winter.
- Summers will become generally drier. There may only be a slight reduction in rainfall in the northwest but as much as a 40% reduction in the south and east.
- Winter rainfall will increase by 20-35% in the south, east and northeast.
- Average snowfall amounts will decrease, perhaps by up to 90% depending on location, and snowless winters may become normal in some parts.
- Scotland's sea levels will rise, perhaps by up to 600mm.
- Sea-surface temperatures will increase around the entire Scottish coastline.
- Scotland will have more severe extreme rainfall events, with rainfall from storms in 24 hours up by 25%, expected to occur on average every 2 years, especially in the east.

The impacts of climate change are already being observed in a variety of sectors and some biodiversity changes in Dumfries & Galloway can already be tentatively linked to climate change.

2. Implications

Two approaches to climate change are needed – reducing the net emissions of greenhouse gases into the atmosphere, and adapting to the changes that are already inevitable.

Reducing greenhouse gas emissions is essential to prevent massive losses of biodiversity. The Scottish target is to reduce emissions by 2.7MtC (million tonnes of carbon or carbon equivalent) per year by 2010. We all have a part to play. For example, one tonne of carbon is emitted by every household in Scotland leaving a 40W light bulb on for 6 minutes, or emitted by around 20 return journeys by plane from Edinburgh to London.

The management of land can act as a source of greenhouse gas emissions, but also a carbon sink or store. **Carbon sequestration** is a process or activity that removes carbon from the atmosphere through the uptake of carbon by growing plants - a **carbon sink**. A **carbon store** locks up this carbon in organic matter.

Keeled Skimmer, one of several new dragonfly species to move into Dumfries & Galloway in recent years, probably as a result of climate change. Knockman Wood, July 2007. (Pete Robinson).

On a global scale, the greatest stocks of carbon are stored in rocks and soil (65,000,000 gigatonnes of carbon) and the oceans (39,000 GtC). That stored in forests (550GtC) and other vegetation (1400GtC) is small in comparison. However, some 4000GtC are stored in fossil fuels and are being released (at the rate of 6.3GtC per year in 2003). In the short-term, land-use activities have the greatest capacity to remove some of this additional carbon from the atmosphere.

In Scotland, forestry and other land-uses (excluding agriculture) are currently net carbon sinks. Although they emit greenhouse gases (some 8% of total Scottish emissions in 2003), they absorb much more. Furthermore, the size of this carbon sink has increased from 0.8MtC in 1990 to 1.3MtC in 2003, primarily through forest growth. However, the carbon sink function from forestry can be temporary and dependent on the subsequent use of forest products. Absorbed carbon can be released again through forest fires, diseases, and soil disturbance by forestry operations, including planting. Burning wood fuel results in carbon emissions but the net result can be neutral or positive if the carbon absorbed during its growth is taken into consideration, and the wood fuel substitutes for fossil fuels. Substituting timber and wood products for energy-intensive building materials such as concrete and steel can also result in a neutral or positive net balance of greenhouse gases.

Agriculture is less effective in reducing greenhouse gases than other land-uses (12% of total emissions in Scotland in 2003). The main emissions are nitrous oxide from organic and inorganic fertilisers and methane from livestock, with only a small amount of CO_2 from energy use.

Further contributions to minimising climate change could be achieved by a range of land-use modifications:

- Creating new woodlands on soils of low organic content.
- Establishing woody crops, such as short-rotation coppice, as a renewable energy source.
- Expanding the use of wood as a substitute for energy intensive building materials.
- Reducing timber and food miles.
- Encouraging more permanent ground cover such as species rich grassland, heather moorland, and wood pasture.

- Reducing methane emissions from livestock.
- More efficient use of organic and inorganic fertilisers through better application techniques and nutrient management.
- Providing advice to farmers through the Farm Soils Plan, the TIBRE Handbook (Target Input for a Better Rural Environment), and the PEPFAA Code (Prevention of Environmental Pollution from Agricultural Activity).
- Restoring peat bogs.
- Conserving soil organic matter through erosion control, cover crops, crop rotation, and incorporation of crop residue.
- Installing alternatives to so called 'hard engineering' for flood protection, such as natural flood attenuation, which results in fewer greenhouse gas emissions during construction, and sequestration during operation.

Peatlands lock up more carbon per hectare than any other habitat. Barend Moss, near Laurieston, May 2008. (Peter Norman)

All of the above have the potential to produce significant biodiversity gains, as well as other environmental benefits, if they are correctly located and implemented.

Adapting to the predicted impacts will require many different forms of action, including changes to the planning system, a different response to flood risks, new building design and construction techniques, and the modification of business activities. The net effect of climate change on the biodiversity of Dumfries & Galloway remains uncertain, but the likelihood is that many more species will be lost than gained unless measures can be put in place to allow species to adapt to the anticipated changes.

A few species are capable of rapid movement and adaptation and have become common, but many others occur only in very low numbers over a wide area, even if ideal habitat is available. These species rely on occasional genetic exchange over a large area (the metapopulation concept). Areas of unsuitable habitat act as a barrier to this exchange, resulting in small and isolated colonies that are unsustainable in the long term.

Should climate change produce environmental conditions that are no longer suitable for a particular species, then this scenario will be greatly exacerbated. Many species will be prevented from moving by areas of unsuitable countryside, even if new areas with suitable environmental conditions are created elsewhere. To counteract this, action is needed at two levels. Firstly, the conservation and enhancement of key biodiversity hotspots is essential to strengthen the ability of species and habitats to withstand a changing climate. Secondly, restoration of substantial areas of the countryside between these hotspots will allow species to move from place to place and successfully adapt to climate change.

Continued Biodiversity Loss

1. Background

Pearl-bordered Fritillary butterfly, once widespread in Dumfries & Galloway but now very rare. (Peter Norman)

Biodiversity is naturally dynamic. Natural processes lead to fluctuations in populations, and periodically to extinctions. Since the arrival of Mesolithic man, biodiversity has also been affected, both positively and negatively, by human activities. Our current diversity of species reflects millennia of interactions between people and nature.

In the 18th and 19th centuries, and especially in the 20th century, the rate of change dramatically increased. The net result of intensification of land use and other development pressures in both urban and rural areas was a reduction in semi-natural land, estimated at 17% in the 40 years or so up to 1988. As a consequence of fragmentation or degradation of the remaining semi-natural habitats, populations of many species declined to non-viable levels; others were directly destroyed.

In the last two decades, some declines appear to have been arrested or reversed through habitat restoration or species management. This will not be possible for all habitats and species. Restoration of seabed life for example to some, mostly unknown, pristine condition that pertained prior to exploitation is unachievable. For others, it may take a considerable amount of time to reverse adverse trends, though progress is being made in many cases.

Small White Orchid, nearing extinction in Dumfries & Galloway. (Peter Norman)

Of the 45 priority habitats and 391 priority species covered by the first UK Biodiversity Action Plan, monitoring in 2005 identified the following trends:

- 22% of priority habitats and 11% of priority species were increasing.
- 39% of priority habitats and 27% of priority species were declining, but the decline was slowing for 25% of all habitats and 10% of all species.
- The UK trend was unknown for 24% of priority habitats and 13% of priority species.
- Habitat loss/degradation (particularly due to agriculture and infrastructure development) and global warming were the current or emerging threats of significance to the highest proportion of priority species and habitats.

Whilst at global level, the target is ‘to achieve a significant reduction of the current rate of biodiversity loss’, the one addressed at European Union level, is even more ambitious - to halt the loss of biodiversity by 2010. Overall, whilst some signs are encouraging, there is still more to do to meet the 2010 target.

2. Implications

Many favourable trends in biodiversity have been brought about, or assisted, by political or other strategic level intervention, regulation and the promotion and funding of better land and water management practices. Biodiversity Action Plans have identified vulnerable habitats and species for targeted action, but must continue to tackle the many problems that remain, recognising that new concerns will emerge through time.

Environmental Inequalities

1. Background

Easily accessible greenspace is not evenly distributed. Dock Park, Dumfries, July 2008. (Peter Norman)

Biodiversity offers many opportunities and benefits to people, but there are inequalities in the sharing of these benefits.

Nationally, environmental inequalities are now recognised to affect both urban and rural areas. The most deprived communities are often those most vulnerable to the pressures of poor local environments. They tend to have the poorest access to environmental information and the fewest opportunities for people to participate in decisions affecting their local environments. Much of the research to date has centred on air and water quality as affected by industry, energy and transport, but biodiversity benefits are also unevenly spread throughout society. Environmental inequality studies have also been centred in areas of high population, but inequalities of biodiversity are just as likely to apply in sparsely populated areas such as Dumfries & Galloway.

A study by the Scotland & Northern Ireland Forum for Environmental Research (SNIFFER) in 2005 identified the following issues:

- For industrial pollution, derelict land and river water quality there is a strong relationship with deprivation. People in the most deprived areas are far more likely to be living near to these sources of potential negative environmental impact than people in less deprived areas.
- For landfills and quarries and open cast sites the patterns of relationship between deprivation and population proximity is less distinct, with no evidence at a national scale that deprived populations are more likely to live near to landfill sites, and limited evidence for quarries and open cast sites.
- People living in deprived areas are less likely to live near to areas of woodland. However, areas of new woodland have tended towards deprived populations.
- For greenspace, the analysis showed that both the least and most deprived areas in Scotland have high percentages of people living near to a local designated wildlife site, indicating that there is no simple relationship.
- People living in the most deprived areas are more likely to experience the poorest air quality. Levels of nitrogen dioxide are especially concentrated in the most deprived areas.

2. Implications

Environmental justice aims to secure a fairer future, enabling all individuals and communities to satisfy their basic needs and enjoy a better quality of life without compromising the quality of life of future generations. It is concerned both with local-level environmental problems and larger-scale sources of pollution, and with both the built and natural environments.

Environmental justice in the biodiversity sector should be achieved through quality of life improvements:

- Tackling problems on the ground leading to improvements in local biodiversity.
- Building biodiversity objectives into regeneration.
- Improving biodiversity in greenspaces and the places people live and work.
- Providing access to biodiversity information and biodiversity learning opportunities for all.

Addressing issues of biodiversity inequality should assist in reducing the social and health disparities, and the spreading of biodiversity awareness and education throughout society will result in significant biodiversity gains.

Agricultural and Forestry Change

1. Background

Farming and forestry are the dominant land-uses in Dumfries & Galloway. They are key contributors to the environment, biodiversity and sustainable development, as well as to the well being of rural communities and local economies.

Forest operations. Garrogill, near Moffat, March 2007. (Richard Mearns)

Historically, the land has been farmed and wood products harvested from it for more than 5,000 years. Both activities have always been subject to constant change. Initially they were practised on the same land - only since the 18th century has there been a clear distinction between farming and forestry and an obvious demarcation of land for one purpose or the other. However, the mid-20th century saw a rate of change for both land-uses never experienced before, largely driven by a desire to yield more food and timber. This resulted in an intensification of production, often at the expense of natural ecosystems, which was exacerbated by entry to the European Economic Community in 1973 and the adoption of the **Common Agricultural Policy** (CAP), together with tax incentives that encouraged large scale conifer afforestation. One result of this was that Dumfries & Galloway became the most heavily forested region in the UK, whilst the numbers of sheep on the remaining open ground increased by around 50%. The late 20th century heralded a further change in both international policy and trade, and increasing environmental concerns.

Ploughing. Dumfriesshire, April 2008. (Richard Mearns)

Since publication of the first edition of the LBAP in 1999, changes to both industries have continued at a rapid rate. **Reform of CAP** in 2003 resulted in the 'decoupling' of agricultural support subsidies from production subsidies, removing the incentive to maximise production. Farmers receive Single Farm Payments in return for meeting an agreed standard of agricultural and environmental practice, but they may also qualify for payments in recognition of work done to deliver additional public benefits such as environmental enhancement, better recreational access or improved animal health and welfare. These are delivered through a system of **Rural Development Contracts**. Since 2007 subsidies for the forestry industry are also part of Rural Development Contracts system.

A range of additional issues will result in further changes for both agriculture and forestry:

Traditional breeds, such as Longhorn cattle, are particularly suitable for grazing many semi-natural grasslands. Colvend, July 2007. (Richard Mearns)

- A requirement to contribute towards mitigating climate change. This may lead to, for example, the production of energy crops and conversion of by-products into energy; making more effective use of renewable resources; managing land to minimise carbon loss; managing methane emissions; reducing other greenhouse gases from transport and other activities, and becoming more energy efficient.
- Due to climate change and competition with land used for energy production, there may be greater demand for land to produce food. This may impact on semi-natural land of high biodiversity value.
- Changing international trading arrangements arising from World Trade Organisation agreements. This may have a major impact on prices, whilst increased market access to the European Union may have further consequences for some sectors.
- Financial pressures resulting from the enlargement of the European Union. This may lead to reductions in the level of subsidies and consequent changes to land management.
- New animal and plant diseases, perhaps exacerbated by climate change and globalisation of trade, requiring higher levels of biosecurity.

2. Implications

Agricultural and forestry change will continue to provide many challenges, but it will also provide new opportunities to influence farming and forestry practices for the benefit of biodiversity. For the foreseeable future, Rural Development Contacts will provide the single largest financial input into biodiversity conservation, affecting the greatest area of land in Dumfries & Galloway.

Higher Priority for the Marine Environment

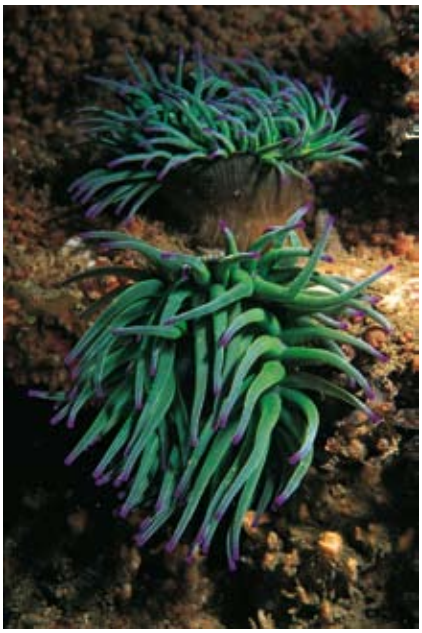
1. Background

Marine and coastal waters are high in biodiversity. They also provide food, recreation and the potential for energy production.

Mauve Stinger Jellyfish. (Paul Naylor)

Nationally, marine policy has a history of haphazard development, presenting a confusing and fragmented management framework to those involved in marine activities. Marine biodiversity and its management have been especially neglected, both in terms of research and public awareness. In Dumfries & Galloway, in comparison to the land, little is known about marine biodiversity and trends. There have been few projects specifically aimed at managing and enhancing marine biodiversity.

Recent initiatives have begun to address these issues, examining how activities interrelate, and aiming to strike the right balance between social, economic and environmental considerations. These initiatives have been driven by the increasing range of potential impacts, including climate change, sea-level rise, renewable energy, commercial fisheries/aquaculture, exploitation of mineral resources, shipping, coastal/marine development, waste disposal and tourism and recreation.



Snakelocks Anemone, mainly restricted to the west coast of Britain including The Rhins. (Paul Naylor)

2. Implications

At a UK and Scottish level new management framework options for the sustainable development of marine resources have been discussed, including a draft Scottish Marine Bill, published in 2008. This is likely to result in policy and legislation changes within the lifetime of this LBAP.

Future changes to marine policy and legislation may result in:

- The establishment of a larger network of nationally important marine protected areas. Locally, Dumfries & Galloway has two marine areas protected under European legislation, at Luce Bay and in the inner Solway. Options for establishing a coastal and marine national park have also been explored.
- The introduction of a marine spatial planning system that guides how and where we use and exploit the sea including fishing, oil and gas exploration, offshore wind development, shipping and coastal development, to avoid conflicts between different users and prevent damage to marine biodiversity.
- Reforms in the laws governing inshore fisheries to provide a viable and sustainable future for fish stocks and fishermen.
- Strengthened laws to protect vulnerable marine species and habitats. For example, a marine wildlife watching Code of Practice has recently been introduced under the Nature Conservation (Scotland) Act 2004.

Flabellina pedata, one of several colourful sea slugs found in coastal waters. (Paul Naylor)

Higher Standards of Water Quality

1. Background

Good quality water is of fundamental importance to biodiversity.

Prior to the rapid agricultural and industrial changes of the 1800s, Scotland's rivers were generally of very good quality. The deterioration of river water quality throughout the 19th and 20th centuries was mainly caused by the discharge of sewage and changes in agricultural and industrial practices that accompanied the economic lifestyle of the time. Significant efforts to restore Scotland's rivers did not occur until the 1960s. Reductions in heavy industry, the enforcement of new legislation and heightened environmental awareness all contributed to improvements in water quality.

The aquatic larvae of stoneflies are good indicators of clean water. (Peter Norman)

In Galloway, acidification of freshwaters increased during the early and mid 20th century. High levels of acidifying pollutants, including oxides of sulphur and nitrogen arising from the burning of fossil fuels and ammonia from intensive livestock rearing, were deposited from the atmosphere. The thin soils overlying hard, slow-weathering rocks had little capacity to neutralise the acidity, and the problems were exacerbated by extensive forestry, as mature coniferous forest filters pollutants from the atmosphere which are then washed into surrounding watercourses. This resulted in acidification of surface waters and significant damage to aquatic ecology. From the end of the 1970s reduced levels of pollutants resulted in a substantial decrease in acidic deposition, followed by more stable concentrations from the 1990s. Attempts have been made to mitigate the effects of acidification, for example by liming of Loch Dee, though such measures cannot provide long-term solutions to the problem. Modifications to forest practice have also reduced the impact, but parts of Galloway remain affected by acidification.

Eutrophication, or nutrient over-enrichment, affected soils and watercourses in Dumfries & Galloway during the 20th century and remains a problem in many freshwaters. Soils have become overloaded with phosphates as a result of nutrient inputs from slurry and fertiliser, together with nutrient-loading from other sources such as sewage treatment works and rural dwellings. These nutrients reach waterbodies through point discharges, such sewage outfalls or farm waste pollution incidents, or more insidiously by percolation through soils, often referred to as diffuse pollution. Eutrophication causes loss of critical water quality resulting in reductions in biodiversity. The development of farm nutrient budgeting is beginning to address such issues.

Since publication of the first edition of the Dumfries & Galloway LBAP in 1999, there has been continued pressure for further water quality improvements. This pressure will be maintained throughout the period of this plan, driven by the requirements of the European Water Framework Directive. This seeks to achieve good water quality across the European Union by 2015, and applies to coastal waters, estuarine waters, inland surface waters and groundwater.

2. Implications

The Water Framework Directive requires the preparation of River Basin Management Plans that have a programme of measures designed to:

- Prevent further deterioration, protect and enhance the status of aquatic ecosystems, and have regard to their water needs and terrestrial ecosystems.
- Promote sustainable water use based on long-term protection of available water resources.
- Protect and improve the aquatic environment, in relation to a progressive reduction in priority hazardous substances.
- Ensure the progressive reduction of pollution of groundwater and prevent its further pollution.
- Contribute to the mitigating the effects of floods and droughts.

Common Reed is increasingly being used to clean water. (Northeastwildlife.co.uk)

OVERALL AIMS

AIM 1: Biodiversity conserved, enhanced and re-created at the landscape and seascape scale.

In order to allow biodiversity to adapt to the predicted changes in climate, there is a requirement to increase the scale at which biodiversity management is carried out. This could be achieved by the large scale creation of new habitats, but in most circumstances it is likely to be more feasible to create **ecological networks** that link patches of habitat that are currently fragmented and isolated. A number of approaches should be adopted and have already begun to reverse this fragmentation and isolation.

Upland grass and heathland, loch and wetlands, native woods and conifer plantations. Glentrool, October 2003. (Peter Norman)

A **forest habitat network** is a landscape structure containing core woodland and forest areas connected by wooded corridors. This allows species of low dispersal ability, or requiring woodland habitat for dispersal, to expand into adjacent habitat patches. It will help maintain and enhance genetic contact within the population of the species and in turn will provide greater species resilience in times of external stress, such as climate change.

A forest habitat network should retain ancient woods and improve their condition, create large woods and well wooded districts, locate new woodland next to existing woodland to minimise isolation, and improve non woodland habitats by restoring scrub and other semi-natural habitat. FCS/SNH recommend at least 30% woodland cover, including some large woods of 20ha or more, though it is not necessary for all woods to be dense closed canopy habitats and there are opportunities to include new wood pastures. The best links are likely to be riparian, as the drainage network is the natural choice for the movement of many mobile species at the landscape scale.

Within Dumfries & Galloway, a practical method to identify key areas for the restoration and expansion of native woodland that links core woods (both native and non-native on ancient woodland sites) is already being implemented through projects such as those of the Cree Valley Community Woodlands Trust, but forest habitat networks will not be practical in all areas. For a variety of reasons, such as landscape, historic environment or economic reasons some areas will be unsuitable. It is also important to avoid fragmenting open habits of high ecological value.

Floodplain restoration is another technique that would allow large-scale enhancement, re-creation and linking of habitats, providing gains for biodiversity and a range of other benefits, including flood alleviation, recreation opportunities and improvements in fisheries and water quality. Allowing floodplains to return to a more natural regime could be achieved by creating washlands, areas of land next to rivers or streams into which flows can be diverted in times of flood. The EU Flooding Directive, which will be transposed into Scots law from September 2007 to September 2009, talks about sustainable flooding and giving rivers more space. It asks member states to “consider where possible the maintenance and/or restoration of floodplains, as well as measures to prevent and reduce damage to human health, the environment, cultural heritage and economic activity.”

Tree lines and small woods link together to provide a network for woodland species. Dalry, October 2003. (Peter Norman)

Floodplain restoration is more constrained by physical topography than forest habitat networks, but the two are not necessarily incompatible – both could be created in the same area, providing a mosaic of woodland and wetland mixed with other habitats, agricultural land and settlements. The key to ensuring the integration of these land uses in a holistic way is **catchment management**. Catchments have many

natural linkages, but many of these may be weakened or severed by conflicting land-use practices. Management at the catchment scale enables different land-uses to work together for the benefit of the whole system.

Dumfries & Galloway is a predominantly rural region, with only around 1.3% of land classed as urban, but the concept of landscape-scale habitat restoration should also be applied to urban areas. Whilst it is true that many wildlife species avoid close contact with people, it is equally true that a large number of others have successfully adapted to urban conditions. Furthermore, towns and villages are the most important places for bringing people into contact with biodiversity, providing enjoyment and education, and tackling issues of environmental inequality. **Urban greenspace networks** provide the mechanism for creating and linking biodiversity areas in towns.

Co-ordinated action for biodiversity, as well as other activities, in the coastal and marine environment should be achieved through **integrated coastal zone management**. This process seeks to integrate the different policies and management actions that have an effect on the coast, and at the same time bring together the full range of stakeholders to inform, support and implement these policies and actions in a co-ordinated and transparent process. It will also ensure that regional and local initiatives do not conflict with national priorities for conservation and sustainable use.

AIM 2: Genetic diversity conserved.

Biodiversity conservation has traditionally been focussed at the species and habitat level, but the role of genetics in plant and animal conservation has recently increased in prominence. For example, the Atlantic Salmon that travel thousands of miles in northern seas do not return to just any river headwater to spawn, but almost every one returns to the river where they themselves originated. This behaviour has resulted in genetically distinct stock between rivers and even within individual rivers, with some evidence of further genetic distinctiveness in the tributaries of large rivers. These fish are genetically adapted to the precise environmental conditions found in their natal rivers. In this example, not only would the translocation of large Salmon from one river to another be unlikely to produce future stocks of large fish in the recipient river, but may actually weaken the genetic stock of Salmon in this river.

Planting of Spanish Bluebells has weakened the genetic stock of native Bluebells. Kirkcudbright, May 2003. (Peter Norman)

Future biodiversity actions need to consider the genetic distinctiveness of different species, sub-species or populations. This information may assist in maintaining existing genetic integrity and local adaptations. However, faced with environmental change, the conservation of species adaptability and the processes sustaining and providing diversity might be of greater general importance than conserving specific local adaptations. This gives rise to many questions relating to the role of genetic data in adaptation, response to climate change and in the significance of genetic variation. It may not always be possible to answer these questions without future research, but it is essential to consider the important role of genetics and the risks to genetic diversity when planning biodiversity projects.

AIM 3: Biodiversity incorporated into all relevant decision-making.

The Nature Conservation (Scotland) Act 2004 included a biodiversity duty for all public bodies. The precise wording contained in the Act is:
"It is the duty of every public body and office-holder, in exercising any functions, to further the conservation of biodiversity so far as is consistent with the proper exercise of those functions."

To date, biodiversity management has been seen as something for specialists, but the 'biodiversity duty' makes it clear that it is now something which everyone involved in providing public services should address as a routine part of their decision making. Particular areas of relevance include development programmes and grant schemes; and in policy,

planning, design and development decisions taken by government and business. Environmental assessment procedures specifically address biodiversity issues for specific projects, including cumulative impact. Biodiversity issues now also need to be considered at the strategic level through Strategic Environmental Assessments.

The LBAP should assist in the successful integration, facilitation, co-ordination and promotion of regional biodiversity action. It provides the focus and priorities to enable relevant decision-makers to integrate improved biodiversity management into all relevant plans and projects and ensure that decisions at all levels take account of biodiversity.

AIM 4: Biodiversity awareness, understanding and engagement improved.

A wide range of techniques has been employed to raise awareness and understanding of biodiversity in the UK. The traditional tools have been leaflets, interpretation boards, guided walks & talks, and the media. Ranger Services and voluntary groups have played a vital role. These tools will continue to be important, but more innovative and imaginative forms of communication are also needed to reach a wider range of people, and specific techniques need to be geared to specific audiences. The biggest challenge for the future is to convert awareness and understanding into engagement – closing the gap between 'saying' and 'doing'.

School group visit to Polbower Burn with Kirkconnel Parish Heritage Society. (Greg Baillie)

A Scottish Biodiversity Communications Strategy Framework was commissioned by the Scottish Executive & Scottish Natural Heritage in 2007. This identifies 3 themes that are particularly important for encouraging people to become more involved in biodiversity initiatives in Scotland:

- Acknowledgement that people have lives to live with many things to think about on a daily basis. Biodiversity is not currently their first priority and the challenge is therefore to capture their imaginations in the places they go to and in the ways they will listen.
- That a segmented approach is required, with the term *'nature and wildlife'* being used in communicating for those who are relatively new to these issues, with the term *'biodiversity'* being used only for those who have already had significant exposure to the term and its concepts.
- In order to put people at the heart of the Scottish Biodiversity Strategy, messages about nature and wildlife need to be fun, participatory and enjoyable. Only then will they resonate with the general public and be in a position to create mass behavioural change.

This requires biodiversity communications based on:

- Enjoying: encouraging people to make the most of nature and the natural world.
- Enhancing: people taking steps to make *their* local environment better.
- Protecting: appealing to people's deeper sense of responsibility and ownership.

AIM 5: Natural processes allowed to operate wherever practicable.

The biodiversity of Dumfries & Galloway has been modified by human activities ever since people first arrived in the area. The scale of early modification was extensive and by the beginning of the first millennium BC almost all British habitats had been transformed from their natural state. Today, no truly natural habitats exist and the overall appearance of the landscape is very much a result of human activities. Despite this, the fundamental processes that keep modified ecosystems functioning are no different to those that operate in entirely natural systems. These include photosynthesis and

As water filters through the roots and decaying plant material in this constructed wetland, toxic metals are removed. Craigenbay 1996. (Forestry Commission Scotland)

respiration; pollination and fertilisation; reproduction and growth; colonisation and succession; nutrient, water and energy cycling; precipitation and evaporation; erosion and deposition.

The geographical scale of the human impact has changed little throughout history, but the type of impact and the pace of change have changed enormously. Up until the 18th century, little thought was given to the human impact on the environment. The overriding belief was that people could control and improve on the order of nature, and such change could bring only benefits. During the 19th century, a number of scientists began to recognise one of the basic laws of ecology: namely that everything is connected to everything else and that one change cannot change just one thing in nature. However, the human impact continued to be seen as insignificant until the early 20th century when environmental problems that were once locally confined began to have regional, national and global implications. In very recent times human activities have even begun to fundamentally alter some of the natural processes themselves.

Further change is inevitable, but an approach based on the functioning of ecosystems is now becoming recognised across marine, freshwater, landuse and soil policy, signalling a much more integrated approach to policy development. For example, the presence of predator populations in naturally functioning food chains is a sign of a healthy situation rather than a problem. There is a good deal of work to be done to understand how ecosystems work and to assess their resilience and vulnerability. This includes developing a better understanding of environmental limits, such as robust methods for determining where critical thresholds lie and where cumulative impacts can cause irreversible change. This approach, which was agreed in 2004 by parties to the Convention on Biological Diversity, includes processes, functions and interactions among organisms and their environment, and recognises humans and cultural diversity are an integral part of ecosystems. Some natural processes will therefore not be appropriate in important cultural landscapes, but in many other areas a more natural approach could be applied. This might be restricted to a pond, an entire forest, an intercontinental flyway or even the whole globe, but at all these scales it is fundamental to sustainable development.

AIM 6: Local distinctiveness enhanced.

The biodiversity of every part of Dumfries & Galloway is distinctive and different from every other part. This has resulted from local environmental conditions, a complex history and the current interaction between people and wildlife. For example, low-lying saltmarshes are characteristic of the Dumfriesshire coast, but where they occur inbetween the cliffs and steep slopes of Galloway they not only look different but have a different history of management and even a different local name – the 'Inks' of Wigtown Bay.

Crab Apples are a common component of scrub in Galloway, but scarce in much of the rest of Scotland. Rockcliffe, July 2006. (Peter Norman).

Local distinctiveness is as much about local trees, ponds and their associations with people as it is about local building stone, architecture and pieces of literature. The ephemeral and invisible are important too - customs, celebrations, names, spoken history, myths, legends and symbols. Often it is the commonplace things, the locally abundant, that contribute to local distinctiveness and require attention just as much as the rare and threatened.

The local environmental character of a place does not remain static. Local features are influenced by new people, ideas, activities, and inevitably change. This change may enrich a place or may homogenise and diminish it. There is a danger that blind adherence to published biodiversity guidance and inflexible regulations will result in a loss of local distinctiveness. For example, the woods of Dumfries & Galloway are all different from each other, partly as a result of environmental conditions, but partly as a result of centuries of human interaction and individual management decisions.

In pursuing biodiversity objectives it is worth bearing the following in mind (adapted from Common Ground's Rules for Local Distinctiveness):

- Change things for the better, not for the sake of it.
- Let the character of the people and place express itself.
- Encourage the species that occur naturally in a locality.
- Enhance natural features of local interest.
- Facts and surveys are not the same as knowledge and wisdom of a place. Both ecological expertise and local knowledge need to be used in decision-making.
- Value subjective and emotional arguments. Just because it cannot be counted, does not mean it is not important.
- Make use of the hidden and unseen stories and legends in interpretation.
- Encourage the production of local natural products - such as food and crafts.
- Respect local names and add new ones with care.
- Remember the depth of people's attachment to places. Do not undermine local pride with insensitive change.
- Plan biodiversity projects in proportion and in scale. Every place has its own distinctive dimensions.
- Avoid urbanisation of the countryside.
- Aim for high standards, not standardisation.

LOCAL, NATIONAL & INTERNATIONAL ACTION FOR BIODIVERSITY

Objective 1: Ensure no net loss of priority habitats and species during the lifetime of this plan.

Priority Action (LNIAB1): Ensure that all objectives in the Dumfries & Galloway LBAP are consistent with international and national targets for biodiversity from the following plans and programmes:

- UN Convention on Biological Diversity
- Biodiversity: The UK Action Plan
- Scottish Biodiversity Strategy and Implementation Plans

Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Background

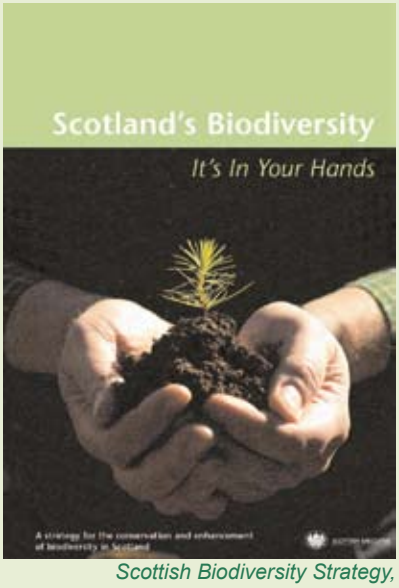
Although locally driven and developed, the Dumfries & Galloway Local Biodiversity Action Plan is part of a national and international programme designed to maintain and enhance biodiversity globally. This LBAP therefore incorporates international and national actions where these are locally applicable.

At the Earth Summit on Sustainable Development in 1992, over 150 countries including the UK Government signed up to the United Nations **Convention on Biological Diversity**. This gave the UK an international obligation to conserve and protect Biodiversity.

In response to the Convention on Biological Diversity, the UK Government produced **Biodiversity: The UK Action Plan** in 1994. A UK Steering Group for biodiversity was established with members from central and local government, statutory conservation agencies, business, farming, universities, non-governmental conservation organisations and others with a stake in land management and use. From 1995, this group produced a framework for action for biodiversity by listing species and habitats which require national action (Biodiversity: the UK Steering Group Report), followed by a series of action plans for individual habitats and species. A review of the entire UK Biodiversity Action Plan was completed in 2007.

The European Union also has a commitment to nature conservation, embodied in the EU Birds Directive (1979), the EU Habitats Directive (1992) and the Natura 2000 network of protected areas under these Directives. The EU developed its own **European Community Biodiversity Strategy** in 1998, which is intended to be complementary to biodiversity strategies developed in individual member states. In 2001 EU Heads of State and Government reaffirmed their commitment at the Gothenburg Summit by pledging themselves to "halt the decline of biodiversity by 2010". This commitment complements the agreement by world leaders in 2002 at the World Summit for Sustainable Development to "the achievement by 2010 of a significant reduction in the current rate of biodiversity loss at the global, regional and national level".

The **Scottish Biodiversity Strategy** entitled Scotland's *Biodiversity: It's in Your Hands*, which aims to conserve biodiversity for the health, enjoyment and wellbeing of the people of Scotland, was published by the Scottish Executive in May 2004. This strategy was developed in close partnership with the Scottish Biodiversity Forum, a broad based working partnership of public, private and voluntary organisations. It represents Scotland's response to its obligations under the Convention on Biological Diversity and to the UK Biodiversity Action Plan, along with the Scottish Ministers' desire to put biodiversity at the heart of our national identity and culture. The strategy covers the period up to 2030. It presents a vision, an aim and five strategic objectives. It also



Scottish Biodiversity Strategy, published in 2004

includes a List of Species and Habitats considered to be of Principal Importance for the purpose of Biodiversity Conservation in Scotland under the Nature Conservation (Scotland) Act 2004 (see below).

To support implementation of the Scottish Biodiversity Strategy, the Scottish Biodiversity Forum produces a set of implementation plans which identify the priority actions to implement the Strategy over a 3 year period. These plans represent the first step towards achieving the Strategy's 25-year vision of Scotland as a world leader in biodiversity conservation.

The **Nature Conservation (Scotland) Act 2004** gives all public bodies a duty to further the conservation of biodiversity, and to have regard to The Scottish Biodiversity Strategy and the Convention on Biological Diversity. The Act came into force on in November 2004 and applies to all public bodies including local authorities, health boards, public utilities, transport agencies, and other public bodies involved in arts, tourism, sport, education or business development.

2. Environmental, Economic and Social Importance of Biodiversity

- National and international strategies and programmes have been developed within the context of sustainable development and are closely linked with social and economic objectives.

3. Factors affecting national and international action

- The complexity of national and international targets for biodiversity, in addition to targets for many other issues, makes implementation at the local level confusing for the non-specialist.

4. Recent and current activity

- The Dumfries & Galloway Biodiversity Steering Group maintains contact and liaison with those working on national and international targets.
- A number of local partners are part of wider national or international organisations.

5. Other recommended actions

- Provide advice to non-biodiversity specialists on the implications of national and international targets at a local level.

6. Further Information

6.1 Publications

- Biodiversity: the UK Action Plan. (1994) Department of the Environment.
- Scotland's Biodiversity: It's In Your Hands. A strategy for the conservation and enhancement of biodiversity in Scotland. (2004) Scottish Executive.
- The Convention on Biological Diversity. (1992) United Nations Environment Programme.

6.2 Websites

- Biodiversity Scotland www.biodiversityscotland.gov.uk
- EU Biodiversity Strategy http://ec.europa.eu/environment/docum/9842sm.htm
- Scottish Executive guidance on the biodiversity duty www.biodiversityscotland.gov.uk
- UNEP Convention on Biological Diversity www.biodiv.org
- UK Biodiversity Action Plan www.ukbap.org.uk

BIODIVERSITY DATA

Objective 2: Ensure that more data relating to Dumfries & Galloway is collected, collated and made available, to assist in the promotion, enjoyment, understanding and enhancement of biodiversity.

Priority Action (BD1): Secure funding to enable the Dumfries and Galloway Environmental Resources Centre to continue to provide a high quality data service to both providers and users of that data.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.
Priority Action (BD2): Collect and make available additional biodiversity records.
Target: A total of 250,000 to be available by 2012.
Lead Partner: Dumfries & Galloway Environmental Resources Centre.

1. Background

Our understanding of biodiversity remains very limited. For most species and habitats we have insufficient knowledge of what we have and what is happening to it. Although the UK has a longer history of collecting such information and conducting biodiversity research than any other country in the world, much of it has not been made accessible to the public and decision-makers in the right format and at the right time. Furthermore, a substantial quantity of it is likely to have been lost as a result of inadequate and uncoordinated storage techniques.

The position in Dumfries & Galloway is substantially worse than in many other parts of the UK. Not only is the region large and sparsely populated, but until recently it has lacked a university, or major research institute/natural history museum. The Scottish Highlands, which shares many of the same disadvantages, has benefited from a long tradition of visiting naturalists and experts, which has not occurred to the same extent in Dumfries & Galloway.

Moth recording group at work. Raeburn Flow, September 2007. (Richard Mearns)

Even at the basic level of a species inventory, new discoveries are still being made in Dumfries & Galloway at a relatively frequent rate, and not all of these are likely to be species that have recently moved into the area.

Requirements for environmental, including biodiversity, information have continued to rise as the environment has become more integrated into a range of other policy areas. A sound understanding of the region's biodiversity has never been as high a priority.

2. Environmental, Economic and Social Importance of Biodiversity

- Many people participate in wildlife recording primarily as an enjoyable recreation activity, rather than any desire to provide scientific data.
- Collecting and processing biodiversity data can involve people with little previous knowledge or experience of biodiversity, allowing them to learn and develop skills, such as the use of computers, which are directly transferable to other areas of work.

3. Factors affecting biodiversity data

- Although the local demand for biodiversity data amongst the public and decision-makers is high, local **support and funding** for co-ordination of the collection, collation and dissemination of this data remains low.

Training for volunteers in how to find Otter tracks and signs. Langholm, May 2006. (DGERC)

4. Recent and current activity

- The Dumfries & Galloway **Environmental Resources Centre** was established in 2004 as a result of an objective in the first edition of the LBAP. It collects, collates, manages and safeguards relevant data and providing a focal point through which anyone may access the information.
- The **Freedom of Information (Scotland) Act** and **Environmental Information (Scotland) Regulations** control dissemination of biodiversity data.

5. Other recommended actions

- Encourage the collection of new biodiversity data through the co-ordination and training of local volunteers with national recording schemes.

6. Further Information

6.1 Websites

- Biological recording in Scotland www.brisc.org.uk
- Dumfries & Galloway Environmental Resources Centre www.dgerc.org.uk
- National Biodiversity Network www.searchnbn.net

6.2 Advisory Organisations

- Dumfries & Galloway Environmental Resources Centre, Dumfries (01387) 247543

DESIGNATED SITES

Objective 3: Maintain and enhance a network of designated biodiversity sites.

Priority Action (DS1): Survey and assess additional potential Local Wildlife Sites.
Target: 30 additional sites assessed by 2015.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Background

Dumfries & Galloway has a high number of statutory sites designated for their biodiversity or geodiversity importance, covering more than 100,000ha of land and water. This includes the following (note that some sites have multiple designations):

- 5 **Ramsar Wetlands of International Importance** covering 33,706ha.
- 17 **Special Areas of Conservation** (SAC) covering 91,963ha.
- 7 **Special Protection Areas** (SPA) covering 48,713ha.
- 97 **Sites of Special Scientific Interest** (SSSI) covering 75,380ha.
- 4 **National Nature Reserves** (NNRs) Cairnsmore of Fleet, Caerlaverock, Silver Flowe and Kirkconnell Flow, covering 9,961ha.
- 2 **Local Nature Reserves** (LNRs) at Castle & Hightae Lochs and Wigtown Bay, covering 2,982ha.

These sites should be viewed as biodiversity hotspots, where there is a concentration of particularly important species or habitats. However, any policy that attempts to conserve or enhance biodiversity solely through designated sites is destined to fail, especially under predicted climate change scenarios. Instead, the biodiversity of designated sites should be maintained, and if possible enhanced, at the same time as improvements in the wider countryside. The species present on designated sites would then have the opportunity to expand their range.

Opening of Mabie Nature Reserve (and Local Wildlife Site) by Butterfly Conservation and Forestry Commission Scotland. July 2007. (Peter Norman)

As a result of the first edition of the LBAP, there are now also 45 non-statutory **Local Wildlife Sites** (LWS) in the region that have been surveyed and agreed with landowners. These sites receive some limited protection through the planning processes, but one of the main benefits they provide is to alert the landowner of the presence of important biodiversity in order that this can be taken into account in management operations.

2. Environmental, Economic and Social Importance of Biodiversity

- Many designated sites provide opportunities for education and enjoyment of the natural heritage. This is particularly the case for National Nature Reserves and Local Nature Reserves.

3. Factors affecting designated sites

- Of the notified features of SSSIs in Dumfries & Galloway surveyed as part of Site Condition Monitoring up to 2006, approximately 31% were considered to be in unfavourable condition, and 69% in favourable condition.

4. Recent and current activity

- **Scottish Natural Heritage** is carrying out Site Condition Monitoring of SPAs, SACs and SSSIs. This identifies sites that are in 'favourable' or 'unfavourable' condition.
- The Natural Care Programme, managed by **Scottish Natural Heritage** has assisted land managers to address management of sensitive habitats in designated sites.
- Funding for the management of designated sites is included in Rural Development Contracts.

5. Other recommended actions

- Continue to identify further sites that are locally important for biodiversity. Work with their owners and managers to secure favourable management.

6. Further Information

6.1 Websites

- SNH Information Service www.snh.org.uk/snhi/

6.2 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 www.snh.org.uk

ANCIENT HABITATS

Objective 4: Recognise the value of ancient habitats.

Priority Action (AH1): Develop a set of indicator species that can be used, in conjunction with documentary evidence, to identify local ancient habitats, in order that these habitats should be given special protection and high conservation priority.
Target: Identify local woodland indicators by 2012.
Lead Partner: Dumfries & Galloway Environmental Resources Centre.

Ancient woods such as Wood of Cree can never be replaced by new woodland creation. (Richard Mearns)

1. Background

When the ice receded from Britain at the end of the last Ice Age some 10,000 years ago, wildlife began to recolonise. Initially this was assisted by the land bridge that existed with the continent until around 8000 years ago, but even after this was severed the biodiversity of Britain continued to evolve and change according to entirely natural processes. This was not to last. From Mesolithic man onwards, the impact of humans on biodiversity increased. The geographical scale of such changes has always been wide, with perhaps the biggest single change being the clearance of natural woodland across most of Britain by the end of the Neolithic period. However, the intensity and pace of this change has increased exponentially, with the last 100 years seeing some of the biggest transformations. The net result is that none of the natural biodiversity of Britain has been left untouched by man. Those habitats that have been least modified are now termed 'semi-natural'.

As a general rule, semi-natural habitats that have existed for the greatest length of time with the least disturbance generally support the most valuable biodiversity. Most research has been carried out with relevance to woodland, but this rule is equally applicable to the majority of other habitats. In woodland, the term 'ancient' is frequently used and given a precise, if somewhat artificial, definition (see below). For other habitats, what constitutes 'ancient' is less clearly defined. Much depends on the type of habitat; a pond is likely to become 'ancient' at a much younger age than a wood.

Ancient soils are perhaps the key to the biodiversity value of ancient habitats. Soils are much more than a medium into which plants are rooted; they are as much a part of the habitat as the plants and animals and are fundamental to the well-being of that habitat. Those that are disturbed by human activities such as digging, ploughing, and fertiliser application very quickly lose their vital components.

Many woodland plants, fungi and invertebrates spread only slowly within a wood and are unable to cross open country to colonise new woods. They are now confined to **ancient woods**, and if lost from such woods will not recolonise for a very long time, if at all. A number of species are therefore indicative of ancient woods. For example:

- The larvae of *Trachodes hispidus,* a nationally scarce weevil recorded at Carstramon Wood, is usually restricted to rotting small branchwood of oaks and other trees lying on the ground in ancient woods.
- The Point Snail *Acicula fusca* is found mostly in moss and leaf litter in old deciduous woods. It is intolerant of human disturbance and has declined as a result of coniferisation of ancient woods. The Plated Snail *Spermodea lamellata,* the Ash-black Slug *Limax cinereoniger* are also useful ancient woodland indicators.
- Deceptive Featherwort *Adelanthus decipiens* a liverwort indicator of ancient woodland was found in Bargaly Glen in 1975.

Tree Lungwort Lobaria pulmonaria, a lichen indicator of ancient woodlands. (Peter Norman)

An Inventory of Ancient, Long-established and Semi-natural Woodland in Dumfries & Galloway was prepared by the Nature Conservancy Council between 1988 and 1990. It provides information on all sites over 2ha.

Outside of woodland, single trees may be 400 years old or more. Such **ancient trees** are frequently remnants of previous habitats. But even where they have obviously been planted by man the long continuity of micro-habitats that they provide, especially those associated with dead or decaying wood, often support rare lichens and invertebrates that are incapable of spreading more than a few metres to adjacent trees. The greatest concentrations of such trees occur in **ancient wood pastures**, where in exceptional circumstances there may be a combination of ancient grassland and ancient trees together on the same site.

Waxcap fungi *Hygrocybe* are attractive, brightly-coloured toadstools which are readily seen and indicate old, not or very weakly fertilised **ancient grasslands**. They are entirely absent from temporary and recent grasslands. A few species return after 10 or 20 years if no further 'improvement' is carried out, but old unimproved grasslands may contain 20 or more of the 50 species known in Britain. Such waxcap grasslands are of international importance, Britain being their most important European stronghold. Ancient grasslands can also support a wide diversity of flowering plants, though some important waxcap grasslands can be relatively botanically poor.

Peatlands by their very nature are ancient habitats, taking hundreds or thousands of years to form. However, a greater variety of species occur on ancient bogs that are undisturbed, or at least not disturbed or burnt for a considerable period of time. Large hummocks of Austin's bog-moss *Sphagnum austinii* and Rusty Bog-moss *S. fuscum* are largely confined to pristine raised and blanket bogs. Extensive areas of Magellanic Bog-moss *S. magellanicum* and Golden Bog-moss *S. pulchrum* in wet hollows are also typical species of undisturbed peatlands.

It does not necessarily follow that just because ancient habitats are the most valuable for biodiversity, they support the most **species**. There are many examples where recently created or disturbed habitats support a large number of opportunist species that are quick to find and exploit new niches. Spiders are particularly adept at this, and a recent habitat is likely to have many more species than an ancient one. However, the ancient one will support more of the specialist and rarer species. Likewise, raised bogs have rather few flowering plants in comparison to most recent habitats, but many of the species that are found there would be unlikely to survive in other habitats.

2. Environmental, Economic and Social Importance of Biodiversity

- Ancient habitats, by their very nature, have been disturbed much less than other habitats by modern man. They therefore contain some of the most valuable archaeological remains, which often tell us not only about the social lives of previous generations, but about their utilisation and management of these habitats.

3. Factors affecting ancient habitats

- With the exception of ancient woodlands, there is a **lack of knowledge** about the location of ancient habitats.
- A **lack of awareness** of the importance of ancient habitats.

Yellow Meadow Anthills indicate grassland that has not been disturbed for decades. Craig Farm, Balmaclellan, April 2006 (Mary-Ann Smyth)

4. Recent and current activity

- Forestry Commission Scotland has a programme of restoring **plantations on ancient woodland sites** (PAWS) back to native woodland.
- Historic Scotland and the Royal Commission on the Ancient and Historical Monuments of Scotland have completed a **Historic Land-Use Assessment** of the Solway Coast National Scenic Areas. This is a desktop survey using maps, so cannot identify most ancient ecological features, but indicates areas where such features are likely to be found.
- **Restoration of lowland raised bogs** has been carried out at a number of sites.

5. Other recommended actions

- **Identify ancient indicators** for non-woodland habitats.
- **Research the history** of sites and landscapes to identify ancient habitats.
- Ensure that all **ancient habitats are protected** from new development. If in doubt, treat the site as ancient.
- Ensure that **long established management practices** and the timing of them, including grazing, mowing and water level control, are not changed without good reason and clear evidence that new management will be beneficial. However, traditional management practices that have been long-abandoned, such as coppicing or pollarding, should not be reintroduced without a full assessment of the likely results.
- Continue **restoration of known ancient habitats**, such woods and peatlands.

6. Further Information

6.1 Publications

- Thompson, R., Humphrey, J., Harmer, R. & Ferris, R. Restoration of Native Woodland on Ancient Woodland Sites. Forestry Commission Practice Guide. Forestry Commission, Edinburgh.

6.2 Websites

- Ancient Tree Forum
  www.woodland-trust.org.uk/ancient-tree-forum

6.3 Advisory Organisations

- Scottish Natural Heritage (01387) 247010
  www.snh.org.uk
- Forestry Commission Scotland (01387) 272440
  www.forestry.gov.uk

NON-NATIVE INVASIVE SPECIES

Objective 5: Minimise the impact of non-native species on biodiversity.

Priority Action (NNIS1): Identify the invasive species in Dumfries & Galloway that pose the greatest threat to biodiversity.
Target: Complete a full risk assessment by 2012.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.
Priority Action (NNIS2): Raise awareness of the risks posed by non-native invasive species through production of a guide for the public by 2014.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

Grey Squirrels are rapidly expanding in Dumfries & Galloway, at the expense of Red Squirrels. (Gordon McCall)

1. Background

The deliberate or accidental introduction of new species to Britain has occurred for thousands of years. These are termed **non-native species,** to distinguish them from native species that arrived as a result of natural processes. An audit conducted by Scottish Natural Heritage identified 988 non-native species present in Scotland; the great majority of them fail to become permanently established. Of those that do, most make a positive contribution to our natural heritage, economy and social well-being, through, for example, agriculture, forestry, horticulture and fisheries.

A few non-native species have taken advantage of suitable conditions and been able to rapidly spread at the expense of native species, dominating habitats and causing environmental damage. These are termed **invasive species**. In some circumstances, such as changes to land management practices, a small number of native species have also spread well beyond their natural ranges and become invasive species, but the majority of invasive species are non-natives.

Invasive species of flora and fauna are rarely as big a threat to biodiversity as habitat degradation and destruction, but they pose a growing problem to certain native species and habitats. Biodiversity on small islands and in freshwaters is particularly at risk. Furthermore, because of the continuing trends in the global movement of people and goods, the potential for these problems to escalate is increasing. Climate change will also have a substantial impact on species assemblages in the coming years – both by affecting the distribution of our native species, and by enabling some non-native species to become more common. Increasingly we could also see more non-native species that are currently benign become invasive as the climate changes.

Co-ordinated effort is required to control the introduction and spread of invasive non-natives. Piecemeal attempts at control ultimately fail due to rapid re-growth or re-colonisation and there is a need for co-ordinated action involving a wide range of agencies and stakeholders. In Britain, a variety of physical, chemical and biological control measures have been employed, but the effectiveness of the methods has varied. Few species have been totally eradicated; none in the marine environment. For some species, control measures and eradication attempts are not viable. Detection, surveillance, and mitigation are equally, if not more, important than eradication or control measures for many species.

2. Environmental, Economic and Social Importance of Biodiversity

- Many invasive species also threaten economic interests such as agriculture, forestry and fisheries. For example, Grey Squirrels cause significant economic losses to commercial forestry.

- The spread of some invasive species, such as Rhododendron, results in wholesale changes to the landscape.

3. Factors affecting invasive species

- A **lack of awareness** of the risks and consequences of the introduction of non-native species and the actions that can lead to their spread, leading to attitudes and behaviour that exacerbates problems.
- **No lead agency** with responsibility to co-ordinate action on invasive species, or any contingency plans to prevent the establishment of new invasive species.

Himalayan Balsam and Japanese Knotweed. Nunholm, Dumfries, August 2007. (Peter Norman)

- **Lack of enforcement** of existing legislation to prevent and control the establishment and spread of invasive species.
- **Limited resources** are available to ensure sustainable action to control established invasive species.
- Limited capacity and resources to improve **detection and monitoring** of invasive species.

4. Recent and current activity

- The Scottish Executive (with the Department for Environment, Food and Rural Affairs and the Welsh Assembly) prepared an Invasive Non-native Species Framework Strategy for Great Britain in 2007. This provides a high-level context for regional or local initiatives.
- Grey Squirrel control is being used as a tool in Red Squirrel conservation. Grey Squirrel Control Officers operating in Annandale & Eskdale are co-ordinating effort to prevent the spread of pox virus by the alien invasive Grey Squirrel.
- Fringed Water Lily has been controlled at Mill Loch SSSI, Lochmaben.

5. Other recommended actions

- **Assess practicality and cost** of controlling/ eradicating invasive species in Dumfries & Galloway.
- **Monitor the spread of priority invasive species** so that appropriate action can be taken to target control.
- **Co-ordinate any control/eradication programmes** with national programmes and those in adjacent areas.
- **Raise awareness** of the activities that may lead to the introduction or spread of invasive species, ways of minimising these risks, and the consequences of not doing so.

Rhododendron ponticum. Tower Wood, Mabie Forest, May2007. (Peter Norman)

6. Further Information

6.1 Publications

- Edwards C. (2006) Managing and controlling invasive rhododendron. Forestry Commission Practice Guide. Forestry Commission, Edinburgh.
- The Welsh Assembly, Scottish Executive & Department for Environment, Food and Rural Affairs (2007) The Invasive Non-native Species Framework Strategy for Great Britain. Protecting our natural heritage from invasive species. Consultation Draft. DEFRA, London.

6.2 Websites

- GB Non-native Species Secretariat www.nonnativespecies.org
- Introduced Species in the British Isles www.introduced-species.co.uk

6.3 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 www.snh.org.uk

Reintroduction and Translocation of Species

Objective 6: Reintroduce or translocate species in Dumfries and Galloway where appropriate.

Priority Action (RTS1): Assess the feasibility and social, economic and environmental benefits of reintroducing key species to Dumfries & Galloway, in line with IUCN guidelines.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Background

The range of species currently present in Dumfries & Galloway, and indeed the rest of the British Isles, has been greatly modified by human activity over the millennia. Many species have been accidentally or deliberately introduced and a small number of these have become invasive (see above). Others that once naturally occurred in the region have since become extinct. Reasons for their extinction vary, but the most common causes are habitat loss and degradation, or deliberate persecution. The impact of extinctions varies according to species, but the loss of certain key species can affect the natural functioning of ecosystems and result in indirect and often unexpected impacts. For example, the extinction of wolves in Scotland has removed the main predator of deer, meaning that the natural regeneration of native woodlands is rarely possible without human management of deer populations.

A variety of measures should be taken to address these impacts:

Re-introduction is an attempt to establish a species in an area, which was once part of its historical range, but from which it has become extinct. Re-establishment is a synonym, but implies that the re-introduction has been successful. It is also sometimes used in preference to re-introduction, as the latter implies that the species had been previously introduced, rather than was a natural component of the flora/fauna.

Translocation is a deliberate movement of wild individuals to another site, which may or may not have an existing population of the same species. It is usually carried out when populations are threatened by development. It can also include movement of individuals that may cause a potential problem, to suitable habitat where there is less risk of a problem. For example, movement of grazing animals to allow tree regeneration.

Re-enforcement or supplementation is an addition of individuals to an existing population.

Conservation introduction is an attempt to establish a species, for the purpose of conservation, outside its recorded distribution but within a suitable habitat and eco-geographical area. This is an appropriate conservation tool only when there is no remaining suitable area left within a species' historic range.

Biological control introduction is an attempt to establish a species from outside its recorded distribution in order to control the population of another species.

2. Environmental, Economic and Social Importance of Biodiversity

- Some reintroduced species are attractive to the public and produce significant economic benefits from tourism. For example, the Galloway Kite Trail was established in 2003 to enable visitors and local people to view reintroduced Red Kites. It links with local tourism businesses and provides a significant boost to the local economy.

3. Factors affecting reintroduction and translocation of species

- Most reintroductions and translocations are illegal without an appropriate licence.
- Reintroductions and translocations carried out with little long-term planning have a high risk of failure, and the possibility of damaging native species. Such reintroductions have been attempted in and around Dumfries & Galloway in

the past, including Ptarmigan in the 1960s/70s. There are however some examples of success, including Mountain Hares and Red Squirrels in the 19th century and Pine Martens in 1981.

- A thorough assessment of attitudes of local people to the proposed project is necessary to ensure long-term protection of the re-introduced population.

Sparling have been the subject of a reintroduction to the River Fleet. (Galloway Fisheries Trust)

- Long-term monitoring is required to assess the success or otherwise of reintroduction or translocation projects. The length of such monitoring will vary according to the species involved, but as a minimum it should include two complete breeding/reproduction cycles, usually longer.

4. Recent and current activity

- Guidelines for re-introductions were published by IUCN - The World Conservation Union in 1995. In summary, these state that introductions should only be considered in the species' former natural habitat and range; in locations where habitat and landscape requirements of the species are satisfied and likely to be sustained for the foreseeable future; where factors that caused the original decline of the species have been identified and reduced to a satisfactory level; that the source population should be closely related genetically to the original native stock; that the source population should not be endangered; that prospective release stock is subject to a veterinary screening process; that adequate funding for all programme phases is secured; and that a pre- and post-release monitoring programme is in place.
- Reintroduction of Red Kites in Dumfries & Galloway by RSPB was carried out between 2001 and 2005.
- Reintroduction of Sparling into the Water of Fleet by Galloway Fisheries Trust and the Fish Conservation Centre was begun in 2007.
- Reinforcement of Sticky Catchfly on the Galloway Coast and Oblong Woodsia fern in the Moffat Hills has been carried out.
- A conservation introduction of Vendace to Dumfries & Galloway was carried out in 1997. The original sites for this species at Lochmaben Lochs were no longer suitable, so Loch Skene, which had no previous history of this species, was chosen instead. It is perhaps now the most important UK site for this species, which is threatened by pollution at its last remaining natural sites at Bassenthwaite and Derwent Water

5. Other recommended actions

- Complete feasibility studies on White-tailed Sea Eagle and Arctic Charr reintroductions.
- Consider reintroducing additional species to Dumfries & Galloway where all IUCN guidelines can be met, there are ecological/environmental benefits, and the long-term economic gains outweigh the initial costs of the reintroduction. Possible species for consideration include Marsh Fritillary and Small Blue butterflies, Freshwater Pearl Mussels and Beavers.
- Restrict translocation to scenarios where it is there is no other viable alternative, and ensure that adequate long-term monitoring is in place.

Red Kite, reintroduced to Dumfries & Galloway in 2001. (Steven Round)

6. Further Information

6.1 Publications

- IUCN - The World Conservation Union (1995) Guidelines for Re-Introductions.
- Joint Nature Conservation Committee (2001) Biological Translocations: A Conservation Policy for Britain. Consultation Draft. JNCC, Peterborough.

6.2 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 www.snh.org.uk

WILDLIFE TOURISM

Objective 7: Increase wildlife tourism in Dumfries & Galloway.

Priority Action (WT1): Encourage all interested parties work together to promote wildlife tourism through the establishment of a partnership of local businesses, tourism and biodiversity organisations to assist in the development of wildlife tourism by 2012.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.
Priority Action (WT2): Organise and promote an annual Wildlife Festival, in association with partner organisations, VisitScotland and tourism businesses.
Target: Annual festival to attract 5,000 people by 2012.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Background

Wildlife tourism is a fast growing sector of the tourism industry in Scotland and identified as one of the 6 key market segments in the development of Scottish tourism in the next decade.

Dumfries & Galloway has many advantages for wildlife tourism:

- A rich wildlife resources capable of attracting a significant proportion of this market throughout the year.
- Some infrastructure for wildlife tourism already in place, including a number of high quality wildlife reserves with good quality visitor facilities.
- Easy accessibility to many other parts of the UK.

Unlike other parts of Britain, Dumfries & Galloway has not yet taken full advantage of its natural advantages for wildlife watching. However, the Area Tourism Partnership Strategy 2007-09 encourages further development, especially Objective 2 'Encourage businesses to take advantage of nature based resources.'

Wild Scotland is the Scottish Wildlife and Nature Tourism Operators Association - a group of wildlife and nature tourism professionals who are all committed to delivering a first class wildlife-watching experience. They aim to encourage the commercial operation, development and promotion of wildlife and nature tourism in Scotland in ways that are sustainable environmentally, economically and socially.

Visitors to the Red Kite Station, Laurieston. (Dean Vaughan)

2. Environmental, Economic and Social Importance of Biodiversity

- Wildlife tourism in Dumfries & Galloway has the opportunity to bring visitors and significant economic benefits to the area at times of the year when other attractions have little to offer.

3. Factors affecting wildlife tourism

- Relatively **little co-ordination of wildlife tourism** activities and marketing, especially between conservation bodies and providers of tourism services.
- A **lack of knowledge and expertise** of wildlife and the facilities available for wildlife watching amongst those in the tourism industry.
- **Poor facilities** for tourists and visitors at some sites.

4. Recent and current activity

- The **Dumfries & Galloway Wildlife Festival** was established by the Dumfries & Galloway Biodiversity partnership in 2004. It takes place during or close to the Easter school holidays and consists of wide range of activities, including guided walks, open days, family activities, art exhibitions and practical conservation work, provided by biodiversity partners across the region. Attendance has risen from around 700 in 2004 to more than 2000 in 2007.
- The **Galloway Kite Trail**, established by RSPB in partnership with local businesses in 2003, is an circular route of some 30 miles around Loch Ken, with an additional 10 miles of forest drive (summer only). The trail includes 6 outdoor viewing points with interpretation, countryside walks, a visitor centre with CCTV (summer only), and a kite feeding station.
- The Farming and Wildlife Advisory Group (FWAG) project, Linking Sustainable Farming, Tourism & Biodiversity, is developing and enhancing opportunities for wildlife and countryside interpretation on **local farms** that have visitor accommodation.
- The free ***Birdwatching in Dumfries & Galloway*** **booklet** was produced in 1997. It is now in its fourth reprint, and more than 100,000 copies have been distributed.

Large flocks of Barnacle Geese are the region's top tourist attraction in winter. Caerlaverock, November 2008. (Northeastwildlife.co.uk)

- There are several accredited businesses in Dumfries & Galloway under the **Green Tourism Business Scheme.** Accreditation is based on a range of environmental criteria, including waste, energy, water, transport and biodiversity.
- A number of partner organisations, for example RSPB and NTS, operate and promote **nature reserves** widely to tourists.

5. Other recommended actions

- Link existing and future wildlife tourism attractions across Dumfries & Galloway in a **co-ordinated marketing** programme.
- **Raise awareness of opportunities** relating to sustainable wildlife watching to the tourism industry and other key stakeholders.
- Ensure a quality and sustainable visitor experience by identifying and **promoting best practice** and adopting appropriate codes of conducts and standards.
- Provide **networking opportunities** for the exchange of ideas on wildlife and tourism-related issues.
- Develop **opportunities on farms** for promoting tourism and recreation rich in wildlife.
- Develop **opportunities on caravan sites and holiday parks** for promoting wildlife tourism.

6. Further Information

6.1 Websites

- Dumfries & Galloway Wildlife Festival www.wildlifefestival.org.uk
- Galloway Kite Trail www.gallowaykitetrail.com
- VisitScotland Sustainable Tourism Unit www.greentourism.org.uk

6.2 Advisory Organisations

- Wild Scotland 01463 723013 www.wild-scotland.org.uk

GEODIVERSITY

Objective 8: Highlight the geological diversity of Dumfries & Galloway, and its close relationship to biodiversity.

Priority Action (GS1): Identify the extent and location of geodiversity resources in Dumfries & Galloway, including the selection of key regional sites for protection.
Target: Set-up a database of protected and other important geological and geomorphological sites. Identify at least 10 regionally important sites by 2012.
Lead: Dumfries & Galloway Environmental Resources Centre.
Priority Action (GS2): Raise awareness and promote understanding of geodiversity among identified audiences.
Target: Promote geodiversity in at least 5 publications by 2015.
Lead: Scottish Natural Heritage.

1. Background

Geodiversity is short for geological diversity and includes the whole range of earth heritage topics. It is the variety of rocks, minerals, fossils, landforms, sediments and soils, together with the natural processes that form and alter them.

The part played by geodiversity in shaping our environment extends far beyond the physical landform. The region's biodiversity is directly dependant on earth processes, the character of the exposed rocks, and the soils that derive their characteristics from the underlying solid geology or deposits. In some cases there are obvious links between geodiversity and biodiversity – sea cliffs only form in the appropriate geological conditions, and blanket bogs are clearly dependent on the underlying soil type. In many other habitats biodiversity is more influenced by factors such as latitude, altitude, slope, aspect, climate, and past and present site management, but many of these are also influenced by geodiversity.

The oldest rocks known in Dumfries & Galloway are from the Ordovician and Silurian periods, between 495 and 418 million years ago. At this time southern Scotland was part of a deep ocean, known to geologists as the Iapetus Ocean. On the northern edge of this ocean was a continental plate, known as Laurentia, while to the south was another known as Eastern Avalonia which was moving gradually northwards. Particles of sediment in the water accumulated on the ocean bed and are preserved today as Shales, Mudstone, Siltstone, Greywacke and Conglomerates. The Iapetus Ocean closed and the two continents eventually collided. As the ocean

Sea-sculptured sandstone at Barlocco. (Richard Mearns)

floor was forced under the northern continent some of it was scraped off, folded and stacked to form a new mountain chain across what is now the Southern Uplands.

When the ocean floor was forced down beneath the continent it caused melting of parts of the crust. Giant blobs of molten rock were trapped deep beneath the surface and slowly cooled and solidified to become

Folded rocks at Ravenshall, July 2007. (Peter Norman)

huge pockets of granite. This granite was to have an influence on the formation of mineral deposits in Dumfries & Galloway.

By the Carboniferous Period, around 340 million years ago Dumfries & Galloway has moved to a position near the equator and lay on the edge of a wide tropical sea. The low lying basins went through repeated cycles of changing conditions from shallow seas to swampy forests and back again. In the clear, warm water beds of limestone accumulated while periodic influxes of sand and mud deposited by deltas building from a landmass to the north formed mudstones and sandstones. The remains of the swampy forests are preserved today as the coal seams of the Coal Measures.

By about 260 million years ago, during the Permian Period, Dumfries & Galloway lay within tropical latitudes and became an arid desert. Giant shifting sand dunes developed and were to become red sandstones. With the onset of Triassic times, about 210 million years ago, the region was still hot and dry but seasonal heavy rains would wash the sand into low lying areas to become layers of sandstone.

There is little further evidence for the region's geological evolution until the glacial periods. Over the last 1.6 million years ice has reshaped the old landscape and created the one we recognise today. Ice sheets hundreds of metres deep fed glaciers that flowed under their own enormous weight. They gouged out valley bottoms and scoured off layers of rock to expose those below. When the ice melted it left the rock debris it was carrying including large boulders have been dumped, sometimes far from their place of origin.

Geodiversity is present across the whole of Dumfries & Galloway but is most apparent in locations where geological deposits and features may be experienced. Local interest extends from granite pavement and moranic deposits in the Merrick Kells to salt marsh in the Upper Solway Flats and Marshes and from significant fossils at Dob's Linn to the complex beach and dune system at Torrs Warren.

2. Environmental, Economic and Social Importance of Geodiversity

- Quarrying of local building stone has contributed to local distinctiveness. The character of towns such as Creetown, Dalbeattie, Dumfries and Annan is very much defined by local granites and sandstones.
- The geology of Dumfries & Galloway has yielded a wealth of minerals and fossil fuels that have been worked for generations. The majority of the mining activities were of a small scale and of intermittent duration but have left a legacy in today's landscape including habitats associated with spoil and slag heaps.
- The total living matter in a hectare of soil ranges from 6,000 to 22,000kg (equivalent to 150-550 sheep). There are up to 10,000 different species of bacteria in one gram of soil, representing more genetic diversity than all the plants, mammals and birds in the whole of Scotland.
- Soils reduce the speed that rainwater reaches watercourses, filtering it in the process, thereby reducing flood risk and improving water quality.
- Scottish soils, especially peat, are rich in carbon and the adoption of sustainable practices that preserve or enhance this carbon sink is important. Carbon can remain stored in soils for years or may be quickly released back into the

atmosphere depending predominantly on how the soil is managed. Activities that contribute to loss of carbon from soils include deforestation, intensive cultivation and drainage of wetland and peatland.

3. Factors affecting geodiversity

- There are no identified **sites of local geodiversity importance**. In some other regions, voluntary groups have made audits of geological sites and features and have selected key sites (known as Regionally Important Geological and geomorphological Sites or RIGS) for protection. These are selected by locally developed criteria and are currently the most important places for geology and geomorphology outside statutorily protected land.
- **Climate change** may result in: warmer temperatures that increase loss of organic matter from soils; increased rainfall that leads to greater erosion, especially of upland peats that store carbon; and sea level rise that increases coastal erosion.
- There is evidence from England and Wales that **soil organic matter** is being lost, which will have serious affects on soil ecosystem services.
- Average **carbon content of soils** appears to be dropping. In England and Wales this has been estimated as 0.6% (4 million tonnes) per year. Soil that is sealed under built structures loses all its ecosystem functions.
- **Soil contamination** from atmospheric nitrogen and heavy metals can impact on soil fertility and biodiversity.

4. Recent and current activity

- A voluntary geodiversity group, GeoD, was formed in Dumfries & Galloway in 2008.
- Nationally important geological and geomorphological sites are protected as Sites of Special Scientific Interest (SSSIs) and represent the basis for site based conservation in Scotland. These were selected through the Geological Conservation Review (GCR), a site based audit of Britain's geological and geomorphological resource. The review identified 45 sites in Dumfries & Galloway, and range from natural outcrops and coastal cliffs to artificial sites such as quarries, pits, and road and rail cuttings.
- A geological trail in upper Nithsdale has been established by Kirkconnel Parish Heritage Society.
- A number of museums raise awareness of the importance of geodiversity.

5. Other recommended actions

- Secure resources to establish a site **monitoring system for geological and geomorphological sites**.
- Undertake an **audit of existing geodiversity information**.
- Carry out a **systematic survey** to identify potentially important examples of local geodiversity.
- **Review existing policy documents** from local authorities and targeted organisations to determine whether appropriate policy(ies) to safeguard geodiversity already exist.
- Identify sites with potential for **self guided walks and geological trails**.
- Identify potential locations for **on-site interpretation**.
- Identify potential locations for formal **education** or community led study.

6. Further Information

6.1 Publications

- Greig, D C. (1971) British Regional Geology: the south of Scotland. Her Majesty's Stationary Office, Edinburgh.
- Stone, P (ed). (1996) Geology in south-west Scotland: an excursion guide. British Geological Society. Keyworth, Nottingham.

6.2 Websites

- British Geological Survey www.bgs.ac.uk
- Scottish Geology www.scottishgeology.com
- The Geological Society www.geolsoc.org.uk
- The Macaulay Institute www.macaulay.ac.uk

RELATED STRATEGIES

Objective 9: Biodiversity incorporated into relevant strategies in Dumfries & Galloway.

Priority Action (RS1): Incorporate biodiversity objectives into all other relevant plans and strategies within the lifetime of this plan.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Background

Biodiversity is not confined to nature reserves or designated sites, but can be impacted on, or enhanced, anywhere in Dumfries & Galloway by virtually any human activity. Therefore, in addition to plans, programmes and strategies relating specifically to biodiversity, it is important to incorporate biodiversity objectives into all strategies where there may be a significant link.

The Strategic Environmental Assessment (SEA) regulations came into force under the Environmental Assessment (Scotland) Act 2005. These require completion of a systematic method for assessing the environmental effects of plans and programmes during their preparation, allowing for the mitigation of any adverse effects before plan implementation. Indeed this LBAP has itself been subject to the SEA process. The SEA process includes biodiversity as a key issue and presents an opportunity to reach a wider range of biodiversity stakeholders.

Neither does biodiversity respect political boundaries and it is important to ensure co-ordinated action across borders. In Dumfries & Galloway, this is particularly important for marine and upland habitats, and to a lesser extent riverine habitats, which are the ones that most commonly straddle administrative boundaries.

2. Environmental, Economic and Social Importance of Biodiversity

- Ensuring biodiversity and other environmental matters are included in economic and social plans, programmes and strategies contributes towards ensuring sustainable development.

3. Recent and current activity

- The Dumfries & Galloway LBAP is already specifically referred to in a number of local land-use strategies, including the Dumfries & Galloway Structure Plan, Local Forest Frameworks, Catchment Management Plans, National Scenic Area Management Strategies, Shoreline Management Plan, and Shellfish Management Plan.

4. Other recommended actions

- Focus attention on making LBAP actions relevant to **education and health sectors**, and others that do not relate mainly to land-use, such as community planning.
- Where possible, encourage specific **LBAP policies and objectives** in related local strategies, rather simple references to the LBAP.
- Prepare a **Supplementary Planning Guidance** note on biodiversity.
- Ensure LBAP objectives are adequately considered in **Environmental Impact Assessments**.
- Establish regular liaison with **adjacent LBAPs** in Ayrshire, South Lanarkshire, Scottish Borders and Cumbria.