

# SINGLE-CELLED SPECIES

## 1. Status and Distribution

In terms of weight, single-celled organisms are the most abundant form of life on this planet. They are too small to be seen by the naked eye but make up around half of all known species in Scotland:

**Viruses:** An estimated 3,300 species in Scotland.

**Bacteria:** An estimated 3,300 species in Scotland.

**Protozoa:** A rough estimate of more than 37,000 species in Scotland.

Viruses cannot multiply on their own, so they have to invade a 'host' cell and take over its machinery in order to be able to make more virus particles. Bacteria are capable of multiplying by themselves, as they have the power to divide. They exist everywhere, including on and inside our bodies. Viruses and bacteria are best known as agents of disease but most of them are completely harmless and some of them are essential for life.

The principal importance of Protozoa is to control the numbers and biomass of bacteria. They are also important as parasites and symbionts (where both partners benefit from the relationship) of multicellular animals.



A slime mould *Lycogala* sp. on decaying wood. (Peter Norman)

Slime moulds share some of the characteristics of protozoa single-celled organisms. However, they have been traditionally studied by mycologists and are often included in fungal studies. Physiologically, the creeping movement achieved by slime moulds is definitely animal-like, but the spore producing reproductive structures are fungus-like. They can be found in a variety of habitats, particularly on rotting wood or seaweed, but almost nothing is known about their distribution and importance in Dumfries & Galloway.

There is still much to discover about single-celled organisms, but it becoming clear that this microscopic life keeps many ecosystems functioning and keeps the Earth habitable. They play a particularly important role in soil ecosystems, though precisely how is not yet clear. It is likely that they are critical to many processes, including decomposition, nitrogen transformations, hydrological cycling and energy balances. Micro-organisms keep soils fertile, and detoxify pesticides and other pollutants.

Viruses numerically dominate the microbial component of the oceans with concentrations often found in excess of 100 million viruses per teaspoonful of seawater. Viral action has far reaching implications in determining microbial biodiversity, nutrient and energy flow, biogas production and hence contribute to global climatic control.

## 2. Threats

The principal threat to single-celled organisms is ignorance of their critical role and the potential impact of human activities. Whilst it is not currently feasible to manage habitats to enhance their populations of single-celled organisms, there are certain activities that are known to be damaging to them, and should be avoided where possible. Principal amongst these is excessive disturbance and contamination of soils.



## 1. Status and Distribution

Although some fungi resemble plants, molecular evidence suggests that they are more closely related to animals. However, they are sufficiently different to both to warrant their own kingdom. Most fungi grow in the form of microscopic filaments called hyphae that extend and branch at their tips to form a vast network or mycelium. The familiar mushrooms are merely the fruiting structures that arise from such a network, but many fungi do not have this shape.



*Shaggy Scalycap Pholiota squarrosa in Castledykes Park, Dumfries. October 2007. (Peter Norman)*

Fungi can reproduce vegetatively, but to exploit new habitats they produce millions of spores. Very few of these will successfully form new colonies. The larger fungi are divided into two main groups based on the way that they produce their spores. The *Ascomycota* produce their spores inside a long cell called an ascus. The *Basidiomycota* form their spores externally on a club-like cell called a basidium.

It is not possible to say with any certainty how many species occur in a particular locality as fruiting is highly variable from year to year. They are also very easy to miss since most species produce fruit bodies that decay and disappear within a few days. There are certainly more than 3,500 larger species in Britain, and as many as 12,000 if the microfungi are included. Few surveys have been completed in Dumfries & Galloway, so the figures below are likely to be well below the actual number of species present.

Minimum estimates of number of larger fungus species in Dumfries & Galloway (excluding lichenised fungi)

Wigtownshire	650
Kirkcudbrightshire	800
Dumfriesshire	450

Fungi play a vital role in nature. Many are saprotrophs, living on dead organic matter such as leaf litter and have an important role in recycling. Others form associations with the roots of trees and other plants (mycorrhizal fungi), assisting in the uptake of water and nutrients. Over 90% of plants have a fungus associated with their roots and many would not survive without their fungal partner. There are also over 1,000 species of invertebrate in the UK that are dependent on fungi for food and shelter.

Some of the most important organisms used in biotechnology are fungi. Brewing and baking have been carried out for thousands of years and both are dependent on fungal yeasts. Fungal fermentation has been harnessed to manufacture important therapeutic compounds, such as antibiotics and the cyclosporins used for preventing rejection of human organ transplants. Many enzymes are produced from fungi for use in the food, textile and other manufacturing industries. Indoor cultivation of edible mushrooms is a major industry, but so far limited to a few species.

Lichens consist of a fungus and an alga that live in close association with each other. The alga manufactures food through photosynthesis, whilst the fungus forms the main body of the lichen and provides a stable, protective environment for its alga.



*Map Lichen Rhizocarpon geographicum. Whithorn, August 2007. (Peter Norman)*

They reproduce by tiny spores that are borne on special miniature 'fruit bodies', though some can also reproduce vegetatively. Some crust lichens grow as slowly as 0.1mm a year and can live to a great age, probably the oldest living organisms in Scotland.

Being home to some 1,600 species, Scotland is a European biodiversity hotspot for lichens, resulting from its varied geology, topography and climate, comparatively rich heritage of ancient woodlands, and its possession of large areas little affected by atmospheric and water pollution, and intensive agricultural practices.



Curry-scented Milkcap *Lactarius camphoratus*, one of many species that exude a milky liquid from the gills. Hills Wood, September 2006. (Peter Norman)

Particularly important habitats for fungi include sand dunes, unimproved grasslands, and upland heaths; with the addition of coastal cliffs, inland rock outcrops and even man-made walls for lichens. However, woods and other habitats with trees are the best of all. Birches, willows, pines and old oaks are especially good for fungi and Ash, Hazel, Wych Elm and Sycamore for lichens, though some species, including rare and threatened ones, occur in association with other trees.

## 2. Threats

- Despite their vital role in ecosystems, fungi are rarely included in recording schemes, conservation projects and environmental assessments.

- Air pollution has been a major factor in the loss of fungi and lichens in the UK, though areas such as Dumfries & Galloway have been less severely affected. Continued improvements in air quality have resulted in recovery of lichen populations.



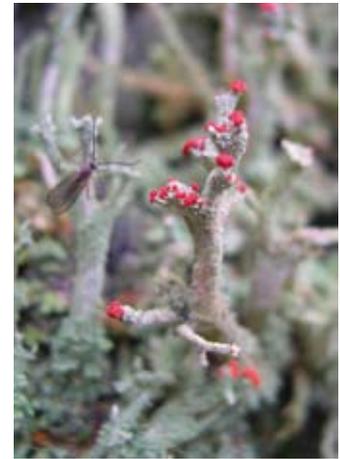
Candle-snuff Fungus *Xylaria hypoxylon*. Drumlanrig, September 2006. (Peter Norman)

- Loss of habitat has affected many species. For example, loss of mature elms through Dutch elm disease has drastically reduced Orange-fruited Elm Lichen *Caloplaca luteoalba* and *Bacidia incompta*, which were both formerly characteristic on the trunks of elms in rural, wayside and

parkland situations. Loss of unimproved grassland and deadwood has had a similar impact on many fungi.

## 3. Opportunities

- Manage fungi and lichen habitats appropriately, including minimum disturbance to soils, minimising nutrient enrichment and pollution, and retaining a full range of dead wood habitats. Habitat management is the only secure, long-term way of ensuring the conservation of most species.
- Encourage mycologists and lichenologists to visit and record in Dumfries & Galloway. Approximately half of Dumfries & Galloway's rare species of fungus were recorded by visiting mycologists on only two days in September 1993 – an indication that there are likely to be more rare species waiting to be discovered by anyone with the necessary identification skills.
- Follow the Scottish Wild Mushroom Code when collecting fungi.



Devil's Matchstick lichen *Cladonia* sp. Ironhirst Moss, February 2007. (Peter Norman)

## 4. Further Information

### 4.1 Publications

- Fletcher, A. (ed) (2001) *Lichen Habitat Management*. British Lichen Society, London.
- Spooner, B. & Roberts, P. (2005) *Fungi*. HarperCollins, London. (A general introduction to fungi but also includes a chapter on conservation)

### 4.2 Websites

- Association of British Fungus Groups [www.abfg.org](http://www.abfg.org)
- British Mycological Society (fungi) [www.britmycolsoc.org.uk](http://www.britmycolsoc.org.uk)
- British Lichen Society [www.thebls.org.uk](http://www.thebls.org.uk)
- UK Fungi <http://fungus.org.uk/>

# NON-FLOWERING PLANTS



Great Horsetail. Port Kale, August 2006. (Peter Norman)

## 1. Status and Distribution

Non-flowering plants consist of ferns, clubmosses, quillworts, horsetails, mosses, liverworts, hornworts and algae. Together they constitute a significant proportion of the UK's biodiversity.

There are around 2,100 species of mosses, liverworts and hornworts (collectively known as bryophytes) in the UK. This is one of the few species groups that is better represented in Scotland than in England, with almost 90% of the UK bryophyte flora found here, constituting around 60% of the European, and possibly as much as 5% of the world bryophyte flora. UK ferns and allied plants are less numerous, with 47 ferns, 7 clubmosses, 3 quillworts and 8 horsetails.

Climate is the major influence on bryophytes and ferns, and Britain's cool wet conditions are ideal for many species, though very few are limited to Britain and most can be found across the world. However, Britain, and north west Scotland in particular, is internationally famous for its 'Atlantic' bryophytes, some of which are otherwise found only in the Himalayas and British Columbia. Indeed, in international terms north west Scotland's bryophytes (and lichens) are perhaps the single most important biodiversity feature of the UK. Some of these important species have small outlying populations in other areas, especially north Wales, the Pennines, the Lake District and Dumfries & Galloway.

Bryophytes and ferns are perfectly adapted for rapid dispersal by vast numbers of tiny wind-borne spores, quickly colonising all natural and man-made habitats and dominating some of them. They are sensitive to air and water pollution, and many act as indicators of

a clean environment. They also fulfill a variety of other environmental roles, including providing a habitat for invertebrates and fungi; nutrient recycling in wetlands, woodlands and forests; stabilising damaged or burnt ground; and reducing flash flooding through their water absorption capacity. Yet they are often an ignored and neglected part of Scotland's biodiversity, and new discoveries are still being made.

Algae are the dominant plants of the marine and freshwater habitats. The majority are invisible to the naked eye and some species are more closely related to fungi and primitive animals than to flowering plants, but the seaweeds are the botanical masters of the sea, sometimes reaching hundreds of metres in length. Together algae carry out just under half of all the photosynthesis on earth, and they fulfill essential roles through modification the atmosphere, production of most of the marine and freshwater nutrients that support fisheries, and by providing ingredients for many foodstuffs. However, some species can cause problems, such as toxic blooms in lochs and reservoirs during the summer.

Algae are the most numerous of the non-flowering plants with more than 20,000 species thought to occur in the UK, around 9,000 of them in Scotland. Diatoms, none of which is larger than 2mm in diameter, are the predominant algal group in terms of both photosynthesis and numbers of species. They occur in almost all aquatic habitats, suspended in water (planktonic), moving through sediments, or attached to rock or other surfaces. A few grow on land, on soil or damp rock faces. Other algae form associations with fungus to create lichens, whilst stoneworts are a unique group of complex algae that typically grow in fresh or brackish water that is clear and unpolluted. 30 are found in the UK.

Minimum estimates of number of non-flowering plant species in selected groups in Dumfries & Galloway

Ferns <i>Filicopsida</i>	40
Clubmosses & Quillworts <i>Lycopsidea</i>	9
Horsetails <i>Sphenopsida</i>	8
Liverworts <i>Marchantiophyta</i>	170
Hornworts <i>Anthocerophyta</i>	3
Mosses <i>Bryophyta</i>	450
Red Seaweeds <i>Rhodophyceae</i>	100
Brown Seaweeds <i>Phaeophyceae</i>	56
Green Seaweeds <i>Chlorophyceae</i>	44



Particularly important habitats in Dumfries & Galloway for non-flowering plants include intertidal rocky shores, coastal sand dunes, coastal cliffs and slopes, native woods, lochs, rivers, fens, raised bogs, blanket bogs, inland rock outcrops, upland springs and flushes, and montane heaths.

## 2. Threats

Lack of knowledge about the distribution of non-flowering plants in Dumfries & Galloway, and the shortage of ecologists able to identify many of these species, is one of the greatest constraints on local conservation projects. However, this should not be used as an excuse for damage. Threats include:

- Changes in climate as a result of global warming may affect upland bryophyte flora.
- Air pollution is less of a threat than it once was, but still has the potential to locally affect non-flowering plant populations.
- Eutrophication resulting from the widespread use of fertilisers can be extremely damaging, especially in watercourses where common species of algae can wipe out more important non-flowering plants.
- Developments, including windfarms, hydro-electric schemes and roads, may be detrimental to habitats rich in non-flowering plants.
- Muirburn of wet ground can wipe out important bryophyte populations.
- The spread of non-native invasive species, especially *Rhododendron* in native woods poses a threat to bryophytes in these habitats. However, Dumfries & Galloway's woods are generally not as badly infested as those further north. Overgrazing and undergrazing of woods may also affect ferns and bryophytes.
- Drainage of bogs and other wetlands, as well as previous afforestation of many of these sites has reduced populations. Commercial peat extraction for horticulture is a non-sustainable use of a resource largely created from bog-mosses.
- Indiscriminate collecting of mosses for floral displays and hanging baskets is known to occur, but its effects are not clear.

## 3. Opportunities

- Raise awareness of the importance and sustainable uses of non-flowering plants
- Train ecologists and amateur naturalists in the identification and recording of non-flowering plants.
- Encourage non-flowering plant experts to visit and record in Dumfries & Galloway.
- Take the requirements of non-flowering plants into account in habitat management works.
- Reduce, and ultimately stop the use of horticultural peat.

## 4. Further Information

### 4.1 Publications

- Long, D. and Ward, S. (2005) *Strategy for the conservation of lower plants and fungi in Scotland*. Plantlife International, Salisbury.
- Rothero, G.P. (2005) *Mosses and Liverworts*. Scottish Natural Heritage, Battleby.

### 4.2 Websites

- British Bryological Society (mosses & liverworts) [www.britishbryologicalsociety.org.uk](http://www.britishbryologicalsociety.org.uk)
- British Pteridological Society (ferns) [www.nhm.ac.uk/hosted\\_sites/bps/](http://www.nhm.ac.uk/hosted_sites/bps/)
- British Phycological Society (algae) [www.brphycsoc.org](http://www.brphycsoc.org)



*A liverwort Conocephalum conicum. Dunskey Glen, July 2003. (Maggi Kaye)*

# FLOWERING PLANTS



## 1. Status and Distribution

Flowering plants form the major part of the very visible and easily recognisable biodiversity of the UK. They consist of two major groups – conifers that have seeds in a cone (Gymnosperms); and the others, which have the seeds in a fruit (Angiosperms). Angiosperms are further divided depending on whether they have one or two seed-leaves. Those with two (Dicotyledons) form most of the flowering plants; those with one (Monocotyledons) include grasses, sedges, rushes and orchids. Together, they range from the tallest trees, through shrubs to very small flowering plants such as pearlworts and Mossy Stonecrop that are less than 1cm high.

There are around 4,100 species of flowering plants in the UK. In the context of Europe, this number is low, partly on account of the physical separation of the British Isles from continental Europe after the last Ice Age. Before this, many species were able to colonise the islands, but the rise in sea-levels to form the English Channel and the North Sea created a barrier to the colonisation of further species. It is also partly because of the smaller range of habitats than on continental Europe with, for example, no mountains to rival those of the Alps nor large expanses of forest. Climatic variations are also smaller than those on the continent and this restricts the UK flora.

Unlike non-flowering plants there is a general decrease in the number of species the further north one goes in the UK. This is



*Sheep's-bit, Killantringan Bay, July 1998. (Peter Norman)*

partly a reflection of climatic differences between the various parts of the UK, but also a reflection of the less diverse geology of Scotland compared to that of southern England. However the west of Scotland, although on the same latitude as southern Norway, Moscow, Hudson Bay, and the Aleutian Islands, is influenced by the North Atlantic Drift or the Gulf Stream that renders the climate more temperate than these places. Consequently there is an overlap of plants in Scotland between northern species of mainly of Arctic, boreal or montane climates, and southern species of temperate, southern temperate, Atlantic and Mediterranean climates.

Of the plant species occurring in the wild in the UK, Dumfries & Galloway has under half, with the distribution between the three constituent counties as shown in the table below.

Number of species recorded in the three vice-counties of Dumfries & Galloway

	Dfs.	Kbt.	Wig.
All records	1288	1488	1209
Modern records (since 1970)	1134	1363	1084
Native	825	925	777
Archaeophytes	63	66	65
Neophytes	181	297	181
Casuals	62	72	58

*Archaeophytes are species introduced by man up to 1500 AD; neophytes are species introduced by man since 1500; casuals are species intermittently recorded and with no established populations.*

Native species make up around 70% of our wild flora, the remaining 30% being introduced to the region, either accidentally or deliberately by man. The proportion of the latter group is likely to increase with human activities.



*Yellow Flag Iris, Brighthouse Bay, June 2004. (Peter Norman)*

The most important habitats in Dumfries & Galloway for flowering plants are those where nutrient enrichment by man's activities has not been high.

These include much of the uplands, the coastline, native woods, raised and blanket bogs, some lowland and upland lochs, unimproved grassland and fens and marshes. Flowering plants of aquatic habitats have traditionally been overlooked by botanists and are under recorded. They have specific habitat requirements, governed by water flow, alkalinity, nutrient levels, substrate and water depth.

## 2. Threats

There is a considerable database on the distribution of flowering plants since 1962 which is being added to continuously. However there is little data on population size, which makes it difficult to assess changes in the flora. Threats include:



- Climate change, or global warming, which will affect not only the species present in the region, but also the composition of the flora of all habitats. Upland and montane species are most at risk.



*Harebell, Ravenshall. July 2007. (Peter Norman)*

- Rising sea levels could affect the shoreline plant communities and a loss of habitat coupled with an inability of the plants to transfer to new areas quickly enough.
- Eutrophication particularly of water-courses and water bodies as a result of widespread use of nitrate and phosphate based fertilisers draining in to the waters. The most vigorous species may out-grow and suppress the slower growing and rarer species that often rely on nutrient-poor soils for survival.
- Developments such as wind-farms, hydro-electric schemes and roads may be detrimental to habitats by alteration of drainage patterns, partial destruction of habitats, and fragmentation of habitats.
- Muirburn can reduce the heather component of heathlands to be replaced by coarse purple moor-grass with a lower species diversity
- Spread of invasive, non-native species such as *Rhododendron ponticum*, Japanese Knotweed *Fallopia japonica*, Variagated Yellow Archangel *Lamiastrum galeobdolon*, New Zealand Pigmyweed *Crassula helmsii*, and other aquatic species. This can result from dumping of unwanted garden plants in the countryside, where a few species may become invasive.
- Overgrazing or under-grazing of marginal habitats such as native woods, bogs, heaths and unimproved grasslands.
- Drainage of upland habitats and wetlands and replacement with a monoculture crop, for forestry and agricultural purposes, thereby reducing diversity.
- 'Gardening' of the countryside by repeated mowing/cutting of road verges which reduces biodiversity and the planting of roadsides with inappropriate species such as cultivated daffodils, introduced willows, seed mixtures derived from

non-local sources (often introducing species not found in the region).

### 3. Opportunities

- Raise awareness of the importance and sustainable uses of flowering plants.
- Increase the recording of flowering plants in the region by training people in identification and recording methods, utilising the Dumfries & Galloway Environmental Records Centre.
- Amend the management of road verges to recognise their important contribution to plant diversity and the attractiveness of the area
- Encourage participation in the government-funded agri-environment schemes.
- Encourage schools to become involved with projects to enhance the school grounds and to become more aware of their environment through visits to nature reserves.
- Encourage developers, land managers and planners to recognise the importance of biodiversity and develop a unified approach to the natural environment.



*Bog Asphodel, Cree Valley. July 2007 (Peter Norman)*

### 4. Further Information

#### 4.1 Publications

- Martin, M. E. R. (1985) Wild Plants of Dumfriesshire. Transactions of the Dumfriesshire and Galloway Natural History and Antiquarian Society III, 60, pp21-42.
- Silverside, A. J. (1990) *The Flowering Plants and Ferns of Wigtownshire: A very provisional checklist*. Unpublished.
- Stewart, O. M. (1990) Flowering Plants and Ferns of Kirkcudbrightshire. *Transactions of the Dumfriesshire and Galloway Natural History and Antiquarian Society III*, 65, pp1-68.

#### 4.2 Websites

- Botanical Society of the British Isles [www.bsbi.org.uk](http://www.bsbi.org.uk)
- Plantlife [www.plantlife.org.uk](http://www.plantlife.org.uk)

# INVERTEBRATES

## 1. Status and Distribution

Excluding microscopic species, at least 30,000 terrestrial and freshwater species of invertebrates are known in Britain, greatly outnumbering the combined total for plants, fish, amphibians, reptiles, birds and mammals. More than 14,000 species of insect alone have been recorded in Scotland. There are 60-70% fewer species in the marine environment, but the diversity of invertebrate lifeforms here is much greater with over 200 Orders, as opposed to less than 40 Orders on land and freshwater.

The number of invertebrate species occurring in Dumfries & Galloway will always remain unknown, although reasonably accurate estimates are available for some of the better studied groups.

Minimum estimates of number of invertebrate species in selected groups in Dumfries & Galloway

Land & freshwater snails & slugs <i>Mollusca</i>	121
Marine shellfish <i>Mollusca</i>	70
Dragonflies <i>Odonata</i>	21
Grasshoppers & Crickets <i>Orthoptera</i>	9
Mayflies <i>Ephemeroptera</i>	16
Lacewings <i>Neuroptera</i>	13
Butterflies & Larger Moths <i>Macrolepidoptera</i>	570
Ground Beetles <i>Carabidae</i>	139
Hoverflies <i>Syrphidae</i>	132
Spiders <i>Araneae</i>	280
Millipedes <i>Diplopoda</i>	26



Velvet Swimming Crab - almost all crustaceans are marine or aquatic species. (Paul Naylor)

Given that many terrestrial invertebrate species favour warm and relatively sunny conditions, Dumfries & Galloway's geographical position with a long south-

facing coast and mild winters makes it more suitable for many species than other parts of Scotland.

Invertebrates occur in every habitat and every location in Dumfries & Galloway. Of particular importance are:

- Intertidal sand, mud and rock for molluscs and many other marine invertebrates.
- Bare ground and dunes for mining bees and solitary wasps
- Wetlands for dragonflies, mayflies, aquatic bugs, water beetles, ground beetles and craneflies
- Flower rich grassland and scrub for weevils, leaf beetles, bumblebees and hoverflies
- River shingle for beetles and flies. Together with riverbanks, this habitat supports over 10,000 species.
- Coastal strandlines for sandhoppers, beetles and snails.
- Coastal slopes for grasshoppers & crickets, butterflies & moths and beetles.
- Decaying wood for longhorn beetles, rove beetles and flies, including hoverflies and fungus gnats. Over 1,000 species are found no-where else.
- Wet woodland for craneflies, moths and flies, including hoverflies.



Yellow Dung Fly *Scathopaga* sp. Kirkcudbright, July 2005. (Peter Norman)



Green Hairstreak butterflies are most common in the region on raised bogs. Catherinefield Moss, May 2007. (Peter Norman)

## 2. Threats

In the past there has been a widespread but erroneous belief that management for plants or vertebrates on a site will automatically cater for invertebrates. It is now clear that the needs of many invertebrates are not being met, even on nature reserves and many of Britain's historically important



invertebrate sites have declined due to a prolonged sequence of inappropriate habitat management decisions.

Not all invertebrates have the same needs and a simple uniform approach to habitat management may not maintain biodiversity, but there are a number of basic principles of invertebrate conservation:



*Speckled Bush Cricket. Ravenshall, August 2007 (Pete Robinson)*

- Many invertebrates have very specialised habitat requirements. Apparently minor features and microclimates may be of vital importance to them.
- Most invertebrates have annual life cycles. Suitable conditions must be present in each and every year. It may only take one 'wrong' year to cause local extinction. Poor timing of habitat management may have profound effects.
- Many species have poor powers of dispersal and cannot easily colonise new sites.
- Life cycles can be complex with different stages requiring different habitats.
- Vegetation structure is important, as is the juxtaposition of habitats, including edges and transitions in vegetation.



*Nursery-web Spider Pisaura mirabilis. Dalbeattie Forest, May 2006. (Peter Norman)*

### 3. Opportunities

- Take the requirements of invertebrates into account in habitat management works.
- Manage sites to create a mosaic of habitats and a varied vegetation structure.
- Raise awareness of the importance and sustainable uses of invertebrates.
- Train ecologists and amateur naturalists in the identification and recording of invertebrates.

- Encourage entomologists to visit and record in Dumfries & Galloway.

## 4. Further Information

### 4.1 Publications

- Kirby, P (1992) *Habitat Management for Invertebrates: A Practical Handbook*. RSPB, Sandy.
- Buglife (2005) *Managing Priority Habitats for Invertebrates*. Buglife.
- Futter et al. (2006) *Butterflies of SW Scotland*. Argyll Publishing, Glendaruel.

### 4.2 Websites

- Amateur Entomologists Society [www.amentsoc.org](http://www.amentsoc.org)
- Bees, Wasps & Ants Recording Society [www.bwars.com](http://www.bwars.com)
- British Arachnological Society (spiders & allies) [www.britishspiders.org.uk](http://www.britishspiders.org.uk)
- British Conchological Society (molluscs) [www.conchsoc.org](http://www.conchsoc.org)
- British Dragonfly Society [www.dragonflysoc.org.uk](http://www.dragonflysoc.org.uk)
- British Entomological and Natural History Society [www.benhs.org.uk](http://www.benhs.org.uk)
- British Myriapod and Isopod Group (millipedes, centipedes & woodlice) [www.bmig.org.uk](http://www.bmig.org.uk)
- Butterfly Conservation SW Scotland Branch [www.southwestscotland-butterflies.org.uk](http://www.southwestscotland-butterflies.org.uk)
- Dipterists Forum (flies) [www.dipteristsforum.org.uk](http://www.dipteristsforum.org.uk)
- UK Moths [www.ukmoths.org.uk](http://www.ukmoths.org.uk)

### 4.3 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 [www.snh.org.uk](http://www.snh.org.uk)
- Buglife Scotland (01786) 447504 [www.buglife.org.uk](http://www.buglife.org.uk)
- Butterfly Conservation Scotland (0870) 7706151 [www.butterflyconservation.org](http://www.butterflyconservation.org)



# FISHES



*Corkwing Wrasse, an abundant fish of shallow waters on rocky coasts. (Paul Naylor)*

## 1. Status and Distribution

The UK has a relatively limited freshwater fish fauna compared with most of Europe, with around 30 species. At least another 330 species of fish have been recorded in UK coastal waters.

Dumfries and Galloway supports possibly the most diverse range of freshwater fish in Scotland, although this includes many introductions, most of them brought in for angling purposes. Habitat requirements vary greatly and most species require different habitats for different stages of their life history, though unpolluted water is a requirement for all. In general terms, river fishes require a continuous flow; oxygen-rich water at suitable temperature and pH levels; a range of water depths and velocities; in-stream cover and overhanging vegetation; suitable substrates for reproduction; and adequate access to the right micro habitats at the right time of year. Fish of standing waters have different requirements, but all sizes of waterbody from ponds to large lochs, with all but the most extreme of nutrient levels, are capable of supporting fish communities.

The sand and mud flats of the Solway support a wide range of marine species and are particularly important spawning and nursery grounds for demersal (bottom-dwelling) species such as Plaice *Pleuronectes platessa* and Common Sole *Solea vulgaris*. More than 130 species have been recorded, including a greater number of tropical or tropical marine species than many other parts of Scotland. These have included Swordfish *Xiphias gladius*, Sunfish *Mola mola*, a number of tunnies and sharks, and even seahorses. This is probably because its waters are the most northerly of the shallow warm waters of the Irish Sea, before the relatively deep colder waters of the North

Channel. Rocky species, such as Conger Eel *Conger conger* and many wrasses, are also represented in the west but, not surprisingly, pelagic species (fish that swim in mid-water) and deep water species are not recorded in large numbers.

The coastal waters of Dumfries & Galloway do not support a large commercial fishery. Recreational fishing of both coastal and freshwaters is, however, more important to the local economy. Direct expenditure on angling was estimated to be worth almost £6.75m to Dumfries & Galloway in 2003, including more than £1m on coarse fishing. In addition to Salmon *Salmo salar* and Trout *Salmo trutta*, game fish include the Grayling *Thymallus thymallus* introduced to the Nith and Annan. Coarse species include Pike *Esox lucius*, Perch *Perca fluviatilis* and Roach *Rutilus rutilus*.



*Lamprey from Water of Fleet. (Galloway Fisheries Trust).*

## 2. Threats

- **Pollution** is a serious threat to all fish. This can arise from accidental spillages, both at sea and in freshwaters, but diffuse pollution may have more widespread and longer-term implications.
- Global **overfishing** of certain species reduces overall stocks, affecting local distributions.
- **Acidification** of freshwaters has had a serious impact in certain locations.
- **Obstacles** on watercourses can restrict or prevent migration.
- Escapes from fish farms may reduce the genetic integrity of native fish stocks.
- **Introduced species**, both non-native fish and non-fish species such as North American Signal Crayfish, pose a threat to some fish populations.



- Most UK freshwaters are free of serious **diseases**, but *Gyrodactylosis* and other diseases has been found elsewhere in Europe and has the potential to spread to Scotland, wiping out stocks completely.



*Atlantic Salmon from the River Dee.  
(Galloway Fisheries Trust)*

### 3. Opportunities

- Improve habitat management of river catchments and coastal areas. This should include habitats that are some distance from water, but may have an impact.
- Improve fisheries management to ensure that decisions are taken that benefit a wide range of species and the wider environment, rather than just the target fish species.
- Encourage fisheries managers and anglers to take all necessary precautions to prevent the introduction or transfer of diseased fish.

## 4. Further Information

### 4.1 Publications

Scottish Natural Heritage (2007) *River Bladnoch SAC Atlantic Salmon Catchment Management Plan*. Scottish Natural Heritage, Battleby.

### 4.2 Websites

- Association of Salmon Fishery Boards <http://asfb.hub.uk.com/>
- Atlantic Salmon Trust [www.atlanticsalmontrust.org](http://www.atlanticsalmontrust.org)
- Scottish Freshwater Fisheries Management [www.sffm.org.uk/](http://www.sffm.org.uk/)
- Shark Trust [www.sharktrust.org](http://www.sharktrust.org)
- Wild Trout Trust [www.wildtrout.org](http://www.wildtrout.org)

### 4.3 Advisory Organisations

- District Salmon Fishery Boards (see ASFB above website for current contact details)
- Galloway Fisheries Trust (01671) 403011 [www.gallowayfisheriestrust.org](http://www.gallowayfisheriestrust.org)
- Fisheries Research Services (01224) 876544 [www.frs-scotland.gov.uk](http://www.frs-scotland.gov.uk)
- Scottish Natural Heritage (01387) 247010 [www.snh.org.uk](http://www.snh.org.uk)



*Thornback Ray, common in both deep and shallow coastal waters. (Paul Naylor)*

# REPTILES & AMPHIBIANS

## 1. Status and Distribution

Some 85 species of non-marine reptile and 45 species of amphibian are found in Europe. Mainly for climatic reasons, Britain has only 6 non-marine native reptiles and 6 native amphibians, and though all 6 amphibians occur in Scotland, only 3 of the reptiles do so. In addition there are records of a few introduced species (of which 1 or 2 species in England may prove to be native), and records of 5 species of sea turtle in British waters.



Common Frog. Lochmaben, June 2007. (Paul McLaughlin)

Dumfries & Galloway is the only part of Scotland to support all Scottish native species of reptile and amphibian: Common or Viviparous Lizard *Zootoca vivipara*, Slow Worm *Anguis fragilis*, Adder *Vipera berus*, Great Crested Newt *Triturus cristatus*, Smooth Newt *Lissotriton vulgaris*, Palmate Newt *Lissotriton helvetica*, Common Toad *Bufo bufo*, Natterjack Toad *Epidalea calamita*, and Common Frog *Rana temporaria*. All these species occur most frequently along the Solway coast, but Common Lizard, Adder, Palmate Newt, Common Toad and Common Frog are more widespread, sometimes extending well into the Southern Uplands.



Common Lizard on fence post at Drumlanrig, April 2007. (Pete Robinson).

In addition there are a few unconfirmed records of Grass Snake *Natrix natrix*, and records of all of the marine turtles. Indeed, records of Leatherback Turtle *Dermochelys coriacea* are now so frequent that it is no longer considered to be just a rare visitor, but an integral part of the region's marine fauna.

## 2. Threats

- The public perception of reptiles, and to a lesser extent, amphibians, is not generally favourable. This sometimes results in deliberate killing.

- Habitat fragmentation has resulted in the isolation of some populations.

## 3. Opportunities

- Create ponds and wetlands in gardens, farms and forests. Together with associated habitat management, these significantly boost local populations of some amphibians.
- Raise the public profile of amphibians and reptiles, and their role in ecosystems.



Young Adder. (Pauline Spilling)

## 4. Further Information

### 4.1 Publications

- Beebee, T. & Denton, J. (1996) *The Natterjack Toad Conservation Handbook*. English Nature, Peterborough.
- Gent, T. & Gibson, S. (eds.) (1998) *The Herpetofauna Workers' Manual*. Joint Nature Conservation Committee, Peterborough.
- Langton, T., Beckett, C., & Foster, J. (2001) *Great Crested Newt Conservation Handbook*. Froglife, Halesworth.

### 4.2 Websites

- Amphibian & Reptile Groups of the UK [www.arg-uk.org.uk](http://www.arg-uk.org.uk)
- British Herpetological Society [www.thebhs.org](http://www.thebhs.org)
- Froglife [www.froglife.org](http://www.froglife.org)
- Herpetological Conservation Trust [www.herpconstrust.org.uk](http://www.herpconstrust.org.uk)
- National Amphibian & Reptile Recording Scheme [www.narrs.org.uk](http://www.narrs.org.uk)

### 4.3 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 [www.snh.org.uk](http://www.snh.org.uk)



# BIRDS

## 1. Status and Distribution

Approximately 700 species of bird are known from Europe, and 514 of these have been recorded in Scotland. This is a relatively small total compared to parts of Africa and South America, but British birds are the most highly studied species group in the world. In Dumfries & Galloway around 350 species of birds have been recorded. Of these, some 160 are known to have bred at some time during the last 100 years.



Whooper Swan. (Gordon McCall)

The most important habitats in the region for birds are the coasts and estuaries, and the many freshwater wetlands. Collectively these support internationally important numbers of overwintering and migrating wildfowl and wading birds. The Solway is regarded as one of the most important estuaries for birds in Europe and is particularly associated with Svalbard Barnacle Geese *Branta leucopsis*, with virtually the entire world population wintering on the Solway. The region's uplands are also important for breeding Hen Harriers *Circus cyaneus* and Peregrines *Falco peregrinus*. A number of wetland and upland sites have been designated as Special Protection Areas for their bird interest.



Black Grouse (Northeastwildlife.co.uk)

Other important populations include Barn Owls *Tyto alba* and Black Grouse *Tetrao tetrix*, whilst Red Kites *Milvus milvus* have been successfully reintroduced. In addition, the region is near the northern British limit for some species, such as Nightjars *Caprimulgus europaeus* and Willow Tits *Poecile montanus*, and near the southern limit for others, such as Black Guillemots *Cephus grylle* and Black-throated Divers *Gavia stellata*.

Other important populations include Barn Owls *Tyto alba* and Black Grouse *Tetrao tetrix*, whilst Red Kites *Milvus milvus* have been successfully reintroduced. In addition, the region is near the northern British limit for some species, such as Nightjars *Caprimulgus europaeus* and Willow Tits *Poecile montanus*, and near the southern limit for others, such as Black Guillemots *Cephus grylle* and Black-throated Divers *Gavia stellata*.

## 2. Threats

- **Habitat change**, particularly as a result of agricultural change and afforestation.
- **Loss of food and disturbance** resulted from Cackle dredging in the Solway, prior to regulation being introduced.
- Deliberate **persecution**, especially of birds of prey, reduced some species to extinction in the 19<sup>th</sup> century, and despite being illegal still limits some populations.
- **Climate change**, though likely to result in new species for Dumfries & Galloway, threatens others, particularly those that breed in the uplands or depend on food from the sea.



Barn Owl, Paul McLaughlin

## 3. Opportunities

- Create new habitats such as wetlands and native woodlands. Most bird species respond to habitat creation much quicker than other species groups.
- Diversify existing habitats. Relatively small changes to the management of extensive habitats such as farmland and forests can often produce significant benefits for birds, such as Black Grouse.
- Encourage participation in the government-funded agri-environment schemes.
- Encourage public participation in web-based surveys such as RSPB's Garden BirdWatch, BTO surveys or BBC surveys.



## 4. Further Information

### 4.1 Publications

- Dickson, R. C. (1994) *The Birds in Wigtownshire*. GC Publishers, Wigtown.
- Dodds, G.W., Appleby, M.J. & Campbell, L. (1996) *A Management Guide to Birds of Upland Farmland*. RSPB, Sandy.
- Forrester, R. & Andrews, I. (eds)(2008) *The Birds of Scotland*. Scottish Ornithologists' Club, Edinburgh.
- Symes, N. & Currie, F. (2005) *Woodland Management for Birds*. RSPB & Forestry Commission England, Sandy.
- Winspear, R & Davies, G. (2005) *A Management Guide for Birds on Lowland Farms*. RSPB, Sandy.
- Various editors. (from 1985) Annual Dumfries & Galloway Regional Bird Reports.

### 4.2 Websites

- British Trust for Ornithology [www.bto.org](http://www.bto.org)
- Scottish Ornithologists Club [www.the-soc.zenwebhosting.com](http://www.the-soc.zenwebhosting.com)

### 4.3 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 [www.snh.org.uk](http://www.snh.org.uk)
- RSPB Scotland, Dumfries & Galloway (01556) 670464 [www.rspb.org.uk](http://www.rspb.org.uk)
- Wildfowl and Wetlands Trust, Caerlaverock (01387) 770200 [www.wwt.org.uk](http://www.wwt.org.uk)



Peregrine Falcon. (Laurie Campbell)



# MAMMALS



*The current status of Water Voles in Dumfries & Galloway is unclear. (Environment Agency)*

## 1. Status and Distribution

More than 300 species of wild mammal have been recorded in Europe. The mammal fauna of Britain is considerably impoverished in comparison, amounting only to around 100 species. At least 79 of these are known from Scotland, though some of the bats, seals, whales and dolphins from only a handful of sightings. This impoverishment is largely due to the cutting of the land bridge between Britain and Europe soon after the end of the last Ice Age, before a number of species had managed to reach Britain. However all of the major mammal groups are present and British mammals are perhaps the best-studied on Earth.

Fifty-two species of mammal have been recorded from Dumfries & Galloway in recent times, as follows:

Insectivores	5
Bats	8
Lagomorphs (rabbits & hares)	3
Rodents	9
Carnivores	9
Ungulates (deer etc)	6
Seals	2
Cetaceans (whales & dolphins)	c10

Of these, at least 12 have been deliberately or accidentally introduced by man. A number of other species are known to have existed in historical times, but are now extinct. Compared to the rest of Scotland, Dumfries & Galloway has an especially rich bat fauna, and is the only area with recent reports of Harvest Mice.

Most terrestrial native mammals evolved in woodland habitats, and most remain associated with trees. However, a number such as bats, Badgers, Red

Deer and Red Squirrels have successfully adapted to highly-modified habitats including conifer plantations, farmland and even urban areas.

## 2. Threats

- There is a **lack of knowledge** of distribution, abundance and population trends for the majority of species in Dumfries & Galloway.
- A number of **non-native mammals** threaten native species. For example, Sika Deer and Red Deer, Grey Squirrels and Red Squirrels, and Mink and Water Voles.
- **Loss of habitat**, especially wetlands and native woods, has particularly affected some insectivores and bats that are dependent on the abundant invertebrate food associated with these habitats.



*Grey Seal (Gordon McCall)*

- The use of **toxic chemicals** in wetlands, farmland, gardens and in buildings has seriously reduced populations of some species, although this has become much less of a threat in recent years and some populations, such as Otters, have dramatically recovered.
- An **absence of natural predators** for larger herbivores such as deer and goats can lead to abnormally high populations that cause serious damage to semi-natural habitats, reduced animal health and ultimately to population crashes.



- A high incidence of **road deaths**, particularly affecting Hedgehogs, Badgers and Otters. The A75 is one of the worst roads in Scotland for mammal road kills. However, there is no evidence that this is having a serious overall impact on local populations.
- A poor **public perception** of some species, especially bats.



*Leisler's Bats in box at Buchan Wood, Glentworth. (Pete Robinson)*

### 3. Opportunities

- Increase the recording of mammals in the region by training people in identification and recording methods, utilising local bat, squirrel and mammal groups and Dumfries & Galloway Environmental Resources Centre.
- Eradication of non-native invasive mammals is unlikely to be possible. Monitor their distribution and carry out localised control programmes, using humane methods that are likely to be most effective to sustain native mammal populations.
- Take account of mammal requirements in habitat management.
- Carry out humane control of deer and goats to maintain populations that in balance with habitats.
- Where possible, install mammal underpasses on roads with a high incidence of mammal kills. Greatest opportunities arise when new sections of road are constructed.
- Continue the educational work of organisations such as the Dumfries & Galloway Bat Group to raise awareness of species that can be encouraged by the public.

## 4. Further Information

### 4.1 Publications

- Corbet, G. B. & Harris, S. (1991) *The Handbook of British Mammals* (3<sup>rd</sup> Edition). Blackwell, London.
- Entwistle, A. C., Harris, S., Hutson, A. M., Racey, P. A., Walsh, A., Gibson, S. D., Hepburn, I. & Johnston, J. (2001) *Habitat Management for Bats. A guide for land managers, land owners and their advisors*. JNCC, Peterborough.
- Forestry Commission, Bat Conservation Trust, Countryside Council for Wales and English Nature (2005) *Woodland Management for Bats*. Forestry Commission, Wetherby.
- Strachan, R. (1998) *Water Vole Conservation Handbook*. Wildlife Conservation Research Unit, Oxford.

### 4.2 Websites

- Badger Trust [www.badger.org.uk](http://www.badger.org.uk)
- British Deer Society [www.bds.org.uk](http://www.bds.org.uk)
- Mammal Society [www.abdn.ac.uk/mammal](http://www.abdn.ac.uk/mammal)
- Mammals Trust UK [www.mtuk.org](http://www.mtuk.org)
- SeaWatch Foundation [www.seawatchfoundation.org.uk](http://www.seawatchfoundation.org.uk)
- Whale & Dolphin Conservation Society [www.wdcs.org](http://www.wdcs.org)

### 4.3 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 [www.snh.org.uk](http://www.snh.org.uk)
- Scottish Badgers [www.scottishbadgers.org.uk](http://www.scottishbadgers.org.uk)
- Bat Conservation Trust Scotland (01786) 826 792 [www.bats.org.uk](http://www.bats.org.uk)
- Deer Commission Scotland (01463) 725000 [www.dcs.gov.uk](http://www.dcs.gov.uk)
- Red Squirrels in South Scotland [www.red-squirrels.org.uk](http://www.red-squirrels.org.uk)

# BIODIVERSITY INDICATORS

Monitoring of progress against this action plan will be carried out using an online national system called Biodiversity Action Reporting System (BARS). Many of the LBAP partners also carry out their own biodiversity monitoring and much of this is collated by the Dumfries & Galloway Environmental Resources Centre. However, it is not feasible to monitor and record everything. Therefore, in order to judge the overall effectiveness of LBAP activities monitoring of a suite of indicators will provide guidance on the main biodiversity trends.

There are 68 indicators set out in the UK Sustainable Development Strategy covering a broad canvas of social and economic activity. Of these, only a handful relate directly to biodiversity. There are four indices relating to bird populations and one each to biodiversity action, fish stocks and river quality. The Scottish Government is signed up to this strategy, but has also published its own Sustainable Development Strategy (Choosing our Future), and its own Biodiversity Strategy. In the latter, two kinds of indicator are described, biodiversity state indicators and biodiversity engagement indicators.

- Biodiversity state indicators are measures of abundance or diversity of species groups, extent and quality of habitats, and abundance of key biological indicators as a measure of wider ecosystem health.
- Biodiversity engagement indicators are measures of understanding of, and engagement with, biodiversity on an individual (personal and professional) and an organisational level. They also aim to examine how this affects actions and decisions of individuals and organisations.

It is important to ensure that local indicators relate to those being used at national level, so that the same information, once collected can be used to indicate a variety of different trends at different geographical scales. LBAP indicators should be able to contribute to the measurement of progress on other regional programmes where they will form a sub set of a wider indicator series. For example on sustainability within the Dumfries & Galloway Community Planning process.

For biodiversity state indicators to be of use the challenge is to have adequate data on abundance and distribution. For biodiversity engagement indicators, sufficient quantity and quality of data is required.

Biodiversity indicators for Dumfries and Galloway are as follows:

## Biodiversity State indicators

1. **Abundance of selected breeding birds** (e.g. Hen Harrier Red Kite) as monitored annually by Dumfries & Galloway Raptor Study Group/RSPB.
2. **Abundance of selected non-breeding waterbirds** (e.g. Barnacle Goose) as monitored annually through monthly winter counts by the Wetland Bird Survey/WWT/RSPB/JNCC.
3. **Abundance of breeding seabirds** as monitored by full seabird surveys across Scotland every 15 years, augmented by annual surveys of a sample of colonies by JNCC/RSPB.
4. **Vascular plant diversity in selected 10km squares** as monitored BSBI Atlas and local change data.
5. **Proportion of notified species populations in favourable condition on protected sites** as monitored every 6 years by SNH.
6. **Proportion of notified habitat area in favourable condition on protected sites** as monitored every 6 years by SNH.
7. **Salmonid counts** in main rivers as monitored annually by District Salmon Fisheries Boards/ Galloway Fisheries Trust.
8. **Freshwater invertebrate diversity** at selected sites as monitored annually by SEPA.
9. **Cockle stock assessment** as monitored annually by Solway Shellfish Management Association/Freshwater Research Services.
10. **Cetacean sightings** as monitored annually by volunteer Cetacean Group/SeaWatch Foundation.

## Biodiversity Engagement indicators

11. **Number of visitors to nature reserves** as monitored annually by WWT/RSPB/SNH/Forestry Commission.
12. **Number of people involved in biodiversity recording** as monitored by Dumfries & Galloway Environmental Resources Centre.
13. **Number of registered Eco-Schools and levels of awards** as monitored by Eco Schools.