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Scotland's State of the Environment Report, 2014

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1 Introduction

Scotland's State of the Environment Report is published on Scotland's Environment Website. It is a web based document which provides an assessment of the state of Scotland's environment and how it is changing. The report evolves through time as new information becomes available. For most sections it is updated at least once a year. However, it is important to take stock every few years and provide a snapshot of the state of the environment at that time. This document is a pdf version of the State of the Environment Report as it stands on 31 December 2014.

As well as hosting the State of Environment Report, Scotland's Environment website provides access to data and information held and managed by a wide range of organisations across Scotland so that it is easily available and in a usable form. The website is the result of an innovative partnership between a wide range of organisations involved in environmental protection and improvement in Scotland. It is funded by the EU Life+ programme and SEPA. The partners are listed in Appendix A.1.

1.1 What is the State of Environment Report?

The 2014 State of the Environment Report provides an assessment of Scotland's environment and how it is changing. It uses the most recent data available from a wide range of sources. It was written by authors from different environmental organisations, and was overseen by an Editorial Group. The editors, authors and contributors are listed in Appendix A2 & A3.

The Editorial Group aims for the report to be:

- impartial;
- trustworthy and evidence-driven;
- engaging, inviting and accessible;
- open to challenge.

We hope that you will be able to find the information you need. The overall key messages are provided, and there are five main chapters:-

- Air;
- Land;
- Water;
- Climate;
- People and the Environment.

Every chapter has a summary and a range of individual topics, each covering part of the environment.

In each topic we describe the condition (state) of that part of the environment and how it is changing. We assess the pressures causing the changes and consider what is being done to solve any problems. For many of the topics, we brought together a group of specialists to summarise the state and trends, and their assessments are shown at the start of each topic. As with any scientific report, we are limited by the available evidence and as a result there may be gaps in our coverage of some environmental issues.

We have referenced all the major points by providing links to sources of information and data, so you can check the facts yourself. In some topics there are links to relevant "Discover Data" applications, where you can interrogate the data at first hand.

We'd like your help to shape future versions of the report. On the website every page has a link to where you can submit comments; we encourage you to question anything you don't understand, and challenge anything you don't believe to be true.

1.2 State and Trend Assessment

The assessments of the state and trend are shown as a series of spectrum diagrams. These show the current condition of the environment covered by each topic as well as the future trend for that environment.

We report how confident we are in these assessments based on the level of agreement between the specialists who took part (high, medium or low agreement) and the evidence available to form that assessment (high, medium or low evidence). The specialists who took part are listed in Appendix A.4.

How the assessments were made

We contacted specialists with knowledge of each topic and asked them to take part in the assessments. The specialists came from a range of organisations across Scotland, including universities, public organisations, the Scottish Government, local authorities and research institutes.

We asked the specialists to independently complete a survey to identify the main pressures affecting the environmental topics they were contributing to. They also assessed the current state of those aspects of the environment, based on the Brundtland Commission definition of sustainability: “development which meets the needs of current generations without compromising the ability of future generations to meet their own needs”. The future trend was generally assessed for the time period in which current human activity is likely to have a strong impact.

These independent assessments were collated and a meeting was held for each topic, during which the pressures, state and trend were discussed. The groups then agreed on the final assessment and their level of confidence in the result.

Critique of the approach

These assessments provide a comprehensive review of the state of the Scottish environment and make use of the available evidence and expertise. However, any overall assessment is necessarily a simplification.

Assessments are of the current “average state”; some aspects of the environment covered by a topic will be in a better state, and others worse. Equally, the condition of some areas is improving, while others are worsening or staying the same.

We have taken account of the scale of any damage to the environment in these assessments; impacts can be locally damaging, but may have little effect on a national scale.

The assessments are based on the agreement between the specialists who took part; other specialists may have different opinions.

1.3 Who wrote this?

The State of the Environment Report contains many topics, each of them written by a lead author, with contributions from other experts. The authors and contributors are listed in Appendix A.3.

The Editorial Group oversaw the production of the report. Our members represent a number of organisations and a range of skills and experience. We are responsible for ensuring the text is consistent, balanced and accurate. You can read more about us in Appendix A.2.

For many of the topics, an assessment of the current state and the future trend was made. Section 1.2 State and trend assessments explains how this was done. Over 90 specialists took part in the assessment process and came to an agreement on the state and trend of each aspect of the environment. Therefore, the assessment may not fully represent the views of any particular individual. The specialists who took part are listed in Appendix A.4.

We are grateful to all who took part and helped to produce the State of the Environment Report.

1.4 Downloads

You can download pdf versions of the 2014 and 2011 State of the Environment Report from Scotland's Environment website. The key messages for the 2014 State of Environment Report are available in Gaelic.

2 Key messages

On the whole, Scotland's environment is of good quality and there have been many significant improvements in recent years. However, the State of the Environment Report clearly shows that some habitats and species are under threat, and poor air quality continues to affect some people in our towns and cities.

Over the centuries our landscapes have been moulded by people and the climate, and few untouched, native habitats survive. Nonetheless, Scotland's iconic environment provides the backdrop for the high quality of life many of us enjoy, and underpins many elements of a successful economy. Conversely, degraded environmental surroundings (often in areas where the poorest members of society live) have negative impacts on our health and happiness.

Our environment provides a wide range of benefits, such as the air we breathe, the food we eat and the water we drink, as well as the many materials needed in our homes, at work and for leisure.

Our land is used for a variety of purposes, and we depend on the soil for producing food and storing carbon. Our seas are biologically diverse and relatively unpolluted, with fishing and energy production amongst their varied uses. In most of the country the state of our freshwater environment is good, and in places this has improved markedly. Air quality meets the necessary standards in most areas, too.

Environmental regulation is generally implemented to an excellent standard, which is reflected in the state of our environment. However, Scotland, like other industrialised economies, has contributed to environmental damage in other parts of the world. Consumerism (our demand for goods, how industry supplies them and how we use and dispose of them) plays a significant role in all the environmental problems we face.

Globally, the biggest challenge to the environment is climate change. Available weather data show that Scotland's climate has changed over the last 100 years, with drier summers, wetter winters and more frequent heavy rainfall events. We are all making a substantial contribution to this rapid change in climate. A different climate will alter our environment dramatically and significantly affect the lives of everyone in Scotland.

All components of the environment are interlinked and depend on each other to remain in good condition. Below, we have described the quality of the individual major components. More detail on the linkages between them is given in each chapter and topic.

Air

Air quality in urban areas has improved significantly since the 1950s, but there are still some areas of towns and cities where the air quality is of concern. In urban areas, emissions from transport are a significant cause of pollution.

Water

Our freshwaters and seas are generally in good condition, and there have been significant reductions in pollution over the last 25 years. There are still problems resulting in the loss of habitat and wildlife (both current and historic) and from water pollution, predominantly from excessive amounts of nutrients entering the water. Floods and droughts can damage our economy and wildlife and affect our health and wellbeing.

Land

Scotland's highly diverse landforms, rocks and soils are the foundation of our landscape, wildlife and cultural heritage. Land is used for a variety of purposes, and we have to balance the many demands we make on it.

What we use the land for and how we manage, maintain and improve it are important causes of change. Expanding built developments and the projected growth in forest cover are changing the landscape, and more intense farming practices and how we manage our towns are altering habitats and wildlife.

What is being done?

Action to address these varied problems is being taken; for example, through the Land Use Strategy, National Marine Plan, Climate Change (Scotland) Act, Water Framework Directive River Basin Management Plans and the Scottish Biodiversity Strategy.

The overarching challenge is to achieve a sustainable balance between short-term needs and maintaining or improving the quality of our environment for future generations.

Reducing our impact on the environment is complex and can only be solved by public organisations, businesses, non-governmental organisations, research organisations and the public working together.

The Scottish Environmental Monitoring Strategy has been developed by CAMERAS (Co-ordinated Agenda for Marine, Environment and Rural Affairs Science) and aims to co-ordinate environmental monitoring across Scotland, to make it more efficient and cost effective. The strategy encourages the development of a series of monitoring actions plans (MAPs). The first phase of MAPs are being developed: a Soil MAP and implementation plan have been published; a Freshwater MAP has also been completed; an Air MAP is being developed. Other MAPs will follow in due course.

3 Air

The quality of the air around us is affected by pollutants released into the atmosphere through human activities, such as transport and industry, as well as from natural sources.

The quality of the air around us is affected by pollutants released into the atmosphere through human activities, such as transport and industry, as well as from natural sources. The quality of Scotland's air has improved considerably over the last few decades, and in general it is now cleaner than at any time since the Industrial Revolution (in the 19th century). However, in some areas poor air quality still affects human health and the environment.

State

Air quality in urban areas has improved significantly since the 1950s, but there are still some areas of towns and cities where the air quality is of concern. We have significantly reduced some pollutants through tighter controls on emissions. However, there is still a significant amount of work to be done.

The main air pollutants are:

- nitrogen oxides;
- particulate matter (fine dust);
- sulphur dioxide;
- ammonia;
- volatile organic compounds;
- ozone.

These pollutants are generated from a wide range of human and natural sources, and affect urban and rural environments, although the sources and effects may be different in the two environments. Despite reductions in emissions, we still see the impacts of airborne pollutants (acid and nitrogen-rich pollutants) in many of our sensitive habitats.

Challenges

The main challenges are emissions from:

- transport;
- energy production;
- industry (including agriculture).

In urban areas, emissions from transport are the primary concern, increasing levels of particulates and nitrogen oxides.

Response

Where air-quality standards are not being met, local authorities have set up Air Quality Management Areas (AQMAs). As monitoring and assessment in Scotland has increased, more AQMAs have been identified.Policy and legislative measures aim to reduce air pollution, but wider measures need to be considered to achieve further reductions.

Air Topic

What is it?

Air Quality - Our understanding of the sources and impacts of air pollution has improved over the years and applying it has led to better air quality in some areas. However, there are still areas in Scotland where poor air quality affects human health and the environment.

3.1 Air Quality

Our understanding of the sources and impacts of air pollution has improved over the years and applying it has led to better air quality in some areas. However, there are still areas in Scotland where poor air quality affects human health and the environment.

Summary

Key Messages

- Air quality has improved significantly since the 1950s, with dramatic reductions in some pollutants, such as sulphur dioxide.
- However, air pollution still damages our health and the environment. It is caused by emissions from industry, transport, energy and agriculture, as well as some household activities, such as heating.
- A number of pollutants are continuously measured across a range of urban and rural locations throughout Scotland. Where air quality standards are not being met, local authorities set up Air Quality Management Areas (AQMAs). As monitoring and assessment activities in Scotland increase, more AQMAs have been identified and declared.
- Although there are a number of policy and legislative measures in place aimed at reducing air pollution, wider measures will need to be considered to achieve further reductions.

State and Trend

State: Moderate - high agreement, medium evidence

Trend: Improving/stable - medium agreement, medium evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- The condition of the air environment has been assessed as moderate, with the majority of pollutants well below limits set for protecting human health and the environment, whilst in some areas pollutants are still above such limits. The overall assessment for air is therefore a simplification of all the different pollutant concentrations in the atmosphere.
- We have taken account of the scale of any damage to the environment and human health in these assessments; impacts of some types of air pollution can be locally damaging but may have little effect on a national scale (e.g. hotspots of urban air pollution caused by traffic congestion), whereas other types of air pollution may cause damage at a national scale (e.g. atmospheric deposition of acids and nutrients).
- The concentrations of some pollutants are decreasing rapidly; others are decreasing more slowly. Thus the overall trend is assessed as improving / stable.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

The quality of the air around us is affected by the pollutants released into the atmosphere through human activities, such as transport and industry, as well as from natural sources. The quality of Scotland's air has improved considerably over the last few decades, and the air we breathe today is cleaner than at any time since the Industrial Revolution. Although many consider our air to be pristine, we still have similar issues to those of other industrialised countries.

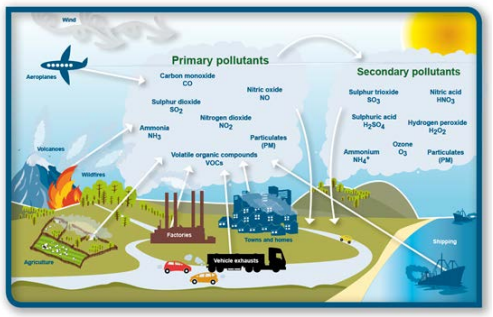

Figure 1: Sources of air pollution

Why does the quality of our air matter?

Air pollution is something that we all contribute to and are exposed to. Poor air quality, particularly within urban areas, can be bad for our health. In general, healthy people may not suffer from any serious ill effects, particularly resulting from the levels of pollution that are commonly experienced in Scotland's urban environment. However, people with pre-existing health conditions (such as heart disease, lung conditions and asthma) may be adversely affected by day-to-day changes in air pollution levels. While the majority of us do not suffer from any ill effects in the short term, continual exposure can cause harm over the long term. Public Health England have presented findings of a study on the increase in mortality risk associated with long-term exposure to particulate air pollution which estimated that in 2010, tiny particles in the air could have contributed to the deaths of 2094 people in Scotland.

Air pollution can also damage the wider environment. It can cause the acidification of soils and water, damaging plant and animal life in forests, lakes and rivers. It can also add nutrients to water and soils, which can damage biodiversity. Air pollution can also damage the fabric of buildings and monuments.

What are the main pollutants?

The main air pollutants are listed in Table 1 along with their main sources and effects. There are a wide range of human and natural sources.

Table 1: Main air pollutants, sources and effects

Pollutants	Sources	Effects
Nitrogen oxides (NO_x)	Mainly from combustion – including emissions from vehicle exhausts as well as from power generation, industry and households.The main source is transport, closely followed by energy generation.	Harms human health (increases symptoms of chronic lung disease).One of the causes of acid rain –contributing to the acidification of soils and water and damaging buildings.Contributes to nitrogen enrichment of soils and water.A key component in increased levels of ground-level ozone (O_3).
Particulate matter (PM) (fine dust)	Mainly from combustion – including emission from vehicles, ships, power generation and households. The main source is burning coal and solid fuel, closely followed by transport.Also from natural sources, such as sea salt, wind-blown soil and sand.	Health concerns focus on particles of less than 10 micrometres (µm) in diameter (PM_{10}) – especially those of less than 2.5 µm across ($PM_{2.5}$) – which contribute to chronic lung and heart disease.
Sulphur dioxide (SO_2)	Mainly from combustion of sulphur-containing fuels, such as coal. Also from industry, shipping and households.	Harms human health (increases symptoms of chronic lung disease).One of the causes of acid rain –contributing to acidification of soils and water and damaging buildings.
Ammonia (NH_3)	Mainly from agriculture – emissions from livestock farming, manure handling and the use of nitrogen fertilisers.	Harms human health as it contributes to the formation of secondary PM.Contributes to acidification and nutrient enrichment of soils and water.
Volatile organic compounds (VOCs)	Mainly from the use of solvents in products and industry, road vehicles, household heating and power generation.	VOCs are a key component in the formation of ground-level ozone – see below.
Ozone (O_3)	A secondary pollutant produced under certain conditions in the atmosphere, including the presence of NO_x and VOCs.	Harms human health (increases symptoms of chronic lung disease).Damages crops.Damages metals and paints.

The main air pollutants affect urban and rural environments, although the sources and effects may be different in the two environments.

Towns and cities have always suffered from some of the poorest levels of air quality. In the past, coal fires were a significant source of urban air pollution. During the winter months, emissions from domestic coal fires would often result in severe smog, which was common in many big cities, including Glasgow and Edinburgh. In London during the winter of 1952, there was a particularly bad smog episode in which the air was so polluted that sulphuric acid formed in the air. The smog lasted for five days and was estimated to be responsible for 4,000 deaths. This led to the government introducing the Clean Air Act in 1956 to prevent it happening again.

The black smoke and acidic pollutants associated with urban smog also caused significant damage to the stonework of many important buildings. Although the winter smog has gone, we now see summer smog (photochemical smog), which is a mixture of pollutants including ground-level ozone (O_3). Summer smog can damage the external fabric of buildings.

Although emissions from industrial and domestic sources have declined significantly, we still have areas (or hotspots) where air quality is of concern today, mainly as a result of transport emissions.

In general, air in our countryside is of much better quality than the air in our towns and cities. However, our rural environment can still be affected by air pollution. The sources and effects of the pollution can be very different from those in the urban environment. Agricultural activity is one of the main sources of air pollution in rural areas (such as emissions from pig and poultry farms).

Pollutants can undergo a variety of chemical changes in the air (including the formation of secondary pollutants) before being deposited back onto the ground, where they can damage soils and vegetation. Pollutants can also travel long distances in the atmosphere before being deposited on our countryside.

The deposition of acid and nitrogen-rich pollutants (such as NO_X and NH_3) can damage habitats by acidifying the soil and water and, and also by increasing the availability of nitrogen. This can affect the type and number of species present, particularly in ecosystems sensitive to those changes.

Air quality standards and objectives

To protect human health and the environment from poor air quality, a set of standards and objectives has been developed, which form the basis of our national air quality policies. The standards are concentrations of pollutants that are considered safe for humans and the environment. Air quality objectives take into account wider issues and can therefore represent either dates by which a standard must be achieved or a number of days in a year that a standard must not be exceeded.

State

The quality of Scotland's air has improved considerably over the last few decades. We have significantly reduced some pollutants through tighter controls on emissions from industry, transport and domestic sources. However, there is still a significant amount of work to be done. Air Quality Management Areas (AQMAs) are still being declared, and significant areas of our natural environment are still affected by pollutants from the air.

In Scotland there are 92 sites automatically monitoring pollutant concentrations in the air (Figure 2). These sites are mostly operated by local authorities, and a few are run as part of a UK-wide monitoring network. The sites are spread across a range of urban and rural locations. The Scottish Air Quality Database (SAQD) hosts most of the air quality data collected across Scotland.

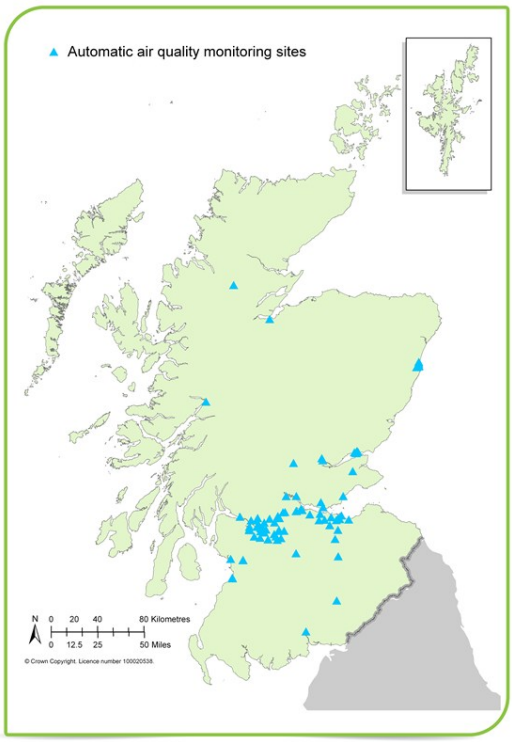

Figure 2: Locations of automatic air quality monitoring sites in Scotland

Source: Air Quality in Scotland

The data collected and held within the SAQD have been used to assess the state and trends in air quality throughout Scotland.

Nitrogen dioxide (NO_2)

There are 76 sites in the SAQD that continually monitor NO_2 in the atmosphere. The annual mean concentrations of NO_2 across sites affected by traffic are very variable and do not show any clear trends. Figure 3 shows the average annual mean NO_2 concentrations at sites across Scotland in 2012; 17 sites had NO_2 concentrations higher than the annual objective.

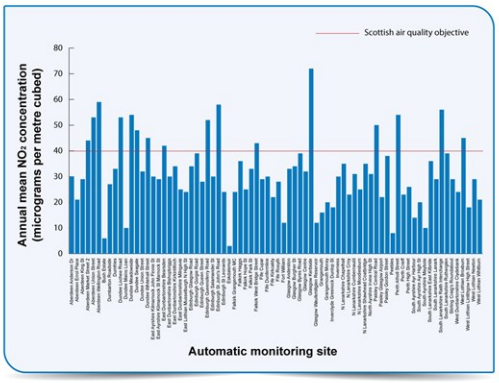

Figure 3: Annual mean nitrogen dioxide (NO_2) concentration across automatic monitoring sites in 2012. The Scottish air quality objective is shown in red

Source: Air Pollution in Scotland 2012 – Ricardo-AEA

Particulate matter

There are currently 74 sites in the SAQD that continually monitor PM_{10} concentration. Although urban background PM_{10} concentrations have been declining since the early 1990s, there is considerable yearly and daily variation across sites where there is traffic. In 2012 the acceptable annual mean PM_{10} concentration was exceeded at 12 sites, while the acceptable daily mean concentration was exceeded at seven sites (Figure 4).

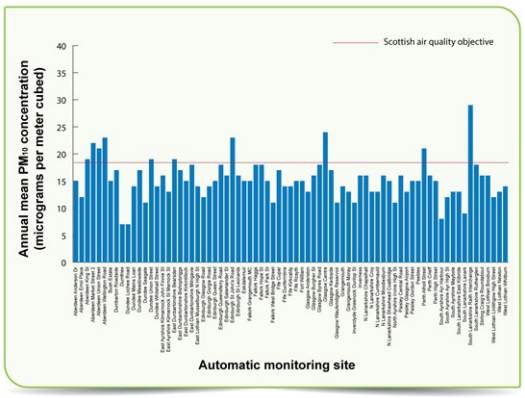

Figure 4: Annual mean PM_{10} concentration across automatic monitoring sites in 2012. The Scottish air quality objective is shown in red

Source: Air Pollution in Scotland 2012 – Ricardo-AEA

As part of a UK-wide monitoring network, six sites now measure $PM_{2.5}$ concentrations. Of these six sites, only four had enough data to calculate representative annual means in 2012. Three of these sites recorded annual mean concentrations below the acceptable air quality objective, while one site in Glasgow recorded an annual mean concentration above the acceptable limit.

Sulphur dioxide (SO_2)

There are currently 10 sites in the SAQD that continually monitor SO2 concentration. There has been a significant reduction in SO_2 concentrations in Scotland since the implementation of the Clean Air Acts in the 1950s and 1960s. This trend continued well into the 1990s and early 2000's, when tighter controls placed on industrial and transport emissions decreased urban concentrations of SO_2. The decrease in concentrations levelled off in the mid-2000s and they are now continually low. Figure 5 shows SO_2 concentrations at a city-centre site in Glasgow from 1996 to 2012.

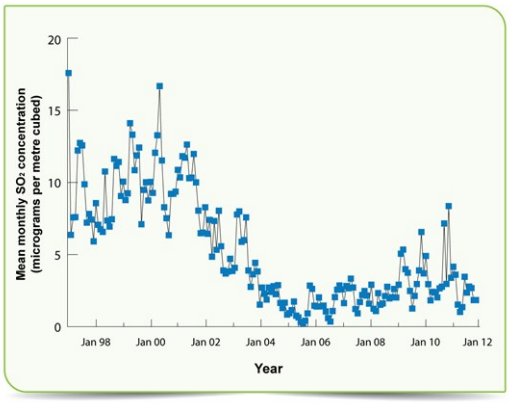

Figure 5: Monthly concentrations of SO_2 at a long-term city centre sampling location (Glasgow)

Source: Data obtained from Air Quality in Scotland – created using OpenAir

Ozone (O_3)

There has been a significant decline in the number of days when ground-level ozone concentrations are high over the last 20 years. Despite this, background levels have continued to rise across Europe and the UK, due in part to the long-range transport of pollutants from other parts of the world.

Ground-level ozone concentrations are generally lower in areas where there is traffic because gases in the exhaust emissions destroy the ozone. Figure 6 shows the difference between ozone concentrations in a city centre location and a suburban location over the same time period.

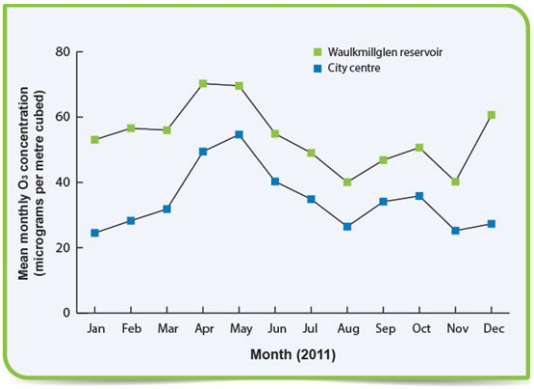

Figure 6: Concentrations of ozone (O_3) measured at a city-centre location and a suburban location in Glasgow in 2011

Source: Data obtained from Air Quality in Scotland – created using OpenAir

Ammonia (NH_3)

Ammonia (NH_3) and particulate ammonium (NH_{4+}) are measured as part of the UK National Ammonia Monitoring Network (NAMN). There are currently 85 sites in the NAMN, with 20 located in Scotland. Although there is considerable variation in levels of NH_3 and NH_{4+} in different regions, depending on local emission sources, the general background concentrations are below 2 micrograms per metre cubed (μgm_{-3}). Figure 7 shows NH_3 concentrations measured near Penicuik from 1996 until 2010.

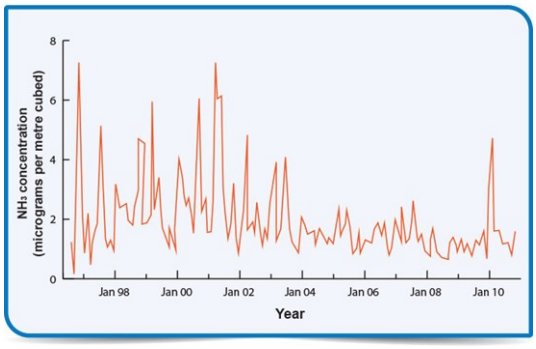

Figure 7: Concentrations of NH_3 monitored at Bush Estate, near Penicuik, Edinburgh 1996–2010

Source: Data obtained from the Defra National Ammonia Monitoring Network

Pressures affecting air quality

There are many pressures that affect air quality. Some relate directly to emissions, while others are more subtle, such as land use and urban planning.

The National Atmospheric Emissions Inventory (NAEI) has been collating emissions data for the UK since 1970, and provides an estimate of emissions in Scotland. Scottish emissions for all pollutants have decreased since 2000. However, the extent of reductions differs between pollutants. Table 2 shows how the main air pollutant emissions have changed since 2000 and suggests how they might change in future.

Table 2: Emissions of the key pollutants in Scotland, 2000-2011

Pollutant	Emissions (thousand tonnes per year)			Main Sources
	2000	2011	Trend	
Nitrogen oxides (NO_x)	177.00	98.00	▼45%	Transport is still the largest source of NO_X, accounting for 29%, while emissions from energy-generating sources account for 25%. As renewable energy sources increase, it is expected that the contribution from energy generation will continue to decrease.
Particulate matter (PM_{10})	17.90	12.30	▼31%	Burning coal and solid fuels is the largest source of PM_{10} emissions. Transport is also a significant source (17%), particularly in urban areas. Biomass (organic matter used as fuel) is a relatively small source, but if the rate of uptake continues as forecast its contributions will become increasingly important, especially in urban areas.
Sulphur dioxide (SO_2)	134.80	61.30	▼31%	Power generation is still the most significant source, accounting for 68%. However, this sector has reduced significantly as the use of gas and renewable energy sources has increased.
Ammonia (NH_3)	40.00	36.00	▼10%	Agricultural emission is the dominant source for ammonia, accounting for 65%. Emissions from waste (10%) have increased by 155% since 2008, mainly because of the increase in composting and anaerobic digestion.

Source: NAEI, Air Quality Pollutant Inventories for England, Scotland, Wales and Northern Ireland: 1990 – 2011

What is being done

Despite the significant improvements in air quality that have been achieved over the years, further measures are required to continue improving Scotland's air quality.

Legislation

In Europe more people die as a result of poor air quality than in road traffic accidents. It is the main environmental cause of preventable illness and premature death in the EU. Poor air quality also affects the environment; therefore, the European Commission has adopted a series of legislative measures to reduce air pollution.

Two main pieces of EU legislation dealing with air pollution.

- The directive on ambient air quality and cleaner air for Europe, which sets EU air-quality standards for ground-level ozone, particulate matter, nitrogen oxides, heavy metals and a number of other pollutants.
- The National Emission Ceilings Directive (NECD) which sets emission limits for sulphur dioxide, nitrogen oxides, ammonia and volatile organic compounds (VOCs), reducing national emissions to meet international agreements.

The European Commission has recently reviewed the EU's air-quality policy and legislation, and a revised Clean Air Policy Package for Europe was published in December 2013. The main components of the package are:

- A Clean Air Programme for Europe which includes measures to ensure that existing ambient air quality targets are met by 2020, and new air quality objectives to bring down pollution emissions by 2030;
- a revised NECD with stricter national targets for the main pollutants;
- a proposed directive to reduce pollution from medium-scale combustion activities.

The UK's Air Quality Strategy for England, Scotland, Wales and Northern Ireland was developed to improve air quality in the UK, to protect our health and the environment. It sets UK objectives for reducing a series of pollutants. For some pollutants Scotland has adopted more stringent objectives than the rest of the UK. The strategy sets out the UK's system for local air quality management (LAQM). The LAQM system is currently being reviewed and the proposals for the revision of the objectives will be released during 2014.

Local authorities

Local authorities must review and assess a range of pollutants that are set out within the Air Quality Strategy, declare as Air Quality Management Areas (AQMAs) any areas where standards are not being met, and put in place an action plan to reduce pollution levels. At present, 13 local authorities in the most densely populated areas of Scotland have declared AQMAs. The number of areas declared has increased from 26 in 2011 to 32 in 2013 and it is expected that this number may continue to rise in the future. Most AQMAs have been declared due to emissions from traffic.

The LAQM process has contributed significantly to the understanding of air quality, but more progress must be made, particularly in areas where the main source of pollution is road traffic, in order to be successful in improving air quality.

Local authorities also manage air quality in terms of planning and development, considering the impacts that development may have on local air quality.

Transport

Transport is the most significant source contributing to poor air quality in urban areas. Although emissions from transport have declined over the years, the rate of decline has started to level off. Therefore without additional measures to tackle transport-related pollution, it is possible that emissions will begin to increase again. Central and local governments have a long-term commitment to de-carbonise the transport fleet by 2050.

There are various measures available to improve air quality, such as Low Emission Zones, congestion charges, vehicles that run on alternative fuel and initiatives to encourage a shift from private to public transport. However, there has been limited progress in introducing larger-scale improvement measures. To help facilitate further improvements in urban air quality, the Scottish Government is currently developing a national low emission strategy for Scotland.

The public also have a role to play, such as using their vehicles less and, where possible, using public transport. By reducing congestion and individual vehicle mileage, this approach would reduce overall emissions. However, this requires a change in people's thinking and more effective and integrated public transport.

Industry

Considerable progress has been made over recent decades in controlling emissions from industrial sources. Robust legislation and stringent operating conditions, combined with technological developments, have significantly reduced national emissions. Further developments in technology and legislation will continue to drive down emissions.

Biomass

Emissions from well-operated and well-maintained modern biomass boilers are generally lower than for coal or oil equivalents. However, when they replace gas-fired appliances in urban areas, where poor air quality may already be an issue, emissions may contribute to local air quality issues. Therefore, biomass uptake in urban areas, both domestic (i.e. wood-burning stoves) and large scale, must be carefully controlled.

Citizen science

We can help in identify local issues through citizen science programmes. This approach allows people to provide information that can be used alongside the information already obtained from the monitoring sites in the SAQD, while raising awareness of air quality. Examples include monitoring air quality at a school or choosing to use less polluting forms of transport.

4 Water

Scotland has around 19,000 km of coastline, which makes up 8% of Europe's coast. The area from the coast to our fishery limits(470 km^2) is around six times the size of the land area of Scotland.

Scotland's water is essential for our health and prosperity. As well as being used for drinking, water is used in industry (e.g. distilling whisky and supporting fisheries), for producing energy (hydropower), and for recreational activities (such as bird-watching, angling and water sports). Scotland's seas support a wide variety of activities, including commercial fishing and energy production. Our water supports an array of habitats and contains nationally and internationally important populations of some species.

Scotland has around 19,000 km of coastline, which makes up 8% of Europe's coast. The area from the coast to our Exclusive Economic Zone is around six times the size of the land area of Scotland.

Covering about 2% of Scotland's land area, our rivers and lochs contain 90% of the UK's surface freshwater.

State

Our water is generally in good condition, and there have been significant reductions in pollution over the last 25 years.

Most of our seas, coasts and estuaries are in good or excellent condition. There are localised areas of concern, but pollution problems caused in the past have largely been addressed.

Habitats within Scottish inshore waters are declining in condition or are stable but still of concern, and most areas have some species that are declining to a point that is now of concern.

Most of our groundwater is in good condition, and approximately two-thirds of lochs and just over half of rivers were reported as being in good or better condition under the Water Framework Directive assessment.

Overall, the wildlife of rivers and lochs is considered to be in good condition, although a number of individual species are declining.

Challenges

For rivers and lochs, the main issues are:

- loss of habitat as a result of development (historic and ongoing);
- agriculture causing nutrient enrichment and habitat loss;
- energy production disrupting the natural movement of water.

The main challenges faced by the marine environment are:

- commercial fishing, which can harm the sea bed and marine species;
- aquaculture causing localised pollution;
- loss of coastal and estuary habitat to development;
- diffuse pollution of estuaries and coastal areas.

Groundwater is under pressure from:

- agricultural inputs;
- water abstraction, causing water-table levels to drop;
- pollution from historic mining activities;
- pollution from historic industrial activities.

Response

We need to work together to balance the many demands on our water environment. The National Marine Plan and River Basin Management Plans aim to encourage development that balances the needs of the economy, society and the environment, now and in the future.

Water Topics

What is it?

Coastal waters - Almost all (97%) of Scotland's coastal waters are in good or high condition, but there are local impacts from commercial fishing, aquaculture and diffuse pollution. Growth in industries such as aquaculture and renewable energy may increase pressure on coastal waters.

Estuaries - Scottish estuaries are important resources for wildlife and humans, and 85% are in good or high environmental condition. However, they remain under pressure from human activity, particularly from nutrient enrichment and the damaging impacts of climate change.

Freshwater lochs - Scotland's freshwaters provide a range of habitats for plants and animals. Overall, freshwater habitats and species are in good condition. However, while some individual habitats and species are improving, others are still under pressure.

Offshore waters - Our seas are biologically diverse and relatively unpolluted. Some fishing is unsustainable, and energy production competes for space and increases pollution risks.

Rivers and canals - Scotland's river quality has improved in recent decades. Almost half of our rivers are now of good or better quality. Plans are in place to improve the remaining poorer-quality rivers.

Benefits and uses

Aquaculture - Aquaculture is a growing and increasingly important industry in Scotland. It helps to underpin sustainable economic growth in rural and coastal communities, particularly in the Highlands and Islands, with many depending on the employment and revenue it provides.

Wildlife

Estuaries and coastal - Scottish coastal and estuarine habitats are full of rich, diverse and fragile sea life that is under considerable pressure and shows signs of damage, but may be recovered through sustainable management.

Rivers and lochs - Scotland's freshwaters provide a range of habitats for plants and animals. Overall, freshwater habitats and species are in good condition. However, while some individual habitats and species are improving, others are still under pressure.

4.1 Coastal waters

Almost all (97%) of Scotland's coastal waters are in good or high condition, but there are local impacts from commercial fishing, aquaculture and diffuse pollution. Growth in industries such as aquaculture and renewable energy may increase pressure on coastal waters.

Summary

Key messages

- Scotland has approximately 48,000 km^2 of coastal waters, which vary from sheltered sea lochs to exposed shoreline.
- The overall status of 97% of Scottish coastal waters is 'high' or 'good', with only 3% rated as 'moderate'.
- A new marine-planning structure, including a National Marine Plan, is being developed to manage the many demands on coastal waters.

State and trend

State: Good - high agreement, high evidence

Trend: Stable/declining - medium agreement, medium evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- This is based on a Water Framework Directive perspective.
- Most coastal waters are in a better condition but some are in a worse one based assessments of the current "average condition".
- The overall trend for coastal waters is that condition is improving but for some waters they are stable or declining.
- Making any overall assessment is necessarily a simplification.
- We have taken account of the scale of any damage to the environment in these assessments; impacts can be locally damaging, but may have little effect on a national scale.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

Coastal waters in Scotland are defined as extending from the 3 mile limit up to the limit of the highest tide. Scotland has approximately 48,000 km^2 of coastal waters, which vary from sheltered sea lochs to exposed shoreline. A wide range of coastal-water habitats supports a diversity of marine life. Many of these habitats and animals are protected.

They include:

- Sites of Special Scientific Interest (SSSIs) – coastal waters classed as SSSIs are intertidal areas, which contain seal populations and intertidal features of interest (such as eelgrass beds, saline lagoons, sand flats and reefs);
- Special Protection Areas with marine or coastal components – these are designated to protect birds;
- Special Areas of Conservation – these include a range of habitats supporting species such as the bottlenose dolphin, harbour seal and grey seal.

Marine habitats and their diversity of organisms provide a range of ecosystem services and benefits of significant value to Scotland. These are discussed in detail in the Marine chapter of the National Ecosystem Assessment.

Coastal waters support a range of commercial activities such as fishing, aquaculture, and ports, as well as recreational activities such as sailing, diving, angling, bathing, and bird watching. The oil and gas industry, and the developing renewable energy industry, is located further offshore.

State

In Scotland, 97% of coastal waters have a high or good status, with 3% affected by inputs of pollutants and damage to habitats. They remain under pressure from a wide range of human activities.

The quality of coastal waters is classified using the Water Framework Directive (WFD) system. Coastal waters with a 'high' status show very little human alteration from undisturbed conditions (i.e., their water quality, habitats and tidal regime are very similar to unaltered coastal waters). 'Good', 'moderate', 'poor' and 'bad' statuses show progressively more impact from human activities. You can find more details about the classification scheme in the 2008 State of the water environment report, and the scheme is explained further in the Policy Statement relating to the Water Environment and Water Services (Scotland) Act 2003.

Waters in a good condition:

- are free from pollutants at concentrations that would harm the water plants and animals they support;
- show minimal changes to their habitats;
- are not negatively affected by invasive non-native species (INNS).

In Scotland, 97% of coastal waters have a high or good status (Table1). Only 3% are in moderate or poor status, which is due to inputs of pollutants or physical damage of the sea bed

Table 1: Classification of Scotland's coastal waters, 2012 data

Indicator	**Status**									
	High		**Good**		**Moderate**		**Poor**		**Bad**	
	Number of water bodies	Area (km^2)	Number of water bodies	Area (km^2)	Number of water bodies	Area (km^2)	Number of water bodies	Area (km^2)	Number of water bodies	Area (%)
Overall status/ potential	146	5,917	299	40,468	12	1,324	0	0	0	0
Water quality	254	30,433	201	17,175	2	101	0	0	0	0
Bed and shores	444	47,059	7	411	4	232	2	7	0	0

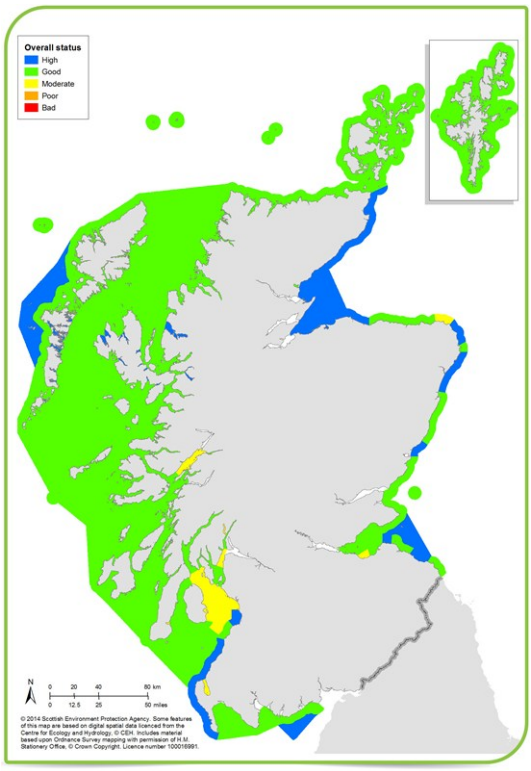

Figure 1: Classification of Scotland's coastal waters, 2012

Water quality

Pollutants from human activities that are discharged into coastal waters harm water, plants and animals in several ways.

Hazardous substances, such as trace metals, pesticides, oils and flame retardants enter the sea through waste water discharged from homes and industry, accidental spills, anti-fouling paint on ships, the dumping of dredge spoil, and from the atmosphere in the form of rain. Contaminants often become bound in sediments or accumulate in fatty animal tissue. Contaminant concentrations in sediments, mussels and fish in Scottish coastal waters are measured and assessed against international standards. These concentrations are generally low, although there are localised problems.

In the Firths of Clyde and Forth some contaminants are present in sediments, including those in harbours, and in mussels.

Polychlorinated biphenyls (PCBs), organochlorines and trace-metal contaminants have been found in stranded whales, dolphins and porpoises. Since 1990, the UK Cetacean Strandings Investigation Programme (CSIP) has been monitoring contaminants and has found that while the concentrations of some are on a downwards trend, PCBs still occur at relatively high levels.

Although a rich nutrient supply makes our coastal waters productive, too much can upset the balance of the ecosystem, leading to eutrophication. This can reduce the amount of oxygen in the water, making it uninhabitable for aquatic animals.

Habitats

Parts of the Scottish coastline have been modified by the construction of sea defences, ports and harbours. These modifications are often necessary to support the use of coastal areas for shipping, and to protect property from flooding and erosion. One section of the Scottish coast, on the southern shore of the Firth of Forth, has been modified to the extent that the associated water body has been downgraded to moderate status.

Bathing-water quality

Where bathing waters meet the criteria to be designated under the EC Bathing Water Directives the water quality must meet the standards set out in the Directive. Designated bathing waters are reviewed each year and the number has increased from 23 in 1988 to 83 in 2013. All but three of the designated bathing waters are coastal waters. Currently the compliance for each designated bathing water is calculated from the season's results. In 2013 no sites failed, with 36 (43%) achieving the mandatory standard and the remaining 47 (57%) the stricter EU Guideline standard for the presence of bacteria in the water. From 2016, bathing waters will be classified based on the previous 4 years performance. Diffuse pollution and discharges from combined sewer overflows are the most significant risk to coastal bathing waters.

Shellfish

Water quality is protected in coastal waters used for the commercial cultivation of shellfish. There are currently 84 designated shellfish waters, mostly in sea lochs in the north and north-west. Around one-third do not achieve the more stringent guideline values for faecal coliform bacteria in shellfish.

The Food Standards Agency (Scotland) classifies shellfish harvesting areas in Scotland every year on a seasonal basis. Most sites in Scotland are class A/B or A all year round. Shellfish from class-A sites can go direct for human consumption, while those from class-B sites must be processed first. The Food Standards Agency (Scotland) also monitors shellfish harvesting areas for the presence of biotoxins and biotoxin-producing algae. Biotoxins are natural substances produced by marine algae (phytoplankton), which can accumulate in shellfish and, if eaten, are a danger to human and animal health. The shellfish monitoring results are updated weekly and a shellfishery is closed if the toxins are above permitted levels.

Invasive non-native species

Invasive non-native species can cause serious problems in coastal waters. They can harm native species and alter the ecology. Twenty coastal waters have been downgraded from high to good status because of the presence of INNS, and they are recognised as a threat to the coastal ecosystem. The "Current condition and challenges for the future" report estimated that almost 10% of coastal waters are at risk of failing to meeting environmental objectives because of INNS.

Litter

Litter can be found below the high-tide level, lying on the sea bed and floating in the sea. The Marine Conservation Society monitors litter on UK beaches through the annual Beachwatch surveys. The results show that there were nearly 2,000 items of litter per kilometre of beach in the UK in 2010.

The amount of litter found on the 57 beaches surveyed in Scotland is slightly above the UK average, and there is a higher percentage of sewage-related (20%) and fly-tipped (1.6%) debris in Scotland compared with the UK averages of 7% and 1% respectively.

Radioactive substances in coastal waters

Radioactivity in the marine environment arising from licensed sites is reported annually in the Radioactivity in Food and the Environment reports. Radioactivity in the environment is well below the allowable rate. However, there are localised issues due to radioactive fuel particles entering the environment at Dounreay in the past, and the historic dumping of radioactive waste at Dalgety Bay.

Pressures affecting coastal waters

Climate change

The Marine Climate Change Impacts Partnership (MCCIP) publishes annual report cards (ARCs) on our understanding of how climate change is affecting UK seas. The latest one, ARC 2013, tells us that:

- temperature records continue to show an overall upward trend despite short-term variability;
- changes to plant growth are expected throughout the UK;
- climate change projections suggest fish species distribution will shift northwards at a faster rate than at present.

Marine climate change could affect the UK's marine leisure industry, which is an important sector of the economy. It identifies three big issues for the industry.

- Sea-level rise, wind and storm surges could damage site infrastructure.
- Changing weather conditions may reduce the number of people taking part in marine leisure.
- There need to be improvements to environmental legislation and more awareness (of carbon emissions in particular).

Regional assessments show that fewer changes attributed to climate change occur in Scottish waters than in English waters. An increased tendency for stratification (where freshwater and salt water doesn't mix thoroughly) leading to offshore blooms of algae (including those associated with killing fish) is predicted for the Scottish west coast.

Many marine scientists consider ocean acidification to be the biggest threat to the marine environment. In the last 200 years ocean acidity has increased by 30%, a rate much faster than at any time in the last 65 million years. Many organisms in the water and on the sea bed could become extinct as a result.

Fishing

The sea bed in coastal areas is inhabited by invertebrates, such as worms, shellfish, sea urchins and starfish. These provide an important role by recycling nutrients, and are a significant food source for fish that feed on the sea bed. In coastal waters, this habitat is under pressure from mechanical damage caused by scallop dredging and bottom trawling. Nets, pots and creels can also damage the sea bed.

Inshore fisheries operate in predominantly coastal waters (Figure 2) using a wide range of fishing techniques and equipment to catch finfish and shellfish species. This activity results in the following pressures:

- killing and removing the species being fished for;
- accidentally killing species not being fished for (known as by-catch);
- damage to the habitat;
- wearing away of the sea bed;
- siltation rate changes (arising from sediment re-suspension).

As well as killing fish and by-catch species directly, dragging nets and fishing equipment over the sea bed also causes damage. Although some damage results from static fishing (using pots and creels), most is caused by mobile equipment (trawling and scallop dredges).

Fishing also results in other pressures, such as underwater noise, but their impact is relatively minor.

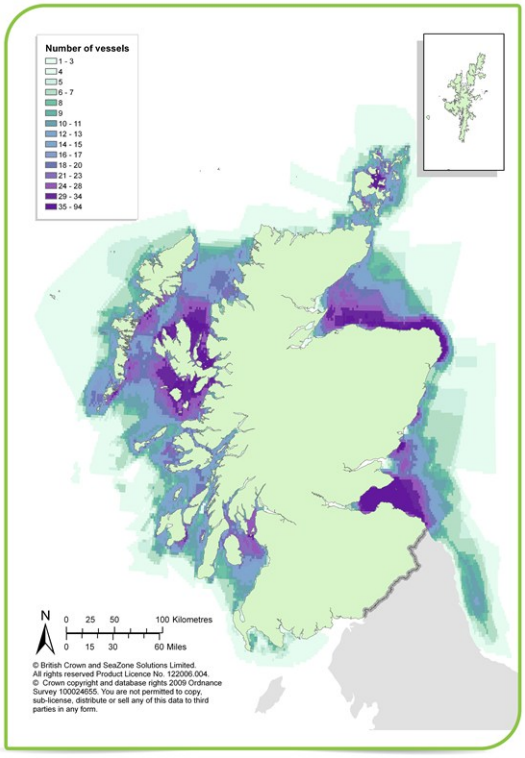

Figure 2: ScotMap output number of vessels fishing. All gear types (2007-2011)

Source: Marine Scotland Science

In coastal waters, killing target and non-target species by creeling, potting and trawling, as well as sea-bed abrasion and habitat damage from trawling, may have a negative effect on the ecosystem.

Stirring up sediment may release pollutants from the sediment, although the extent of this issue is unknown. Re-deposited sediment can smother organisms on the sea bed and may kill some sensitive species.

Inputs of nutrients to coastal waters

Nitrogen originates from run-off from land, especially in agricultural areas. The amount of nitrogen in coastal waters depends on the volume flowing from rivers into the sea, and this, in turn, depends on rainfall.

Contaminants

Contaminants enter coastal waters from discharges, run-off from land and rivers (direct and via estuaries) and are deposited from the atmosphere. Levels of some contaminants (phosphate, cadmium, copper, lead, nickel, zinc, mercury and lindane) entering coastal waters have been monitored at the tidal limit of rivers and in major discharges to estuaries and coastal waters since 1990. Data from this monitoring programme show that inputs from point source discharges have decreased.

The number and volume of oil and chemical spills are collated and reported by the Advisory Committee on Protection of the Sea (ACOPS). Most spills in coastal waters occur in ports and harbours and are generally small (less than 220 litres). These spills usually result in localised contamination of harbour sediments. Larger spills are generally related to damage to vessels. One of the biggest recent spills followed the grounding of a deep-sea fishing vessel on St Kilda in 2008.

Overall, the concentration of contaminants in Scottish coastal waters is low and they do not exceed WFD chemical standards.

Dredging and dumping

Disposal of dredged material is licensed and allowed only from ports, harbours and marinas. In general, only dredged material with contaminant concentrations below a threshold can be disposed of at sea, and dredged material may be re-used for land reclamation or beach nourishments when contaminant concentrations are low. There are currently 66 active disposal sites affecting 42.36 km^2 of sea bed. The majority are in coastal waters.

Aquaculture

Scotland is the third-largest producer of farmed salmon in the world. Fish in floating net cages are fed specially formulised pelleted diets. Faecal matter and waste food, often containing medicines used to control sea lice, are deposited on the sea bed beneath fish-farm cages. Stocking densities and the use of medicines are regulated to minimise the impact on the environment. Escaped fish may carry disease, and can interbreed with wild fish, leading to a dilution in genetic integrity of the wild population.

Microbiological contamination

Discharges of human and animal waste can lead to microbiological contamination. Human waste is discharged to the marine environment through treated sewage (from either sewage treatment works or septic tanks) and storm-water discharges. These sources are managed to minimise their impact, although sewage from treated discharges and from storm-water discharges remains a significant cause of pollution for coastal bathing waters.

It is more difficult to manage animal waste, which can enter coastal waters via rivers and run-off, as well as direct from wildlife and dogs on beaches. This has been linked to microbiological contamination of bathing beaches and shellfish waters.

Noise

Underwater noise is generated by dredging, shipping and construction. This may cause species that communicate by sound to avoid important areas (for example, spawning grounds) and reduce their ability to detect food. It may even damage their hearing, affecting their ability to communicate with each other about food, danger and reproduction. More evidence is needed on the extent of noise disturbance and its impact on wildlife.

Litter

The impact of litter on wildlife has not been quantified, but there are concerns about increasing amounts of litter on beaches, the sea bed, in the water and floating on the surface. The Beachwatch surveys have identified plastic as the main type of litter, with sources including:

- litter dropped by the public;
- sewage-related debris (such as cotton buds);
- discarded fishing gear;
- litter dumped at sea (deliberately or washed overboard from ships).

There is a particular problem with high densities of cotton-bud sticks on beaches in the Inner Firth of Clyde. Cotton-bud sticks pass through the screens on sewage outfalls and are slow to degrade.

A recent Fishing For Litter project press release showed that fishing vessels in Scotland have voluntarily removed more than 600 tonnes of marine litter from Scotland's seas. Although the amount of litter floating in coastal waters has not been measured, 45% of birds found in Scottish waters contained plastic in their stomachs.

Invasive non-native species

Invasive non-native species can be introduced by visiting ships and recreational craft (attached to the hull or in ballast water), floating litter and by aquaculture (escape of the farmed species or, more commonly, unintentional introduction alongside the farmed species). Invasive non-native species can significantly alter the ecology of our native communities, as well as causing problems for shipping and aquaculture. An example is the carpet sea squirt, which was found in a marina in Largs in October 2009. The carpet sea squirt spreads rapidly, smothering the sea bed and underwater structures.

What is being done

Regulation is currently the main mechanism for protecting coastal waters. In addition, some good-practice initiatives are in place, such as the development of marine spatial plans and voluntary coastal zone management partnerships.

Policy and legislation

Water Framework Directive

One of the main aims of the Water Framework Directive is to ensure that coastal waters achieve an ecological status of 'good', or equivalent (as defined in the directive) by 2015.

The European Water Framework Directive provides a framework for protecting and improving the condition of the water environment across Europe, through the development of River Basin Management Plans (RBMPs). In Scotland we are implementing the WFD through the Water Environment and Water Services (Scotland) Act 2003, which makes SEPA responsible for coordinating the development of the RBMPs, working in partnership with many sectors, public bodies and non-governmental organisations, These same sectors and organisations are responsible for the successful implementation of the plans, by developing partnership initiatives, and delivering public investment programmes and responsibilities.

Any new activities likely to have an adverse impact on the water environment are controlled under the Water Environment (Controlled Activities) (Scotland) Regulations 2011, known as 'CAR'. These include discharges of wastewater or industrial effluent, cooling water abstractions and engineering activities that can affect coastal waters.

The targets for improving the status of all coastal waters to at least good are shown in the river-basin management plan. Sea-bed damage is the main cause of downgrading in coastal waters. A long-term target has been set for improving coastal waters damaged by fishing, as this involves a collaborative approach to managing and improving the environment. River-basin management planning is designed to do manage coastal waters, and offers opportunities for more effective co-ordination between partners. Actions needed to improve the quality of coastal waters to good environmental status are detailed in individual Water Bodies Data Sheets.

Table 2: Targets for improvements to the status of coastal waters to be achieved through the Water Framework Directive (WFD)

Overall status/ potential	Target area (km^2) by year		
	2015	**2021**	**2027**
High	15,649	15,649	15,649
Good	28,698	29,388	31,532
Moderate	3,362	2,672	528
Poor	0	0	0
Bad	0	0	0
Total	**47,709**	**47,709**	**47,709**
Proportion of total at good or better status (%)	**93**	**94**	**99**

Litter

The recent European Marine Strategy Framework Directive includes litter as a descriptor of good environmental status. Member states will have to agree methods to assess litter, and set targets for achieving good status for litter by 2020. Other legislation designed to reduce litter in coastal waters include:

- International Convention for the Prevention of Marine Pollution from Ships, which prohibits the at-sea disposal of plastics and rubbish from ships;
- EU Port Waste Reception Directive on port reception facilities for ship-generated waste and cargo residues.

Marine Strategy Framework Directive

The European Marine Strategy Framework Directive (MSFD) was transposed into UK legislation in July 2010. The directive requires member states to manage their seas to achieve good environmental status by 2020. The MSFD applies to coastal water and seawater out to the territorial limit, and it does not apply to estuaries. The MSFD lists 11 qualitative descriptors of good environmental status.

Key requirements of the MSFD:

- an assessment of the current state of UK seas;
- a detailed description of what GES means for UK waters, with a set of associated targets and indicators.

These two elements (above) were published in the Marine Strategy Part One on 20 December 2012. Monitoring to measure progress towards environmental status should be established by July 2014. Member states must establish a programme of measures to achieve good environmental status by 2016.

Marine (Scotland) Act

The Marine (Scotland) Act helps balance competing demands on Scotland's seas. It aims to protect and enhance the marine environment and boost economic investment and growth in areas such as marine renewables. The Act will be implemented in the following ways:

- the marine planning system balances the need for resources with the need to protect our marine environment. The National Marine Plan sets out objectives and national priorities, while regional marine plans provide the context in which conflicts between different sectors can be resolved and key areas for key uses can be defined;
- there is a marine licensing system for developments in coastal waters that require approval;
- there are new powers to designate Marine Protected Areas (MPAs). This provides greater flexibility for Ministers to use area-based measures to conserve marine biodiversity as well as nationally important historic assets such as historic shipwrecks. The Scottish Government is in the process of establishing new (MPAs) of national importance to meet international commitments for protecting our seas;
- improved protection for seals and a new comprehensive licence system will ensure appropriate management when necessary.

Sustainable resource management

Shellfish waters

Actions required to improve the quality of shellfish waters are outlined in individual Pollution Reduction Plans. Scottish Water has made significant investment in sewage treatment to reduce microbiological inputs to these waters; however, studies have shown that run-off from land contaminated with animal faeces is a significant source of contamination in some waters. Rules are in place to help control diffuse pollution, and initiatives are used in some areas to tackle diffuse sources entering rivers.

Inshore fisheries

Fishing provides fish and shellfish for human consumption. Inshore fisheries are managed to maintain our fish stocks.

Scottish Government is currently assessing the potential effects of a ban on certain types of fishing gear within 1 or 3 miles of the coast.

Bathing waters

At some locations electronic signs are being used to provide bathers with daily predictions of water quality. These signs are located at 23 bathing waters and contain individual beach profiles with information about pollution sources and risks.

Contaminants and nutrients

The Oslo and Paris Commission (OSPAR) has been working for more than 20 years to reduce levels of hazardous substances entering the marine environment by regulating industries and phasing out the use of some toxic substances.

There is some evidence of a decrease in the use of a third of the 26 priority chemicals identified by OSPAR. Water-borne cadmium, lead and mercury entering coastal waters are decreasing, and there has been a decrease in lindane. However, polychlorinated biphenyls can still be detected in sediments and biota. More information is required to determine whether the ban on brominated flame retardants has been successful.

Best Management Practices guidance for agriculture and Sustainable Drainage System guidance have been produced to address the problem of diffuse pollution.

Dumping material at sea has progressively reduced since the 1980s as bans were imposed on the dumping of radioactive wastes (1982), colliery mine stone (1995) and sewage sludge (1998). The disposal of wastes is currently allowed only at licensed sites at ports, harbours and marinas. These restrictions have led to an overall reduction in disposal of dredge spoil at sea since 2005.

Chemicals used to control diseases in farmed fish are licensed and their use is monitored.

Litter

There are several practical initiatives to reduce litter in Scotland's environment.

- Scottish Water's Bag It and Bin It campaign aims to stop contamination of beaches caused by sanitary waste through the sewerage network.
- The Keep Scotland Beautiful beach award scheme.
- The Forth Estuary Forum and Firth of Clyde Forum actively campaign to reduce litter on beaches in their areas.
- The Fishing For Litter project encourages fishermen to return litter caught in their trawls for monitoring and proper disposal. It has been estimated that litter costs the marine fishing industry up to £30,000 per year per boat, due to contamination of catches, broken gear and fouled propellers.

Recreation

The Green Blue organisation gives guidance to recreational boat users on how to reduce their impact on the water environment. The Green Blue's Marine Toolkit is designed to help managers of leisure-boating businesses and leaders of boat clubs keep to the regulations and reduce waste.

Oil spills

Port authorities have a responsibility to respond to spills from boats in their harbour area. Clearwater Forth is an example of an emergency response plan for the Forth.

In the event of a major spill from shipping or offshore oil and gas installations, the national contingency plan is implemented.

Invasive non-native species

The Invasive Non-Native Species Framework Strategy for Great Britain sets out the agreed hierarchical approach to invasive non-native species:

1. Prevention;
2. early detection, surveillance, monitoring and rapid response;
3. mitigation, control and eradication.

4.2 Estuaries

Scottish estuaries are important resources for wildlife and humans, and 85% are in good or high environmental condition. However, they remain under pressure from human activity, particularly from nutrient enrichment and the damaging impacts of climate change.

Summary

Key messages

- In Scotland there are 49 estuaries assessed as part of the Water Framework Directive (WFD), including nine salt-water lagoons, covering an area of approximately 1,000 km^2. The Solway estuary alone covers 300 km^2.
- Just over half of the estuaries are in good condition, with a further third at high status.
- A range of pressures from human activities have a significant impact on the remainder.
- Estuaries have been lost or damaged by land claim, building and sea defence walls.
- Historically, some estuaries (e.g. Forth and Clyde) have been affected by chemical contamination, but this has been greatly reduced.
- Nutrient enrichment from diffuse pollution is still a problem in some estuaries, although inputs are reducing.

State and trend

State: Good - high agreement, medium evidence

Trend: Improving - high agreement, medium evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- This is based on a Water Framework Directive perspective.
- Assessments are of the current “average condition”; some estuaries are in a worse condition, and others are in a better one. Equally, the condition of some estuaries is improving, while others are declining or stable.

- Making any overall assessment is necessarily a simplification.
- We have taken account of the scale of any damage to the environment in these assessments; impacts can be locally damaging, but may have little effect on a national scale.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

Estuaries connect rivers and the sea. Scotland’s predominantly low-lying east coast is dominated by the three major firths and their adjacent estuaries – the Forth, Tay and Moray. The west coast, however, is quite different, characterised by a highly indented landscape with long, narrow fjordic sea lochs and the two major estuaries of the Solway and the Clyde. In estuaries the fresh water from rivers becomes increasingly salty (saline) as it mixes with seawater. The Clyde estuary is an example of a stratified estuary (where freshwater and salt water doesn’t mix thoroughly). In contrast, estuaries on the east coast are usually partially or well mixed.

Some estuaries contain saline lagoons, which are often almost entirely cut off from the sea and have ecological conditions somewhere between freshwater lochs and the sea.

In Scotland there are 49 estuaries assessed as part of the WFD, including nine salt-water lagoons, covering an area of approximately 1,000 km^2. The Solway estuary alone accounts for 30% of the total area of estuaries in Scotland.

Human activity around estuaries has often developed around important transport routes, and today many contain ports and harbours, industry and large population centres – most large conurbations in Scotland are located on estuaries. As a result, these estuaries receive large volumes of treated sewage and industrial waste water (treated sewage and industrial effluent), which can contaminate sediments.

Estuaries provide valuable habitats and breeding grounds for fish and birds, and the surrounding organic-rich mudflats and salt marshes provide an abundant food supply for these species. Migratory water fowl are attracted to Scottish estuaries by the milder weather; over half a million waterbirds spend the winter in Scotland. Animals and plants living in estuaries have adapted to cope with the changes in saline levels and the depth of the water, which occur twice a day with the ebb and flow of the tide.

Many Scottish estuaries are protected because they are home to national or international important habitats and wildlife. They include:

- Sites of Special Scientific Interest (SSSIs) – some contain intertidal features of interest (such as eelgrass beds, saline lagoons, sand flats and reefs)
- Special Protection Areas with marine or coastal aspects – these are designated to protect birds
- Special Areas of Conservation – these include a range of habitats and species

Marine habitats and their diversity of organisms provide a range of ecosystem services and benefits of significant value to Scotland. These are discussed in detail in the Marine chapter of the National Ecosystem Assessment.

Estuaries can be damaged as a result of building development as well as by contamination from waste water and fertilisers used in agriculture. Damaging estuaries can result in the loss of socio-economic benefits (e.g. their use for transport and for cooling during the process of electricity generation), income from tourism, water storage (increasing the risk of flooding) and important habitats, as well as their role as nursery and overwintering grounds for commercially important fish species.

State

Overall, half of Scotland's estuaries are in good environmental condition, with generally clean water and little evidence of human alteration. A further third are at high status. The condition of the remaining seven of Scotland's estuaries are affected by high levels of nutrients entering the water, or factors (such as damaged habitats and invasive non-native species (INNS)), which have a negative impact on a smaller number of estuaries.

Impacts from INNS and climate change may become more common in the future, as the climate changes.

The environmental condition of estuaries is classified using the WFD classification scheme. Estuaries given a 'high' status show very little human alteration from undisturbed conditions, and those with a 'good' status have only low levels of human alteration. Estuaries with a 'moderate', 'poor' or 'bad' status show progressively more impact from human activities.

If an estuary has been significantly altered by human activity to provide an important socio-economic benefit (such as a harbour) then it cannot meet good status. In these cases, the estuary will be classified according to its potential - whether the estuary is in as good a condition as it can be, accepting that it has already been significantly physically altered.

You can find more details about the classification scheme in the 2008 State of the water environment report, and the scheme is explained further in the Policy Statement relating to the Water Environment and Water Services (Scotland) Act 2003.

Estuaries in a good condition:

- are clean and free from levels of pollutants that would harm the water and the plants and animals it supports;
- have minimal changes to their habitats and tidal regime;
- are not negatively affected by invasive non-native species.

Overall, over 85% of our estuaries have a high or good status (Table 1 and Figure 1).

Table 1: Classification of Scotland's estuaries, 2012

Indicator	Status									
	High		Good		Moderate		Poor		Bad	
	Number of water bodies	Area (km^2)	Number of water bodies	Area (km^2)	Number of water bodies	Area (km^2)	Number of water bodies	Area (km^2)	Number of water bodies	Area (%)
Overall status/potential	16	120	26	433	6	431	1	10	0	0
Water quality	25	237	18	326	6	430	0	0	0	0
Bed and shores	32	742	10	196	3	40	2	11	2	5

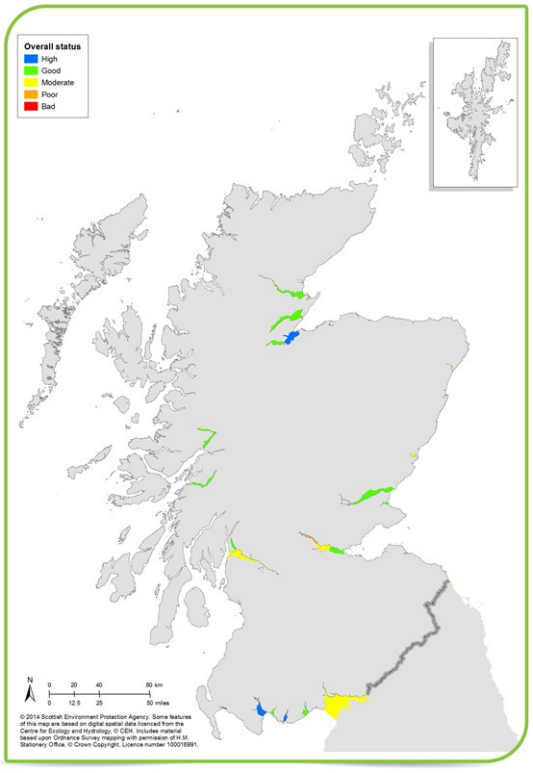

Figure 1: Overall status of estuaries in 2012.

Water quality

Water quality in estuaries is affected by:

- diffuse pollution;
- waste-water discharge.

Just six of Scotland's estuaries have a status of moderate because of relatively high concentrations of nutrients that can harm wildlife.

The Solway estuary, the Montrose basin and the Ythan estuary are all at moderate status because of high nutrient inputs from agriculture. The Montrose basin and the Ythan estuary are small estuaries on the east coast, but the Solway accounts for 30% of the total area of estuaries in Scotland.

Although a rich nutrient supply makes our estuaries productive, an excessive nutrient supply can upset the balance of the ecosystem, leading to eutrophication. Excessive input of nutrients accelerates the growth of algae and other water plants. The decay of these plants at the end of the growing season may cause oxygen depletion, which impacts on wildlife. Aquatic animals can also be starved of oxygen as a result of the breakdown of organic matter in waste water discharges (e.g. in sewage), using up oxygen as it decays.

Although most estuaries are at good or high status for oxygen, the Clyde and upper Forth estuaries have altered oxygen levels, due to waste-water discharges. The sediments in both estuaries contain organic matter from previously untreated discharges, and this contributes to the problem.

Some chemicals in water that damage wildlife are defined as hazardous substances. When attached to sediments, hazardous substances can persist for many years, and when in animals they can accumulate through the food chain.

Contaminants in sediments and mussels in the Forth and Clyde estuaries are relatively high, mainly because of historic discharges. There is evidence that contaminant concentrations in mussels are decreasing, although the concentrations in sediments have not yet decreased to the same extent.

The population of sediment-dwelling animals in intertidal and subtidal sediments in the Forth estuary has gradually become more varied over the last decade; an indication that this estuary is recovering from contamination from previously untreated discharges.

At present the concentrations of hazardous substances in all of Scotland's estuaries are within national and international standards and the WFD classification for these substances indicates that they do not pose a threat to wildlife.

Habitats

Habitats around estuaries can be affected by development and dredging.

Most estuaries in Scotland have been modified to some extent by building sea defences, reclaiming land, constructing ports and harbours, and dredging. However, only seven of our 49 estuaries are currently at moderate, poor or bad status as a result of these modifications.

Mudflats and salt marshes are rich food sources for fish and bird life, and important nursery and overwintering habitats for many fish species. Land claim (taking land to build on or to construct sea defences and ports) has resulted in the loss of areas of mudflats and salt marshes. [1]In the Forth estuary it is estimated that land claim has led to the loss of 45-55% of the Forth's intertidal areas over the last 400 years. This leads to fewer fish, which ultimately affects animals such as seals and dolphins.

Commercial dredging (to maintain navigation and commercial fishing for shellfish such as prawns and scallops) has also damaged fish breeding grounds and sea-bed habitats in some areas.

1. T.C. Smout& M. Stewart (2102) The Firth of Forth: An Environmental History. Birlinn Limited, Edinburgh. ISBN: 9781780270647.

Invasive non-native species

Invasive non-native species can cause serious problems to estuaries, they can harm native species and alter the ecology. Although only five of our estuaries are affected by invasive non-native species (INNS), the

"Current condition and challenges for the future" report estimated that more than 20% of estuaries are at risk of failing to meet environmental objectives because of them.

Some marine non-native species are widespread in Scotland. They can cause serious problems to the environment and the economy. Examples include the carpet sea squirt, which can reproduce and spread rapidly and tends to smother other marine life that grows on the sea bed and underwater structures such as pontoons. Wireweed can alter the shore ecology and, in large quantities, it can get entangled in propellers or block engine cooling systems.

Pressures affecting estuaries

Waste water

Large volumes of waste water (treated sewage and industrial effluent) are discharged to some of Scotland's estuaries. Waste water can contain the following:

- **organic matter, such as sewage** – this can accumulate in sediments and remove oxygen from the water. Organic enrichment of sediments unbalance the species community, and decrease diversity;
- **nutrients** – in excess, these can stimulate the growth of algal mats in intertidal areas. These mats smother the sediment, preventing colonisation by organisms that are an important food source for wading birds. The decay of these plants can remove oxygen from the water, damaging wildlife;
- **hazardous substances** – these can affect the diversity and abundance of plants and animals. Some substances can cause disruption to the sexual characteristics of organisms and develop disorders.

Diffuse pollution

Diffuse pollution arises from activities across a river catchment, and cannot be linked to any specific discharge point. Diffuse pollution can come from:

- **agriculture** – nutrients, sediments, pesticides and organic matter washed off the land into water courses;
- **urban** – pollutants washed off roads into storm drains and sewage overflows;
- **oil spills** – from shipping and recreational craft;
- **shipping and maintaining navigation routes** – for example, anti-fouling treatments (applied to boats to prevent the nuisance growth of organisms), and sediment stirred up during dredging and dumping of the spoil.

Habitat modifications

Estuaries can be modified by the construction of ports, harbours and sea defences and the land taken to build them. In addition, dredging and canalisation can also make significant changes to the sea bed and shoreline.

Climate change

The Marine Climate Change Impacts Partnership (MCCIP) publishes Annual Report Cards (ARC) on our understanding of how climate change is affecting UK seas. The latest one, ARC 2013, tells us that:

- temperature records continue to show an overall upward trend, despite short-term variability;
- changes to plant growth are expected throughout the UK;
- climate-change projections suggest that the distribution of fish species will shift northwards at a faster rate than at present.

Water abstraction

There are 20 water abstractions from Scottish estuaries, the majority of which use the water for cooling.

Cooling water is screened to remove sediment, weeds and fish that could block the pipes. The removal of fish may have a significant impact on estuaries; it has been estimated that nearly 12.5 million fish, weighing about 75 tonnes, were trapped on the cooling water screens of Longannet Power Station in 1999[1]. A system to return the fish to the estuary is currently being considered at Longannet. This would reduce the number of fish that die and return all fish (alive and dead) to the estuary to reduce the impact on the estuarine ecosystem.

1 Greenwood MFD. (2008) Fish mortality by impingement on the cooling-water intake screens of Britain's largest direct-cooled power-station. Marine Pollution Bulletin 56, 723–739.

Noise

Underwater noise is generated by dredging, shipping and construction. This may cause species that communicate by sound to avoid important areas (for example, spawning grounds) and reduce their ability to detect food. It may even damage their hearing, affecting their ability to communicate with each other about food, danger and reproduction. More evidence is needed on the extent of noise disturbance and its impact on wildlife.

Dredging

Marine Scotland regulates dumping on the sea bed by issuing licences under the Marine (Scotland) Act 2010. Since the 1980's, dumping at sea has progressively reduced, with bans imposed on dumping radioactive waste (1982), colliery mine stone (1995) and sewage sludge (1998). Only the disposal of dredged material from ports, harbours and marinas is currently allowed.

Dredging tears up sea-bed habitats and can pose a contamination risk, with the re-suspension of hazardous material contained in the sediment, or its deposition at the dumping site of the dredged material. The Clyde, Forth, Tay and Dee estuaries are regularly dredged to maintain navigable channels for shipping, and the Tay estuary is dredged to remove sand for commercial use. The Forth and Tay estuaries contain licensed dump sites for dredged material.

Invasive non-native species

Invasive non-native species can significantly alter the ecology of our native communities, as well as causing problems for shipping and aquaculture.

Invasive non-native species can be introduced by visiting ships and recreational craft (either attached to the hull or in ballast water), floating litter and by aquaculture (escaped farmed species, and, more commonly, unintentional introduction alongside the farmed species). Once established, it is extremely difficult to get rid of an invasive species in the marine environment.

Litter

Litter causes harm to wildlife by ingestion or entanglement. Litter can come from sewage, recreational activities, shipping and commercial fishing.

There are currently no systematic data on the presence of litter in estuaries, but it is known to be widespread on the shore and the sea bed. Most litter is plastic; this slowly degrades into micro-particles, and can be found throughout Scotland's seas.

What is being done

Legislation has been introduced over many years, which is designed to protect the environmental quality of estuaries. In addition, some good-practice initiatives, and financial aid for land managers, are in place to tackle problems such as diffuse pollution.

Policy and legislation

Water quality in estuaries has improved in recent decades as a result of improvements to effluent treatment prompted by European legislation.

The European Water Framework Directive provides a framework for protecting and improving the condition of the water environment across Europe, through the development of River Basin Management Plans (RBMPs). In Scotland we are implementing the WFD through the Water Environment and Water Services (Scotland) Act 2003, which makes SEPA responsible for coordinating the development of the RBMPs, working in partnership with many sectors, public bodies and non-governmental organisations, These same sectors and organisations are responsible for the successful implementation of the plans, by developing partnership initiatives, and delivering public investment programmes and responsibilities.

Any new activities likely to have an adverse impact on the water environment are controlled under the Water Environment (Controlled Activities) (Scotland) Regulations 2011, known as 'CAR'. These include discharges of wastewater or industrial effluent, cooling water abstractions and engineering activities that can cause damage to estuarine habitats.

Planned improvements to the status of estuaries, which are to be achieved through the WFD, are shown in Table 2 and discussed in the river basin management plans. River-basin planning is a collaborative approach to managing and improving the environment, and offers opportunities for more effective co-ordination between partners. Actions needed to improve the quality of estuaries to the status of 'good' are detailed in individual water body data sheets. Overall, the objective is for 99% of our estuaries to be at good or high status by 2027.

Table 2: Planned improvements to the status of estuaries to be achieved through the WFD

Overall status/potential	**Target area (km^2) by year**		
	2015	**2021**	**2027**
High	217	217	217
Good	336	336	767
Moderate	430	430	9
Poor	10	10	0
Bad	0	0	0
Total	**992**	**992**	**992**
Proportion of total at good or better status (%)	**56**	**56**	**99**

Diffuse inputs of nitrates from agriculture are regulated by the Nitrates Directive (91/676/EEC). Areas where the nitrate concentration in groundwater is high are designated as nitrate-vulnerable zones and action is being taken to reduce the inputs of nitrates from agriculture in these areas. The catchments of the Solway estuary, the Montrose basin and the Ythan estuary all contain nitrate-vulnerable zones. Sources of nitrate entering the River South Esk, which drains into the Montrose Basin and the River Ythan, are also being studied as part of SEPA's diffuse-pollution monitoring programme, which aims to reduce diffuse pollution through encouraging best practice in land management.

The Oslo and Paris Commission (OSPAR) has been working to reduce inputs of hazardous substances to the marine environment for over 20 years by regulating industries and phasing out the use of some substances, for example:

- **polychlorinated biphenyls** – UK sales were stopped in 1986;
- **brominated flame retardants** – banned from 2004;
- **tri-butyl-tin** – use was banned on all boats from 2008.

Although these have been banned, they can still be detected in some parts of the environment due to their persistence and their continued release from materials made using them.

SEPA uses controlled activity regulations to regulate the discharge of hazardous substances, and policy 61 outlines the controls on the discharges of these substances.

Litter

The recent European Marine Strategy Framework Directive includes a requirement to assess litter, and set targets for reducing litter by 2020. Other legislation designed to reduce litter include:

International Convention for the Prevention of Marine Pollution from Ships, which prohibits the at-sea disposal of plastics and rubbish from ships;

EU Port Waste Reception Directive on port reception facilities for ship-generated waste and cargo residues;

Marine (Scotland) Act

The Marine (Scotland) Act helps balance competing demands on Scotland's seas. It aims to protect and enhance the marine environment and boost economic investment and growth in areas such as marine renewables. The Act will be implemented in the following ways:

- the marine planning system balances the need for resources with the need to protect our marine environment. The National Marine Plan sets out objectives and national priorities, while regional marine plans provide the context in which conflicts between different sectors can be resolved and key areas for key uses can be defined;
- there is a marine licensing system for developments in coastal waters that require approval;
- there are new powers to designate Marine Protected Areas (MPAs). This provides greater flexibility for Ministers to use area-based measures to conserve marine biodiversity as well as nationally important historic assets such as historic shipwrecks. The Scottish Government is in the process of establishing new (MPAs) of national importance to meet international commitments for protecting our seas;
- improved protection for seals and a new comprehensive licence system will ensure appropriate management when necessary.

Sustainable management

A range of practical water and catchment-management activities have been introduced to improve the environmental condition of estuaries.

Diffuse pollution

Sustainable Drainage Systems are being encouraged as a way to reduce contaminants from built up areas entering the environment.

In rural areas, several initiatives are in place to encourage, and contribute to the costs of, better land use practices to reduce diffuse pollution from agriculture.

Modified habitats

The loss of habitat due to land claim is difficult and costly to reverse. However, there are already some small-scale restoration projects in Scotland that aim to restore intertidal habitat, encouraging wildlife and reducing flooding by increasing the amount of water held back in the wetlands. Examples include:

- Black Devon Wetland (Forth Estuary);
- Skinflats (Forth Estuary);
- Nigg Bay (Cromarty Firth).

The RSPB is planning a larger-scale project to restore a network of intertidal habitats in the Forth estuary.

Litter

There are several practical initiatives to reduce litter in Scotland's environment:

- Scottish Water's Bag It and Bin It campaign aims to stop contamination of beaches caused by sanitary waste through the sewerage network;
- The Keep Scotland Beautiful beach award scheme;
- The Forth Estuary Forum and Firth of Clyde Forum actively campaign to reduce litter on beaches in their areas;
- The Fishing For Litter project encourages fishermen to return litter caught in their trawls for monitoring and proper disposal. It has been estimated that litter costs the marine fishing industry up to £30,000 per year per boat, due to contamination of catches, broken gear and fouled propellers.

Recreation

The Green Blue organisation gives guidance to recreational boat users on how to reduce their impact on the water environment. The Green Blue's Marine Toolkit is designed to help managers of leisure-boating businesses and leaders of boat clubs keep to the regulations and reduce waste.

Oil spills

Port authorities have a responsibility to respond to spills from boats in their harbour area. Clearwater Forth is an example of an emergency response plan for the Forth.

In the event of a major spill from shipping or offshore oil and gas installations, the national contingency plan is implemented.

Invasive non-native species

The Invasive Non-Native Species Framework Strategy for Great Britain sets out the agreed hierarchical approach to invasive non-native species:

1. prevention;
2. early detection, surveillance, monitoring and rapid response;
3. mitigation, control and eradication.

4.3 Freshwater Lochs

Scotland's lochs are an important part of our landscape and provide water for drinking and power generation as well as space for recreation. They are generally in good condition.

Summary

Key Messages

- Scotland's lochs are renowned for their beauty and form a dramatic part of our landscape.
- There are over 25,500 lochs in Scotland, with the Western Isles and Sutherland having the highest concentration of lochs.
- Almost two-thirds of lochs surveyed are of good or high quality.
- Some lochs are still recovering from historic damage; for example, from acid rain.
- There are unlikely to be dramatic improvements in lochs affected by abstractions (removing water) or impoundments (dams) in the short or medium term.
- Lochs provide a range of benefits, including supplying much of our drinking water and renewable energy from hydropower.
- Lochs also support tourism and provide important recreational space for boating, fishing, kayaking and nature-watching.
- Integrated catchment management is necessary to improve the lochs that are of a poorer quality.

State and Trend

State: Good - high agreement, high evidence

Trend: Stable/improving - medium agreement, high evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- These assessments are of the current "average condition"; some lochs are in a worse condition, and others are in a better one. Equally, the condition of some lochs is worsening, while it is improving in others.
- Making any overall assessment of the condition of our lochs is a simplification.
- We have taken account of the scale of any damage to the environment in these assessments; local damage may have little effect on a national scale.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

There are over 25,500 lochs in Scotland, varying greatly in size and volume (Figure 1). Many of the smallest lochs and lochans are concentrated around the northern and western Highlands and are found on peatlands (Figure 2). Larger lochs are often found in U-shaped valleys that were formed during the last ice age. Loch Lomond has the largest surface area (71 km^2), while Loch Morar is the deepest at 310 m. Loch Ness holds the most water with 7.4 million m^3; more than all the English and Welsh lakes combined.

Figure 1: Number and area of Scottish lochs

Figure 1 shows that together, the eight largest lochs cover an area of 301 km^2 – almost five times the area of the 17,637 smallest lochs combined.

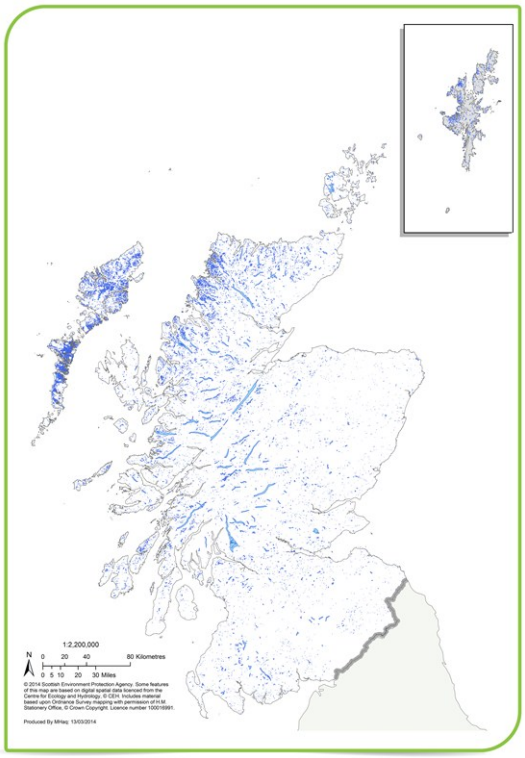

Figure 2: Location of Scottish lochs

Scotland's lochs provide many benefits and services, and they are important as an economic resource. The most obvious examples are for water supply and generating electricity.

Hydropower generation is found mainly in the uplands of the central Highlands and northern areas of Scotland. Lochs for water supply are mainly found near to larger towns and cities in the south of Scotland, but there are some notable exceptions, such as Loch Katrine in the Trossachs and Megget Water in Upper Tweedale.

Lochs in Scotland also make a significant contribution to the cultural and social wellbeing of the nation. Lochs are valued recreational resources, used for boating, fishing, kayaking and nature-watching. The dramatic setting of many lochs, and the myths and folklore associated with some lochs – such as Loch Ness – make them popular tourist attractions.

State

The quality of nearly 63% of assessed lochs has been assessed as 'good' or 'high'. Many lochs are relatively unaffected by human activity, compared with the majority of lakes elsewhere in the UK and Europe.

The Water Framework Directive (WFD) assessment applies to the 334 lochs whose areas is greater than 0.5 km^2 in size. These make up two-thirds of the total area of Scottish lochs. The assessment system used by the WFD divides lochs into five classes depending on levels of human impact on the environment. Lochs with high status show very little human alteration from undisturbed conditions, and those with good status have only low levels of human alteration. Those with moderate, poor or bad status show progressively greater impact.

Some lochs are man-made or have been significantly altered by human activity to provide an important socio-economic benefit; for example, damming a loch for hydropower generation. In these cases, the loch cannot meet good status, so it is assessed according to its potential. A modified or artificial loch is considered to have good ecological potential if it is free from pollution and managed in the best possible way to protect the environment and maintain the wider socio-economic benefits.

The detailed classification results for each individual loch can be found on the Discover data pages.

Table 1 shows the water-assessment results for Scottish lochs for 2012, and Figure 3 shows the overall status of the lochs. The overall status of 63% of the 334 assessed lochs was classified as good or high in 2012.

Figure 3 shows that the majority of the lochs in the Highlands have a high or good status, although many of these are affected by hydropower schemes. Lochs in the more intensively farmed areas are often polluted by nutrients through run-off from fields, and are affected by changes to their habitats.

Table 1: Classification of Scotland's lochs, 2012

Indicator	**Status**									
	High		**Good**		**Moderate**		**Poor**		**Bad**	
	No. of lochs	Area (km^2)	No. of lochs	Area (km^2)	No. of lochs	Area (km^2)	No. of lochs	Area (km^2)	No. of lochs	Area (km^2)
Overall status/ potential	69	87	141	538	78	258	35	56	11	53
Water quality	102	150	133	520	88	301	10	20	1	2
Water levels	230	586	19	59	13	27	15	92	57	229
Beds and shores	217	478	22	59	52	251	42	205	1	1

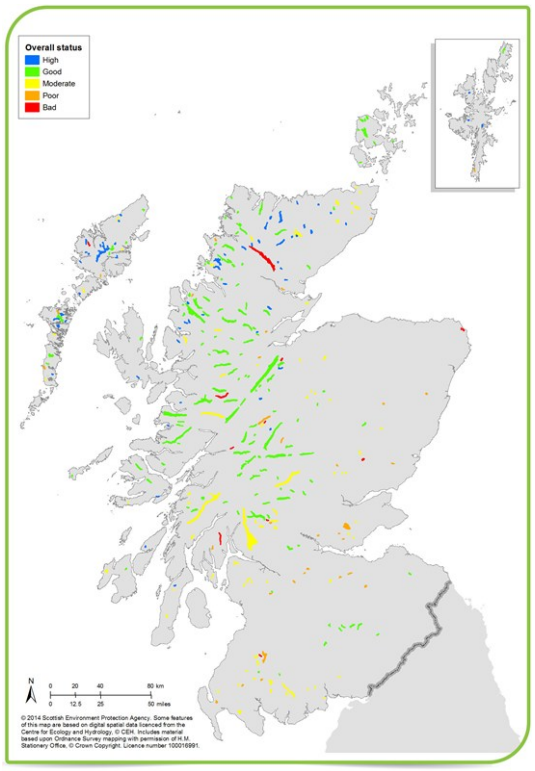

Figure 3: Overall status of lochs, 2012 data

Water quality

Many of the lochs at less than good status are affected by land-management practices or acidification.

Water quality is measured using a combination of chemical and biological pollution indicators. The plants and animals that live in our lochs are affected by a range of pollutants, including excessive nutrients, chemicals and sediment. Excessive inputs of nutrients can boost the growth of algae and other water plants, causing oxygen depletion and major changes in the balance between the plants and animals living in the loch. Although rarely a problem, other pollutants can be directly toxic, causing death of organisms, reducing their growth or interfering with reproduction. Some of these pollutants break down very slowly and can accumulate over time in sediments and plants, and sometimes within the bodies of animals. A total of 235 of the 334 assessed lochs (70%) were at good or high status for water quality in the 2012 assessment (Table 1).

Although water quality in Scotland's lochs is generally high, we have to maintain this standard and improve other lochs where water quality is not as good.

Excessive nutrients

When nutrients, such as nitrogen and phosphorus, are present in excessive concentrations they may accelerate the growth of algae and other water plants in the loch, reducing oxygen levels and making it impossible for some plants and animals to survive.

Many of Scotland's lochs have naturally low levels of nutrients, so even quite small increases can significantly alter their sensitive ecosystems. In Scotland, the addition of phosphorus to lochs has the greatest impact on water quality. Phosphorus can enter lochs through run-off or drainage from land, or directly from fish farming and sewage inputs.

Algal blooms

Blooms of cyanobacteria (blue-green algae) are a particular concern for human health, as they can produce toxins. Algal blooms in reservoirs mean that water companies have to apply extra treatment before the water

can be supplied for drinking. It may also be necessary to restrict the use of lochs for water sports to protect human health.

Acidification

Water quality in some lochs, particularly those in upland locations, has been affected by atmospheric pollution since the industrial revolution. Industrial and vehicle emissions containing compounds of nitrogen and sulphur are very acidic and when deposited in lochs they can cause the water to become acidic as well. In general, acidified lochs contain fewer plant and animal species. Several populations of Arctic charr and brown trout have become extinct in lochs in Galloway as a result. The problem is especially acute in the south-west of Scotland where soils surrounding the lochs are unable to neutralise the acidity. Conifer trees are also extremely good at collecting acidic water droplets from the air, which can make things worse.

Strict controls on industrial emissions and reduced acid deposition mean that some lochs are showing signs of recovery from acidification. However, other lochs will recover more slowly and their full recovery may be prevented by the effects of nitrogen emissions from vehicles and the impacts of climate change.

Invasive non-native species

Invasive non-native species (INNS) can be introduced unintentionally in many ways; for example, discarded exotic plants from garden centres. If they become established in the wild, they tend to thrive at the expense of native water plants and animals.

The WFD classification includes an assessment of the impact of the INNS that pose the greatest risk to lochs; currently, information on where invasive NNS are causing problems is limited, but in 2012, three lochs (Loch Ken, Strathclyde Loch and Lochrutton Loch), an area of 8 km^2 in total, were at moderate status because of invasive NNS, with 33 lochs (covering a total of 125 km^2) being downgraded to good status. Invasive NNS are recognised as a risk to Scotland's lochs; the "Current condition and challenges for the future" report estimated that 2% of lochs are at risk of failing to meeting environmental objectives because of them.

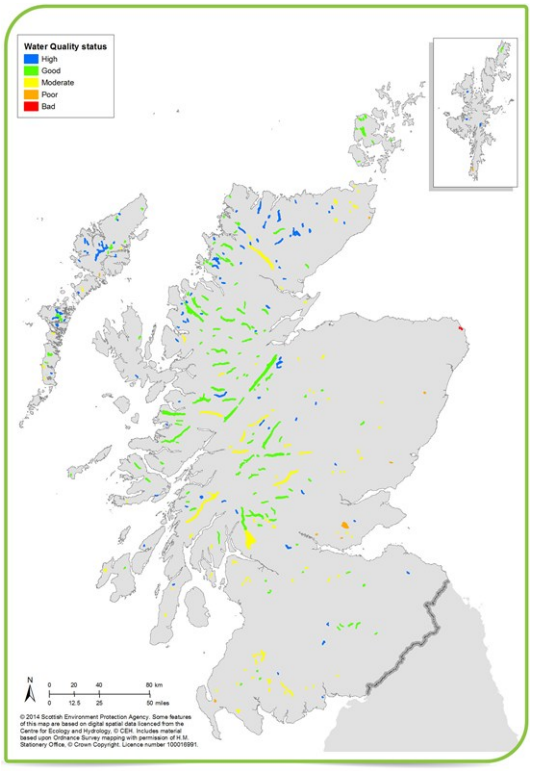

Figure 4: Water quality of lochs in 2012

Water levels

Loch ecosystems are affected by changes in their water levels. Lochs need to hold enough water to maintain the habitats of animals and plants, and to limit their vulnerability to pollution and high summer temperatures. Natural changes in water levels occur in most lochs throughout the year; however, fluctuations that are too rapid or large can damage habitats and reduce species numbers.

Figure 5 shows the condition of water levels in lochs. A total of 249 of the 334 assessed lochs (75%) were at good or high status for water levels in the 2012 assessment (Table 1). Many of the lochs affected by alterations to water level are used for electricity generation or drinking-water supply.

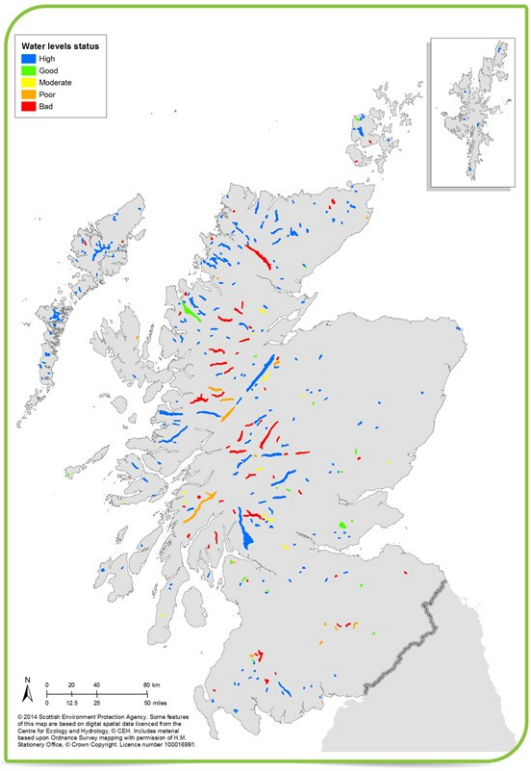

Figure 5: Condition of water levels in lochs in 2012

Beds, banks, and shores

The beds and banks of lochs provide habitats on which many plants and animals depend. Some species are mobile and some, such as rooted plants, live attached to the bed. A total of 239 of the 334 assessed lochs (72%) were at good or high status for beds and banks in the 2012 assessment.

Alterations to loch beds and banks caused by engineering activities such as road-building or preventing wave damage can reduce the area, diversity and quality of available habitats. Loss of vegetation on banks and shores can also make the loch more vulnerable to pollution and erosion, and reduce the food available for wildlife in the loch. Man-made obstacles, such as weirs and dams, can block access to the loch for fish. The impact of weirs and dams on migratory fish is included in the WFD assessment of loch beds and banks (Figure 6).

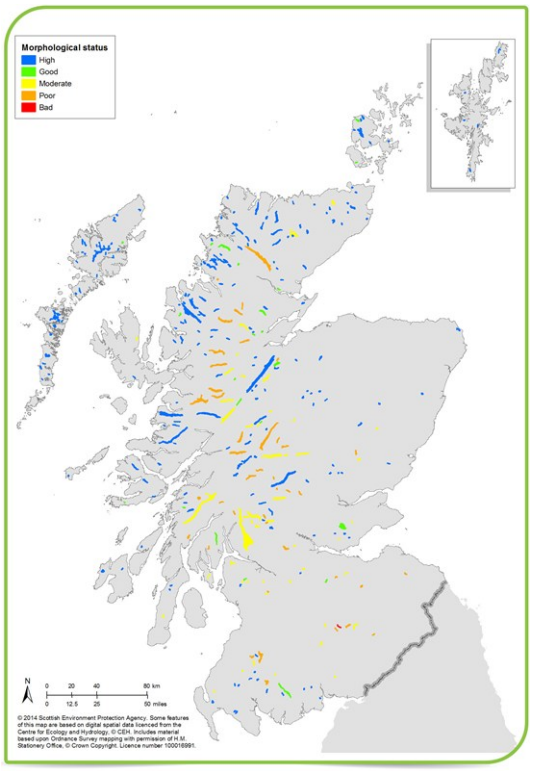

Figure 6: Condition of the beds and banks and impact of fish barriers in lochs in 2012

Pressures affecting freshwater lochs

The pressures on Scotland's lochs reflect firstly the variety and intensity of the activities undertaken on and around them, and secondly the wider environmental trends that are being experienced on a global scale.

The main pressures affecting Scotland's lochs are:

- changes to water levels from hydropower generation and water-supply industries;
- nutrients from land-management activities, including agriculture and forestry, and from sewage inputs;
- obstacles to fish migration, such as weirs and dams;
- pollutants deposited from the atmosphere, leading to acidification.

Changes to water levels

Artificial lochs built for hydropower and drinking-water supply usually involve a dam to raise the water level of an existing river or loch. Water-supply reservoirs tend to fill up over the winter, and are then gradually drawn down through the summer as the demand for drinking water is greater than the amount of water flowing in.

Hydropower reservoirs are filled and allowed to draw down regularly, and there are relatively rapid fluctuations in the water level. These rapid fluctuations can lead to draw-down scars on the banks, similar in appearance to the rings around a dirty bath. This scarred area provides an unstable and poor-quality habitat for plants and animals, and has a negative effect on the appearance of the loch.

Dams can also affect loch ecosystems by preventing or making it difficult for migratory fish, such as salmon, to move upstream and spawn in headwater tributaries. When gravel and coarser sediments get trapped behind dams, this can lead to the erosion of gravel habitats downstream, by interrupting the supply of new gravel.

Nutrients

Increased levels of nutrients can lead to the growth of unwanted and harmful algal blooms that reduce oxygen levels in the loch. This is a process known as eutrophication and can result in the deaths of other plants and animals in the loch.

Increased levels of nutrients, such as nitrogen and phosphorus, enter lochs mainly as a result of land-management practices such as agriculture and forestry and from the aquaculture industry. These pollutants are known as ‘diffuse pollutants’ because they cannot be traced to a single source. Instead, they arise from many individually minor inputs that, when combined, can result in a major problem. Well-managed farm and forest land presents minimal risk to lochs, but poor land-management and land use change can lead to diffuse pollution, as shown in Figure 4.

Although it is rare for sewage to be directly discharged into lochs, there are some local problems caused by septic-tank discharges that are high in phosphorus, or through rivers that sewage has been discharged into.

Sediment and disease-causing microorganisms are also commonly associated with diffuse pollution from rural land management and from sewage discharges. For more details on the interactions between land use and watercourses, read the soils topic.

Atmospheric deposition
When pollution – mainly compounds of nitrogen and sulphur from burning fossil fuels – is washed out of the air it can produce *acid rain*. This rainwater can cause the acidification of lochs in areas where the soils and underlying rocks are not able to neutralise the acidity in the groundwater.

Obstacles to fish migration
There are many small weirs and dams in lochs across Scotland, many of which were erected more than 50 years ago. They were initially used to control the water level for activities such as fishing, boating, local water supply and electricity generation. Although small, these obstacles can prevent migratory fish travelling to breeding areas and prevent or reduce successful spawning upstream.

Climate change and invasive non-native species
The condition of lochs can also be affected by climate change, which can increase the other pressures described above.

For waters that are already under pressure from nutrient inputs, the higher temperatures predicted as a result of climate change may further stimulate excessive and damaging growth of water plants. The potential increase in extreme rainfall events may result in more of the soil and nutrients from agricultural land being washed into surface waters.

INNS already pose a significant threat to the ecosystems of our lochs. Our current relatively cool climate prevents many species from other parts of the world from establishing themselves and posing a threat to native plants and animals. However, a warming climate may favour some of these currently benign species, which could decrease the ecological quality of our lochs.

Urban pollution
Run-off from roads and urban developments also contains pollutants that can affect water quality in lochs. Additionally, road-building, housing, commercial and recreational developments have all played a part in the loss of shoreline and inshore shallow-water areas of Scottish lochs. This loss may affect the wide range of plant and animal species dependent on these shallow, well-lit areas of lochs.

4.4 Offshore waters

Our seas are biologically diverse and relatively unpolluted. Some fishing is unsustainable, and energy production competes for space and increases pollution risks.

Summary

Key Messages

- Scotland's seas are mainly clean and safe, although there are some localised areas of concern.
- Our seas support a diverse array of habitats, and nationally and internationally important populations of certain species.
- Our seas support a diverse array of habitats, and nationally and internationally important populations of certain species.
- The two widespread significant pressures on offshore waters are:
    - human activity contributing to climate change;
    - fishing, which impacts on the sea bed and species.
- Decision-making is being improved through marine planning and the development of the National Marine Plan.

State and trend

A detailed assessment of Scotland's Seas was made in Scotland's Marine Atlas (2011).

Please read the topic for more information; if you have any questions about Scotland's offshore waters please feel free to contact us via the contact us facility on the website.

Overview

Scotland's seas support around 6,500 species of plants and animals. Examples include:

- **seabirds** – in breeding colonies around the coasts of Scotland;
- **seals** – grey seals;
- whales, dolphins and porpoises, collectively known as **cetaceans;**
- sharks, rays and skates, including the basking shark, which is the world's second-largest fish;
- deeper-water species, such as cold-water corals and deep sea sponges;
- occasional visitors; for example, leatherback turtles and bearded seals;
- **plankton** – microscopic plants and animals at the bottom of the food chain.

Scotland's 'offshore waters' begin three nautical miles from the coast and extend to the Exclusive Economic Zone (EEZ) limit, generally about 200 nautical miles, covering a sea area of **462,263** square kilometres (km^2). Beyond the EEZ is the seabed forming the continental shelf. The sea areas less than three nautical miles from the coast are known as 'coastal waters'.

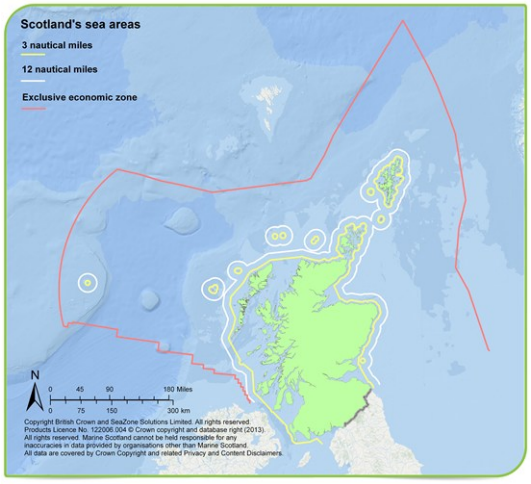

Figure 1: Scotland's marine limits

Table 1: Scotland's sea areas

Description of sea area	Geographical limit	Area of sea covered (km^2)	Legislative description
Waters covered by the Water Framework Directive (WFD)	High water mark to yellow line in Figure 1	48,710	Limit to which WFD measures have been implemented
Territorial waters outside WFD limits	Yellow line to white line in Figure 1	41,694	Territorial sea limit – limit of Scotland as defined in the Scotland Act
Territorial waters	Low water mark to white line in Figure 1	55,484	
Offshore waters	White line to red line in Figure 1	371,859	
Scotland's seas	Yellow line to red line in Figure 1	413,553	
Area within fishery limits	High Water Mark to red line in Figure 1	462,263	Exclusive Economic Zone (EEZ)

Scotland's seas range from shallow shelf seas (less than 200 m deep) to deep oceans (more than 2000 m deep). The shelf seas contain features like banks and deep channels, whereas the deep oceans have complex, varying depths broken up by steep ridges, seamounts (mountains under the sea) and banks. The seas around Scotland contain a wide variety of habitats and species. This diversity is due in part to the geographic position of Scotland, with influences from warm Gulf Stream waters in the west and cooler waters from the Arctic in the north and east.

Mud, sand and coarse sediments predominate in the North Sea and in the area to the west of the Hebrides and north of the mainland. By contrast the sea bed to the far west and north is characterised by mud and fine clay, with coarser sediments in shallower water and on banks and seamounts.

There is limited, but increasing, knowledge of the sea-bed habitats in waters more than 200 m deep. However, we do know that these habitats contain cold-water coral reefs, coral carbonate mounds, submarine canyons, seamounts and deep-sea sediments.

Seawater circulation

A position on the continental shelf means that the seas around Scotland are directly affected by several oceanic currents (Figure 2). The processes that cause deep and shelf waters to mix are complex, and have a significant impact on conditions in Scottish waters. For example, processes that cause mixing in the sea to the west of Scotland bring nutrients closer to the surface. This encourages plankton growth, which is an important food source for commercial fish stocks.

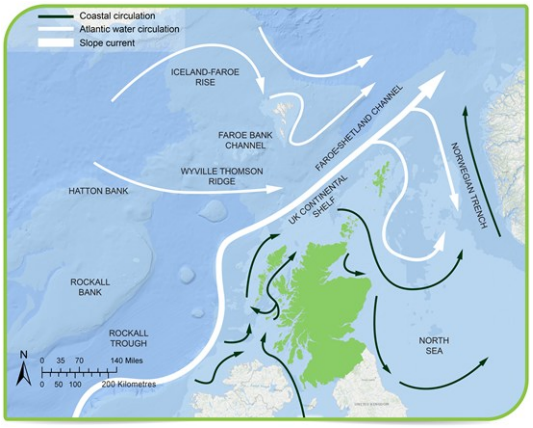

Figure 2: Scotland's seawater circulation

Offshore waters and the economy

Fishing has a long history in Scotland, and it is important to the economy because of the value of the catches landed as well as for the employment it provides, often in more remote communities where employment opportunities are scarce. In 2012, 411,765 tonnes of fish were landed from Scottish waters, with a sale value of £464 million.

In 2011, Scotland accounted for over 60% of European Union oil production, and approximately one-third of EU total hydrocarbon production. Most oil and gas extraction in Scottish territorial waters takes place in offshore waters. The main benefit to Scotland is employment, in exploration as well as support services.

Development of offshore renewable energy sources will help to provide Scotland with secure, clean energy supplies in the future. For example, the two demonstrator wind turbines located in the outer Moray Firth, and recent decisions have given the go-ahead for further offshore developments Wave and tidal energy is also developing currently.

Many leisure and recreation activities take place along the beaches and inshore coastal waters but offshore waters are also used, for example, for diving on wrecks, yachting and some wildlife watching.

State

The warming of the Earth’s oceanic surface and pressures from fishing are affecting offshore marine wildlife.

Scotland's Marine Atlas is the main source of data on the condition of Scotland’s seas. Key data are summarised below.

Offshore habitats and species

Scotland has internationally important numbers of 24 species of breeding seabirds that are important indicators of the state of the marine environment. Scottish populations of these birds are studied as part of the UK Seabird Monitoring Programme. This shows a decline in the abundance of seabirds since the early 1990s, stabilising to approximately 72% of the 1986 level by 2007-2010.

Numbers of grey seals increased until the 1990s but recently this increase has slowed down.

Some Cetaceans can range widely, whereas others are more localised. Their greatest diversity in Scottish waters is found off the continental shelf to the north-west of Scotland.

All species of Sharks and rays are on the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic list of threatened and declining species due to fishing for these species in particular, and as a result of them being inadvertently caught when fishing for other species.

We know less about deeper-water habitats, such as cold-water corals, and it is difficult to estimate their state.

Plankton is monitored mainly in coastal waters, and changes have been observed that may be linked to climate change. There has been a northward shift in the distribution of many species of plankton over the last 50 years, and the timing of plankton production has also changed.

Several non-native species are present in Scottish waters and some are considered to be invasive, such as acorn barnacles and wireweed.

Overall, the assessments of habitats and species show declines in many areas, pointing to changes in biodiversity throughout Scotland's seas.

Commercial fish and shellfish stocks

Commercially important fish and shellfish species fall into the following groups:

- **widely distributed stocks (around the north and west of Scotland)** – the most important species are mackerel and blue whiting, with lesser fisheries for megrim, anglerfish, saithe, hake and Atlanto-Scandian herring. The mackerel stocks are in good condition, as are the stocks of Atlanto-Scandian herring, but there is concern about blue whiting stocks. Megrim and anglerfish stocks are currently under assessment, but recent surveys point to an increase in megrim and the anglerfish stock is generally stable;
- **north sea stocks** – cod, haddock, whiting, herring, sole and plaice are the six main stocks. Herring, haddock and plaice are being fished sustainably, but sole and cod are being fished above sustainable limits. It is very difficult to assess the numbers of whiting, and the status of this stock is unknown;
- **west of Scotland stocks** –two haddock stocks are present (in separate locations) and are fished close to the set limits, along with the cod stock, which is in very poor condition. West-coast herring is fished at a broadly sustainable rate and data for the whiting fishery are sparse, but the indications are that the stock is in a very poor condition;
- **shellfish** – nephrops, scallops, lobster, brown crab and velvet crab represent almost one-third of the value of all landings by Scottish vessels in 2011. Most edible crab stocks are fully exploited or overexploited, as are lobsters. There are underexploited stocks of brown crabs to the north and west of the Hebrides. The nephrops stocks in the North Sea are also underexploited. Scallop stocks to the west of the Hebrides and off the north-east coast are overexploited or nearly so, whereas stocks around the Shetland Isles appear to be the healthiest.

The warming of Scotland's seas has changed plankton communities and the incidences of more southerly fish species migrating northwards has increased. The implications for the fishing industry are fewer opportunities to catch and sell some species. For example, it appears that the environmental conditions for cod in the North Sea are less favourable than in the past.

Hazardous substances

Hazardous substances are released into the environment as a result of human activities or natural processes. They can be present in the water column, sediment and wildlife (including fish), and include:

- polychlorinated biphenyls (PCBs);
- polybrominateddiphenyl ethers (PBDEs);
- trace metals (e.g. copper, zinc, lead, cadmium, arsenic);
- endocrine disruptors.

Offshore monitoring is difficult, particularly the deep seas to the west of Scotland, but the limited data for hazardous substances in the offshore environment do not show any problem areas.

For example, deep water fish (currently non-commercial species in Scotland – black scabbard, black dogfish and roundnose grenadier) caught at depths of 400–1500 m off the west coast of Scotland have low concentrations of PCBs and PBDEs. These concentrations are probably due to diffuse atmospheric inputs.

Oil and gas exploration

Several surveys (e.g. Fladen Ground and East Shetland Basin) of hydrocarbons in sea-bed sediment, which gives an indication of the amount of oil released in waste drill cuttings, show that the concentrations of hydrocarbons more than 5 km from drilling platforms have decreased since the first surveys in 1986. The overall assessment is that there are few or no concerns and that there is no indication of hydrocarbon contamination more than 5 km away from any oil installation.

Although dumping drill cuttings contaminated with oil or diesel into the sea has been prohibited since 2000, problems may still be caused by previously dumped drill cuttings close to oil installations. Intensive studies of drill cuttings piles have shown that over time the extent of pollution and associated biological effects is decreasing, and that there are clear signs of recovery further than 500 m from the platform.

Accidental oil and chemical spills

The Advisory Committee on Protection of the Sea produces annual reports on oil and chemical spills in coastal and offshore UK waters.

Oil and chemical spills are monitored to manage any contamination of the sea or harm to wildlife. The Maritime and Coastguard Agency (MCA) is responsible for taking action in relation to oil and chemical spills in Scottish seas. Most offshore spills occur at oil and gas installations, which are located mostly in the East Shetland, Fladen and Forties sea areas. There are very few spills elsewhere. The most recent published data are for 2011 (ACOPS 2011), and these reported that the spills were minor. They had no significant impact, and many were so small that they dispersed naturally.

Eutrophication

Eutrophication occurs when excess nutrients in water increase the growth of algae and plants. This leads to undesirable effects; for example, fish deaths caused by decaying algae removing oxygen from the water. The key nutrients that cause marine eutrophication are nitrogen and phosphorus. These nutrients occur naturally but their concentrations can be increased by domestic waste and run-off from farmland. This can affect coastal waters the most, so most monitoring of nutrient concentrations is carried out in coastal waters. Offshore waters in the northern North Sea have also been monitored, and the nutrient concentrations do not show any problems.

Litter

Marine litter is defined as 'any persistent manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environments, including material lost at sea in bad weather'. Plastic is

the main type of litter found in our seas. Other types of litter include paper, textiles, rubber, wood and metal. Marine litter in our offshore waters comes from the land, shipping, and other industries. It is also carried by currents from other countries. Litter on beaches is recorded by the Marine Conservation Society. Data on the amounts and types of offshore litter are limited due to limited monitoring. The KIMO Fishing for Litter project provides fishing boats with bags to collect marine litter caught in nets and fishing gear. This is then brought ashore and weighed. Plastic and polystyrene makes up the bulk of this litter.

Noise

For most marine mammals, many marine fish and possibly shellfish, sound is important for communication and navigation, searching for prey and for avoiding predators and hazards. There are many sources of man-made noise in the sea, such as:

- shipping;
- seismic surveys;
- offshore construction and industrial activities;
- sonars (sound navigation and ranging).

There are currently not enough data to assess noise pollution in Scottish waters. As part of the Marine Strategy Framework Directive implementation, noise is being studied and a ‘noise registry’ being established.

Pressures affecting Scotland's seas

Increasing average temperatures and changes in water chemistry are putting pressure on marine ecosystems.

There are two significant, widespread pressures on the Scottish marine area:

- warming of the Earth’s oceanic surface and the consequent changes in seawater salinity (saltiness), temperature and circulation;
- fishing, which affects the sea bed and species.

Pressures that could have a more localised impact are:

- marine litter, from both land and sea sources;
- accidental oil and chemical spills, from transport and energy exploitation;
- noise, for example from renewable and traditional energy exploitation;
- invasive non-native species, arriving due to climate change or being transported.

Commercial fishing

Many commercial fisheries target a range of species, and catching non-target species may be unavoidable. This may reduce stocks of species not being targeted. Fish can get trapped in lost or abandoned fishing nets or lobster creels, which can further reduce fish stocks.

Fishing gear dragging along the sea bed can damage the sea bed habitat. Noise and litter also have a physical impact, although how this affects marine life is not yet fully understood.

Climate change

Scotland's maritime climate is largely influenced by the water temperature, its salinity, the circulation of currents and the exchange of heat, water and gases with the atmosphere. Changes in these climatic influences affect Scotland's seas. In recent decades Scotland's seas have become warmer and the shelf seas and ocean waters to the north and west of Scotland have become more saline. As a consequence of this, cold-water species have moved further north, and the likelihood is that warmer-water species will replace them. Warmer conditions in the North Sea have triggered a change in plankton abundance and distribution, and this has had a knock-on effect on some seabird species due to reduced availability of prey.

Acidification

Acidification of seawater, which happens when the sea absorbs carbon dioxide from the atmosphere, is also on the increase. The effects of this are complex, affecting things like marine biogeochemical and ecosystem processes and organisms that need calcium carbonate to grow their shells.

Offshore marine litter

The damaging effects of marine litter are found throughout the seas. Wildlife can ingest litter or become entangled in it. Plastics and microplastics can transport hazardous substances around the world's oceans. Invasive non-native species can also be transported on marine litter.

Offshore renewable energy

Renewable energy may cause noise pollution and habitat loss. Noise can be generated during construction and from turbines moving. Habitats can be lost or damaged during construction activities. There is also more risk that ships could collide with the equipment, causing pollution due to accidental spillages.

Offshore oil and gas

The oil and gas industry has been active in Scottish waters since the late 1960s. The main pressures arising from this industry are:

- habitat damage or loss arising from the physical presence of exploration structures and pipelines;
- chemical pollution due to accidental spills;
- noise pollution.

Noise

The increase in offshore construction will have at least a local impact on noise levels in the sea. There is also noise generated at offshore installations as well as by shipping.

Invasive non-native species

Non-native species are introduced both accidentally and deliberately into the Scottish marine environment. One of the main causes is ballast water from ships. When established, non-native species can multiply and spread in ways that damage native species.

What is being done

Legislation is paving the way for practical measures that will improve the management of all Scotland's seas, including offshore waters.

Policies and legislation

The European Marine Strategy Framework Directive (MSFD) requires Member States to prepare national strategies to manage their seas to achieve or maintain Good Environmental Status (GES) by 2020. The MSFD covers a wide range of environmental indicators, including biological diversity, marine food webs, levels of noise and marine litter.

The Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009 are important pieces of legislation for marine planning and conservation in Scottish seas to their EEZ limits. The Marine Scotland Act (2010) implements the European Marine Strategy Framework Directive and sets obligations relating to global and regional (North Atlantic and European) legislation and directives.

Internationally there are a number of instruments to safeguard the seas. The International Maritime Organisation (IMO, the United Nations agency responsible for the security and safety of shipping and the prevention of marine pollution from ships), oversees the implementation of the MARPOL Convention (covering prevention of pollution of the marine environment by ships from operational or accidental causes) and the London Convention (promotes the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter). In addition, the EU Birds and EU Habitats Directives provide for designations to protect marine habitats and species.

Sustainable management

Sustainable fisheries

Reform of the Common Fisheries Policy and new approaches to managing Scotland's inshore fisheries aim to ensure that fishing activities are sustainable and can also be used to protect habitats and other species. This action will contribute to cooperative strategies under the EU Marine Strategy Framework Directive to ensure our marine environment is in Good Environmental Status.

Litter

Fishing for Litter is a scheme to clean up the North Sea. It involves fishermen returning the litter caught in their trawls for measuring and disposing of properly. Currently, 162 fishing vessels and 17 harbours in Scotland are signed up to this. By March 2011, 200 tonnes of litter had been removed from the North Sea, ranging from plastic debris to mattresses and fridges.

Ballast water legislation

The International Convention for the Control and Management of Ships' Ballast Water and Sediments is part of IMO and aims to prevent the potentially devastating effects of the spread of harmful aquatic organisms carried by ships' ballast water from one region to another.

OSPAR

The OSPAR Convention guides international co-operation on the protection of the marine environment of the North-East Atlantic. Work to implement the OSPAR Convention and its strategies is taken forward through the countries agreeing to legally-binding decisions.

Oil and chemical spills

The Maritime and Coastguard Agency (MCA) responds to oil and chemical spills at sea.

4.5 Rivers and Canals

Scotland's river quality has improved in recent decades. Almost half of our rivers are now of good or better quality. Plans are in place to improve the remaining poorer-quality rivers.

Summary

Key Messages

- Scotland has approximately 125,000 km of rivers and 220 km of canals.
- Many rivers are relatively undisturbed by human activity, compared with the majority of rivers elsewhere in the UK and Europe.
- River quality has improved significantly in the last 25 years and just under half of our rivers are now of good or high status.
- Our poorer quality rivers are affected by agriculture, hydropower schemes and urbanisation.
- Ambitious targets have been set for rivers, with an objective for 96% to be at good or high status by 2027.
- There are still significant problems that need to be addressed through collaborative approaches, involving water users and land managers.

State and trend

State: Moderate - medium agreement, high evidence

Trend: Stable/improving - high agreement, high evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- Assessments are of the current "average condition"; some rivers are in a worse condition, and others are in a better one. Equally, the condition of some river waters is declining, while others are improving.
- Making any overall assessment is necessarily a simplification.
- We have taken account of the scale of any damage to the environment in these assessments; impacts can be locally damaging, but may have little effect on a national scale.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

There are approximately 125,000 km of rivers in Scotland, varying from small highland burns to deep, wide lowland rivers such as the Tay. There is also a 220 km canal network.

Scotland's rivers are an important part of the landscape, providing water for industry and agriculture and habitats for wildlife. Some prestigious Scottish industries, such as whisky production and fishing, benefit from the high quality of the country's rivers. Fishing for salmon and sea trout takes place in almost every river, and angling for brown trout is also widespread. It has been estimated that freshwater angling across Scotland as a whole supports around 2,800 jobs, generating nearly £50 million in wages and self-employment income for Scottish households.

The canal network was built between 1768 and 1822 and ranges from the highland Caledonian Canal to the Forth and Clyde canals in the industrial Central Belt. Canals originally provided transport routes from the coast, improving access to supplies of raw materials like coal, iron-ore, stone and agricultural produce. In recent years much of the canal network has been regenerated to preserve our industrial heritage and support tourism. One example is the Falkirk Wheel, a spectacular 35 m boat-lift that joins the Union canal to the Forth and Clyde canal.

Rivers make a major contribution to the tourism industry, as well as to the quality of life of people living in Scotland. Rivers are some of our most important recreational resources, providing places to fish, swim, canoe, watch nature or simply relax.

Rivers are also important for the dilution of waste water. With appropriate management, our river waters have the capacity to provide these important services without damaging their ecology or compromising their other uses and benefits.

Electricity, gas and water supply account for over 2.7% of Scottish gross value added (the contribution to the economy of each individual producer, industry or sector in Scotland). Hydropower contributes 19.4% of the total electricity capacity of Scotland.

Water bodies with severely damaged ecological quality support few uses. They provide fewer social and economic benefits than good-quality waters, and are often visibly unpleasant, giving an impression of neglect; in some cases they even pose a risk to human health.

Listen to our rivers and canals podcast by Nathan Critchlow-Watton.

State

Scotland has around 25,000 km of rivers that are monitored and assessed, more than half of which are in good condition or better. This includes most of the rivers in the Highlands and Islands, where there are fewer pressures on the environment. There is a decline in condition in the Central Belt, and in more intensively farmed areas.

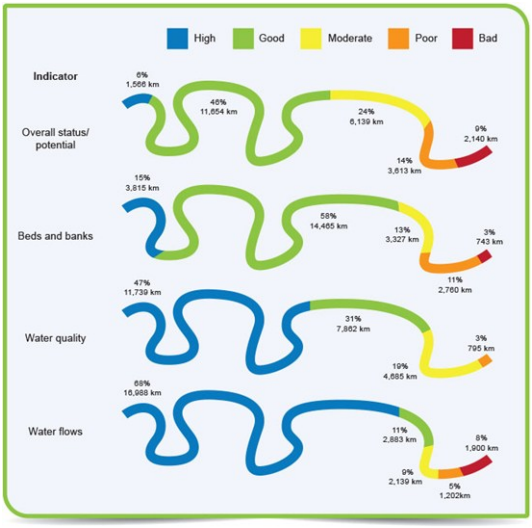

Figure 1: Status of Scotland's rivers and canals, 2012 data

You can find the full classification results for each individual water body by following the link to the water body classification tool.

Overall status

The Water Framework Directive (WFD) assessment applies to 25,000 km of rivers and all canals. The condition of Scotland's rivers and canals for 2012 is shown in Figures 1 and 2. To be at high or good status, rivers need to:

- be free from pollutants at levels that would harm the water, plants and animals they support;
- have minimal changes to their habitats and water flows;
- contain a certain range of plants and animals;
- not be negatively affected by invasive non-native species (INNS).

Rivers assessed as moderate, poor or bad reflect increasing impacts from human activities.

Canals and some rivers are man-made or have been significantly altered by human activity to provide an important socio-economic benefit; for example, damming a river for water supply. In these cases, the river or canal cannot meet good status, so it is assessed according to its potential. A modified or artificial river or canal is considered to have good ecological potential if it is free from pollution and managed in the best possible way to protect the environment and maintain the wider socio-economic benefits.

You can find more details about the classification scheme in the 2008 state of the water environment report. The classification scheme is explained in more detail in the policy statement on the Water Environment and Water Services (Scotland) Act 2003.

Around half of the assessed rivers and canals are at good or high status or potential.

Many of Scotland's rivers are relatively undisturbed by human activity compared with the majority of rivers elsewhere in the UK and Europe.

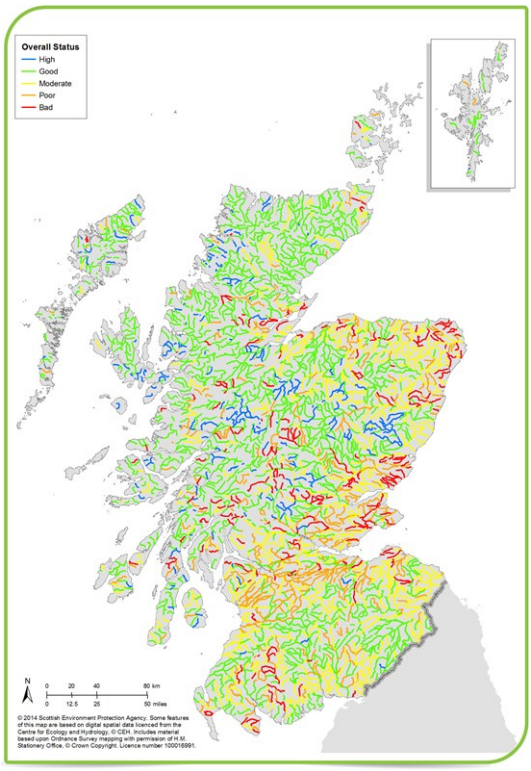

Figure 2: Overall status of rivers and canals, 2012 data

Beds and banks

The beds and banks of rivers and canals provide habitats that many plants and animals depend on. Some, such as rooted plants, and animals like some caddis flies, live attached to the riverbed. Other animals live among the different bed and bank habitats, using them for shelter, feeding and reproduction.

Eighty seven per cent of assessed rivers and canals were at good or high status for beds and banks in 2012 (Figure 3). Areas where the beds and banks are not in as good a condition are clustered in urban and industrial areas, such as the Central Belt, or where intensive agriculture has led to straightening and dredging rivers and removing bankside vegetation.

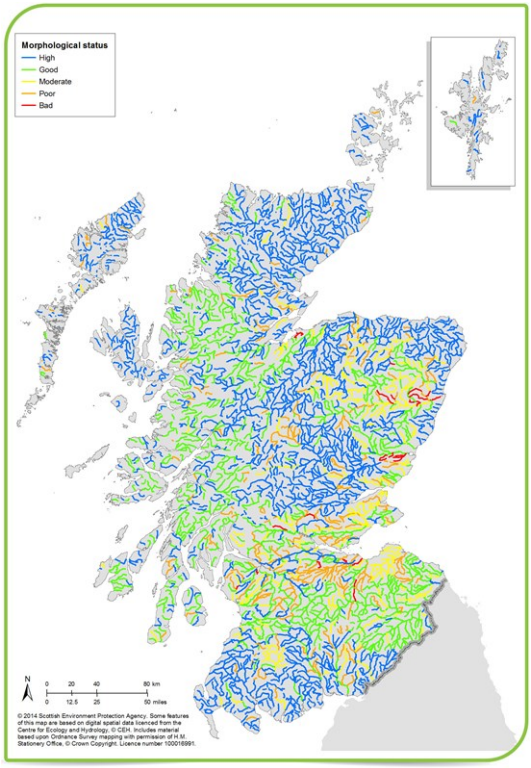

Figure 3: Status of the beds and banks and impact of fish barriers in rivers and canals in 2012

Note: The condition of the beds and banks in artificial water bodies, such as canals, is shown as good where best practice for their management is met.

Water quality

Water-quality status gives a representation of the condition of a river using a combination of chemical and biological pollution indicators. The plants and animals that live in our rivers are affected by a range of pollutants, including excessive nutrients, chemicals and sediment. Excessive inputs of nutrients can accelerate the growth of algae and other water plants, which leads to oxygen being removed from the water and major changes in the balance between the plants and animals living in the river. Other pollutants can poison organisms, reduce their growth or interfere with reproduction. Some of these pollutants break down very slowly in the water environment and can build up over time in sediments and plants, and sometimes within the bodies of animals.

There has been significant progress in preventing and reducing pollution over the last few decades; under the pre-WFD scheme, between 2000 and 2006 the length of rivers in Scotland that were affected by pollution was reduced by 37%.

In 2012, nearly 80% of assessed rivers and canals were at good or high status for water quality (Figure 4).

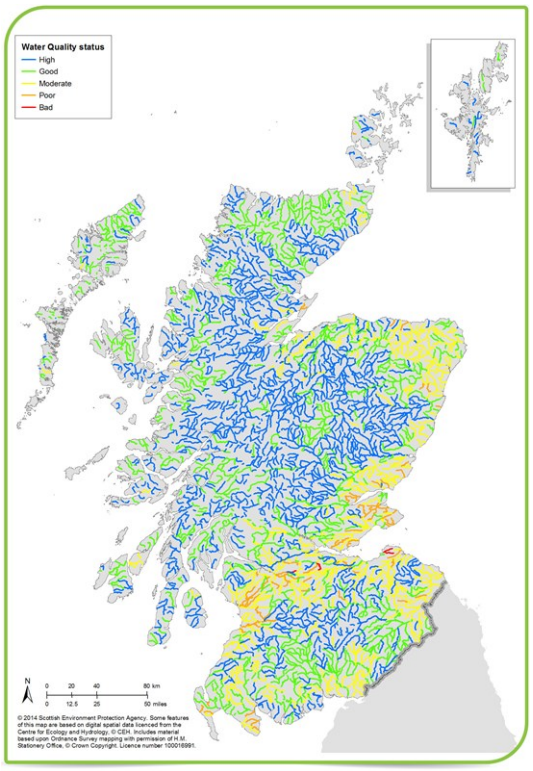

Figure 4: Water quality status of rivers and canals in 2012

Figure 5 shows how water quality has changed between 1991 and 2012. There has been a progressive decrease in the number of rivers and canals that are polluted or slightly polluted, and an increase in those that are unpolluted or unaffected by pollution.

The largest improvements have resulted from tighter controls over standards for waste disposed into rivers from sewage works and industrial discharges.

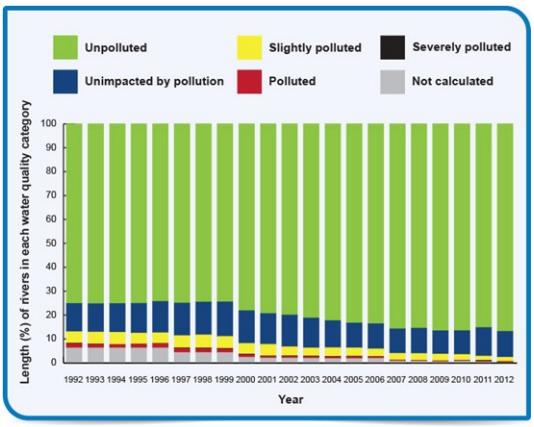

Figure 5: Improvements in water quality

Water flows

River ecosystems respond to changes in water flow. Rivers must contain enough water, throughout the year, to maintain the habitats of animals and plants, and to reduce vulnerability to pollution and high summer temperatures. Variations in flow are also needed to maintain a diverse habitat for different species, and trigger the migration of fish like salmon.

Around 80% of assessed rivers and canals were at good or high status for water flows in 2012 (Figure 6). Those at less than good status are concentrated in the Central Belt, in areas of intensive agricultural irrigation and in areas of the Highlands where water flows have been altered for the generation of electricity.

Although data on flows in rivers have been collected across Scotland for decades, the first full assessment of the state of river flows was only carried out in 2007. The intensification of agriculture and increasing urbanisation (with the associated run-off, flood defences and increased demand for water) during the 20th century have resulted in changes to the flows of our rivers.

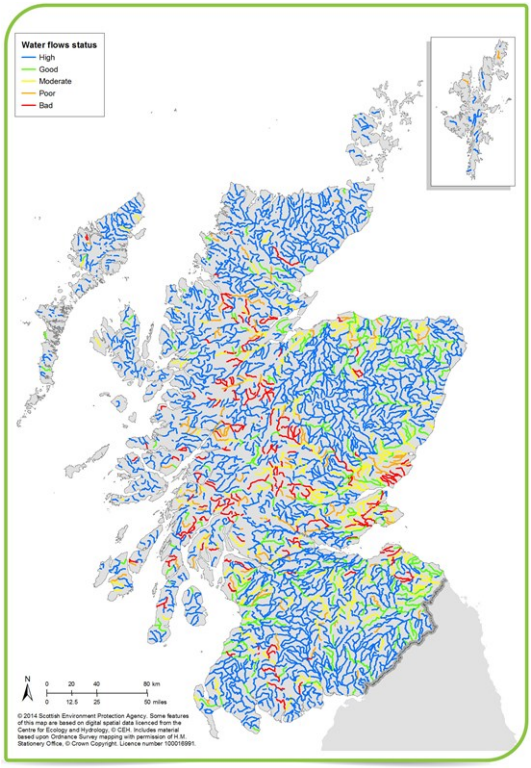

Figure 6: Condition of water flows in rivers and canals in 2012

Note: The condition of water flows in artificial water bodies, such as canals, is shown as good for those water bodies that achieve good ecological potential.

Invasive non-native species and wildlife

The wildlife of Scotland's rivers is generally in good condition. However, the ecological quality of some rivers can be affected by invasive non-native water plants or animals. Once established, they tend to thrive at the expense of our native water plants and animals.

Currently information is limited on where invasive NNS are causing problems, but in 2012, 345 km of rivers and canals were at moderate status for invasive NNS, while 570 km were at good status. The "Current condition and challenges for the future" report estimated that 7% of river water bodies are at risk of failing to meeting environmental objectives because of them.

Pressures affecting rivers and canals

Scotland's rivers are affected by pressures linked to activities within Scotland and outside our borders. Diffuse pollution and habitat damage are two of the main problems we face.

The 2009 river-basin management plan summarises the main pressures currently affecting Scotland's aquatic environment. Although rivers and canals are not considered separately, it was reported that overall, the main pressures on the environment are from:

- agriculture;
- sewage disposal;
- hydropower.

Agriculture

Well-managed farms present minimal risk to rivers and canals, but poor management can lead to serious problems from diffuse pollution. Diffuse pollution arises from land-use activities across a river catchment, rather than entering the water from a pipe or discharge. The problems it causes include excessive inputs of nutrients, run-off of harmful chemicals, such as pesticides, and too much sediment. Excessive inputs of nutrients and organic matter can reduce oxygen levels in the water, which harms aquatic animals.

In the past, rivers were dredged, straightened and widened to improve the drainage of surrounding agricultural land. These activities all affect river and bankside habitats and alter the ecosystem. Habitats can be damaged by alterations to field drainage, which increases the speed at which water runs off fields into rivers. This can lead to more frequent and severe downstream flooding and water-quality problems from the accumulated pollutants. For more details about the interactions between land use and rivers, read the soils topic.

Sewage disposal

In the past, sewage disposal was one of the major problems facing rivers. The situation has dramatically improved, with most sewage discharges now controlled and regulated. Despite these improvements, around 9% of rivers are still affected by sewage discharges. This is due to a combination of poorly managed sewage works, inputs from individual septic tanks and discharges from overflowing sewage works and combined sewage outflows (CSOs) during storms. CSOs are often located in urban areas, and the combination of overflowing CSOs and run-off from roads and car parks, which often contains hydrocarbons, litter and road salt, can be very harmful to the wildlife of urban rivers.

Hydropower and water supply

Reservoirs built for water supply are often close to larger towns and cities in the south of Scotland, although there are notable exceptions such as Loch Katrine and Meggat Water. Hydropower facilities are mainly found in the uplands of Argyll, Perthshire and the Highlands. Water flows are altered by obstacles, such as weirs and dams, in rivers downstream from reservoirs and abstraction (water removal) points. These structures can affect ecosystems and species; for example, freshwater pearl mussels and migratory fish like salmon, which are prevented from spawning.

Urban development

In addition to the activities described above, increasing urban development puts significant pressures on rivers and canals in Scotland.

Urban development has involved dredging and straightening rivers, as well as reinforcing their banks to create flood defences. Building has taken place right on the edge of rivers. These activities reflect the increasing demands on land and water resources and have serious impacts on river ecology, leading to some rivers having their status downgraded. Loss of vegetation on riverbanks can also make rivers more vulnerable to pollution and erosion.

Changes to river flows have been recorded during the 20th century as a result of increasing urban development in which surfaces are ‘sealed’ beneath tarmac and buildings. Run-off from these surfaces can carry pollutants into rivers. It also increases the risk of flooding, because rain runs quickly from roofs and other hard surfaces into drainage systems, which lead to local rivers.

Alongside these challenges, increasing urban development also encourages the spread of invasive NNS in the form of many common garden plants sold at garden centres. If these plants are allowed to spread to wild habitats, they often thrive at the expense of native species.

Climate change

Climate change predictions suggest that we can expect milder, wetter autumns and winters and warmer, drier summers. Extreme weather is likely to become more variable and more frequent, leading to a greater risk of droughts and floods. Table 1 sets out some predicted changes and their likely effect on rivers.

Table 1: Potential impacts of climate change

Predicted change	Possible outcomes
Less overall summer rainfall	Less water in rivers to dilute pollutants. Longer periods in which rivers shrink to occupy a fraction of the width of their beds. This will lead to declines in the abundance of plants and animals.
More rainfall in winter/autumn, leading to higher annual river flows	Increased dilution. Pollutants washed into the sea faster, with less time to be broken down in fresh water.
Higher temperatures in all seasons	Excessive and damaging growth of water plants in rivers with existing nutrient problems. Increased demand for water at just the time when there is less of it that can be taken without reducing the ecological quality of our rivers and lochs. Invasive NNS already pose a significant threat to the ecosystems of our rivers and canals. A changed climate may tip the balance in favour of some of these currently benign species. Rivers not shaded by bankside vegetation may overheat, reducing oxygen levels for wildlife Reduced snow cover will result in changes in flow rates in spring, which will alter the life-cycles of some species of wildlife.
Increased frequency of extreme precipitation events (i.e. periods of more intense rain)	More of the pollutants that collect on roads and urban surfaces will be washed into rivers. Soil, nutrients and other pollutants from land washed into rivers. Increased erosion rate of storm-swollen rivers, leading to habitat changes. More frequent and powerful extreme events will cause sewerage systems to overflow more often and lead to increased flooding of land and property.
Sea-level rise	Direct loss of habitat at the mouth of the river. Changes in base levels of rivers, which affects discharge points and abstractions.

What is being done

Scotland has a long track record of protecting and improving the quality of Scotland's waters through action to prevent and reduce pollution. There are ambitious targets to achieve further improvements over the coming years, and these are set out in Table 2. The ultimate aim is for 96% of our rivers to be at good or high status/potential for habitats, water quality, invasive NNS and flows by 2027.

Table 2: Targets for improvements to the status of rivers to be achieved through the Water Framework Directive (WFD)

Overall status/potential	**Target length (km) by year**		
	2015	**2021**	**2027**
High	1,556	1,556	1,556
Good	12,963	15,384	22,476
Moderate	6,175	4,878	698
Poor	2,671	1,971	247
Bad	1,733	1,309	121
Total	**25,098**	**25,098**	**25,098**
Proportion of total at good or high status (%)	**58**	**67**	**96**

The scope of WFD improvements are far greater than any previous initiatives, and can be addressed under two broad themes.

Policy and legislation

The European Water Framework Directive provides a framework for protecting and improving the condition of the water environment across Europe, through the development of River Basin Management Plans (RBMPs). In Scotland we are implementing the WFD through the Water Environment and Water Services (Scotland) Act 2003, which makes SEPA responsible for coordinating the development of the RBMPs, working in partnership with many sectors, public bodies and non-governmental organisations, These same sectors and organisations are responsible for the successful implementation of the plans, by developing partnership initiatives, and delivering public investment programmes and responsibilities.

Any new activities likely to have an adverse impact on the water environment are controlled under the Water Environment (Controlled Activities) (Scotland) Regulations 2011, known as ‘CAR’. These include discharges of wastewater or industrial effluent, and abstractions for irrigation, hydropower or drinking water, as well as engineering activities in or near rivers

Scottish Water is building on the already considerable reductions in pollution from sewage discharges through the ongoing investment-planning process, which will also reduce the pressures from water abstractions for drinking water supply.

Flooding is predominantly a natural event, which can seriously affect people's quality of life and livelihood. The 2009 Flood Risk Management Act encourages a more sustainable approach to flood management, and will also provide opportunities to restore and enhance river habitats. Details of Scotland's approach to managing flood risk are available on SEPA's website.

Scotland's Land Use Strategy sets out the key principles for using Scottish land. These principles are embedded in River Basin Management Plan practice and will be given increased prominence in future RBMP delivery programmes.

The RBMPs offer opportunities for developing approaches to managing and improving our water environment at a catchment scale through more effective co-ordination between partners.

A catchment-scale approach is being used to tackle diffuse pollution to benefit the rural economy as well as improving the health of rivers. SEPA has created a Diffuse Pollution Management Advisory Group to ensure that actions to reduce diffuse pollution are managed effectively and that there is input from rural, environmental and biodiversity groups.

Part of the work of the group has been to set up a project based on partnerships between SEPA and farmers to work towards reducing diffuse pollution in 12 river catchment areas where it was a particular problem. The project uses a combination of approaches, including monitoring the water quality of 5,600 km of rivers to date and carrying out 1,270 farm visits, with a further 2,500 planned before the end of 2015. SEPA estimates that around 75% of the farms visited have taken steps to reduce diffuse pollution. We believe that working with land managers and other stakeholders to identify pollution risks and agree on the best way to reduce them is the best way to ensure that effective action is taken.

4.6 Aquaculture

Aquaculture is a growing and increasingly important industry in Scotland. It helps to underpin sustainable economic growth in rural and coastal communities, particularly in the Highlands and Islands, with many depending on the employment and revenue it provides.

Summary

Key messages

- Farmed Atlantic salmon is the dominant product of aquaculture (96%) in Scotland.
- Scotland is the largest producer of farmed Atlantic salmon in the EU, (93% of total EU production), and the third largest in the world, producing 162,223 tonnes in 2012 worth approximately £537 million at the farm gate.
- Using Scotland's seas, lochs and rivers for aquaculture requires careful management to minimise risks to the wider environment and wildlife.
- The pressures on aquaculture include disease and parasite control, as well as challenges that may arise as a result of climate change.
- Industry and regulators are working together to develop best practice in aquaculture, which will help to secure the industry's future in Scotland and protect stocks of wild fish.

State and trend

A summarised assessment of the state and trend has not been made for this topic.

Please read the topic for more information; if you have any questions about Scotland's Aquaculture please feel free to contact us via the contact us facility on the website.

Overview

Aquaculture is the cultivation of animals and plants in the aquatic environment. In Scotland, intensive farming of finfish and shellfish predominate, producing products for human use.

Aquaculture in Scotland mainly provides finfish for the table, producing Atlantic salmon and rainbow trout, with brown trout, sea trout, halibut and Arctic char making a small but important contribution.

Scotland also has a successful shellfish-farming sector specialising mainly in producing blue mussels and Pacific oysters, with smaller numbers of native oysters and scallops. A small seaweed aquaculture industry is also emerging. The products from these seaweed farms are likely to be used in several ways, including food for human consumption, animal feed, and fertilisers.

Aquaculture products can be used for many purposes, from food to biofuel. However, at present, food production is the main driver for Scottish aquaculture.

There are aquaculture sites across Scotland (Figure 1). The vast majority of shellfish and seawater finfish sites are on the west and north coasts of the mainland and in the Western Isles, Orkney and Shetland.

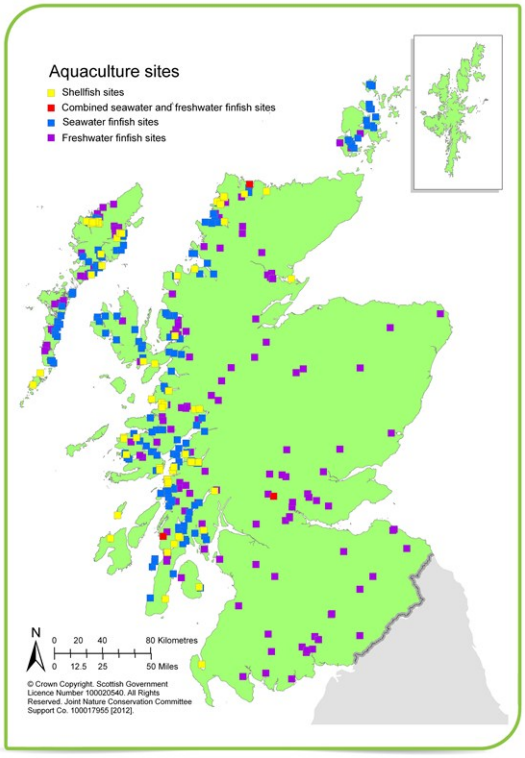

Figure 1: Aquaculture sites across Scotland

Source: Scotland's Aquaculture

These are the main types of Scottish aquaculture operations.

Marine finfish

Salmon are moved into marine farms after spending the first year of their lives in freshwater farms, mimicking the natural life cycle of salmon in which the fish spend their early years in lochs and rivers before migrating to the sea.

The marine farms where fish are grown are on the west and north coasts of the mainland and on the Western Isles, Orkney and Shetland (Figure 1). They are normally positioned in sea lochs, voes and inlets, where some shelter is provided from the worst of the weather.

The farms typically consist of one or more groups of cages arranged in a grid pattern and securely anchored to the seabed. These cages, also known as pens, consist of a floating ring on the surface of the sea, supporting a large net bag hanging in the water. The floating rings are normally 90-110 metres in circumference and the net bags are 15-20 metres deep, enclosing 10,000–15,000 cubic metres of water, equivalent to approximately 20 swimming pools.

The fish are held in the net bags, which allow water to flow past the fish – bringing fresh oxygen and carrying away waste products such as carbon dioxide and ammonia. Solid wastes such as faeces fall through the cage structure to the seabed. The fish are fed with feed pellets, and medicines can be administered either in the food or by adding them to the water in the cage.

In addition to salmon production, small quantities of rainbow trout, sea trout and marine species such as halibut, cod and haddock have been produced in recent years. The farming techniques and equipment have been adapted to meet the different requirements of each species.

Freshwater finfish

Freshwater finfish aquaculture is an important part of the aquaculture sector. It supplies young fish to marine farms, and is a producer in its own right.

Salmon naturally spend part of their lives in freshwater and part of their lives in seawater; salmon are hatched and reared through the early stages of life in land-based hatcheries. When they have reached a certain size the young salmon are transferred to cage sites in freshwater lochs. They stay in the cage sites until they are between 12 and 18 months old, when they become smolts and are able to survive in seawater. At this point the fish are transferred to marine farms, mimicking the natural migrations of wild salmon.

While cages in freshwater lochs account for the majority of freshwater aquaculture, a variety of other rearing systems are used. These include tank-based systems and rearing ponds.

The majority of freshwater finfish aquaculture produces fish, principally Atlantic salmon and rainbow trout, for human consumption. Rainbow and brown trout are also produced to stock water bodies for angling, and Atlantic salmon are produced to stock water bodies for angling and to replace stocks for conservation purposes.

Shellfish

Most shellfish production is centred on mussels, but oysters and scallops are also grown. Farming typically takes place in sea lochs and voes on the west coast of the Scottish mainland, on the Western Isles and on Shetland, with Scotland's irregular coastline offering many ideal sites for shellfish production. It is essential to have pristine clean water in which to grow wholesome shellfish.

Most cultivated mussels are grown on vertical ropes or fabric suspended in the water from horizontal flotation buoys arranged in long lines.

Scallops can be grown in a similar fashion, hanging from lines or grown in small, suspended net enclosures known as lanterns. Oysters are normally grown in bags made from heavy plastic mesh, either lying directly on the shore or set up on trestles.

The shellfish species cultivated in Scotland are all filter feeders; they feed by circulating water through their gills, filtering out the plankton and other food particles. Shellfish do not need to be fed, being entirely dependent on this naturally occurring food.

Similarly, mussel farms are populated by young larval mussels (known as spat) arriving naturally on the tide and settling on the ropes in the shellfish farm. The natural stocking and feeding means that shellfish farming is considered to be very environmentally sustainable.

State

Scottish aquaculture is dominated by Atlantic salmon. Scotland is currently the largest producer in the EU; globally, only Norway and Chile produce more Atlantic salmon than Scotland. In 2012 162,223 tonnes were produced, estimated to be worth around £537 million. Shellfish production is dominated by blue mussel farming, which produced 6,277 tonnes in 2012.

Finfish

Over 96% of the fish farmed in Scotland were Atlantic salmon.

Table 1: 2012 Scottish Fish Farm Production Survey figures

Species	Production (tonnes)
Atlantic salmon	162,223
Rainbow trout	5,670
Halibut	73
Brown trout	42
Arctic char	0.20

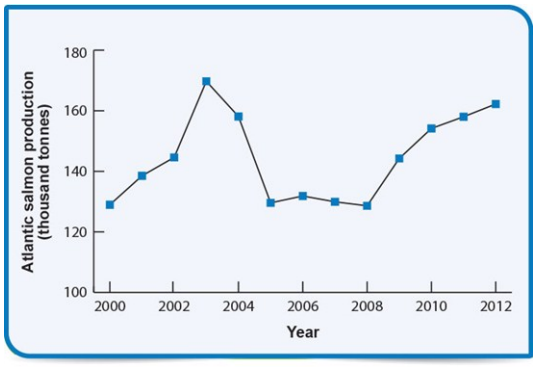

Figure 2: Atlantic salmon production, 2000 to 2012

The largest variation in salmon production occurred between 2002 and 2005 (Figure 2). This was due mainly to a large smolt placement in the years 2000-2002, with an increased average weight, which produced a higher yield of fish between 2002 and 2003. The number of smolts placed between 2003 and 2005 were reduced, which was partly due to a low market price for salmon.

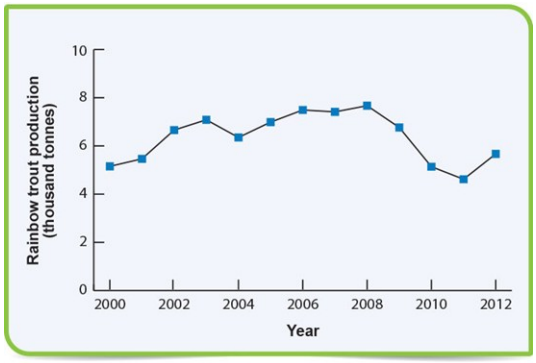

Figure 3: Rainbow trout production, 2000 to 2012

Rainbow trout production is at a fraction of the scale of salmon production, but there is growth in the sector. This is stimulated by increasing demand and a move to produce rainbow trout in marine cage sites as well as freshwater sites, similar to salmon production. This change allows larger production units to be developed, with faster growing fish. Overall, this should lead to further growth in this sector; Marine Scotland predicted that production in 2013 would be approximately 6,700 tonnes – 1,000 tonnes more than 2012.

Marine shellfish

Scotland has a successful shellfish farming sector, which mainly produces blue mussels and Pacific oysters. Smaller amounts of native oysters, as well as queen and king scallops, are also farmed. There are active shellfish sites throughout Scotland (Figure 1).

Table 2: Scottish Shellfish Farm Production Survey, 2012

Species	Production
Blue mussels (tonnes)	6,277
Pacific oysters (thousands of shells)	2,706
Native oysters (thousands of shells)	317
Scallops (thousands of shells)	58
Queen scallops (thousands of shells)	9

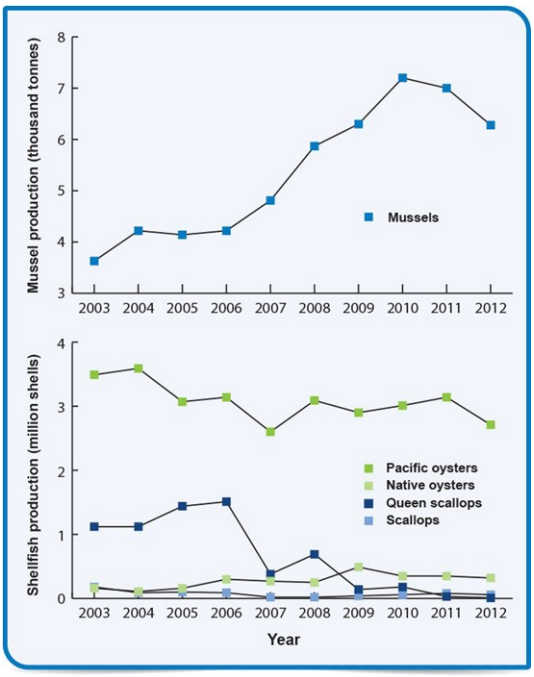

Figure 4: Shellfish production, 2003 to 2012

Between 2010 and 2012 mussel production decreased by 10% (Figure 4) and responses to the shellfish production survey attributed the cause to environmental effects, such as changes in recent years to where and when spats settle.

Economic contribution

The value of aquaculture production has grown by an average of 4.6% a year between 2000 and 2009.

Scottish salmon is exported worldwide as a premium product, and key export markets include the EU and the USA, with emerging economies such as China becoming more important every year.

The aquaculture industry helps to support sustainable economic growth in rural and coastal communities, in particular in the more remote areas of the Highlands and Islands. According to a 2012 report from the Scottish Salmon Farming Producers' Organisation, salmon farming provides 2,124 jobs directly, and the Scottish Government estimated that in 2012 shellfish farming supported 358 jobs throughout Scotland. It is estimated that 6,200 jobs are reliant on the aquaculture industry in Scotland.

Pressures

Achieving sustainability in aquaculture is challenging, and pressures range from maintaining healthy fish stocks and protecting the environment, to staying competitive in global markets for aquaculture products.

Using Scotland's natural resources for aquaculture requires careful management. Development must be sustainable – economically, socially, culturally and environmentally – minimising risks to wildlife. The aquaculture industry must be considerate towards those who share the aquatic environment.

The key pressures affecting the aquaculture industry and its operating environment are:

- provision of feed;
- disease and parasite control;
- climate change;
- global trade and economic development.

Provision of feed

All of the finfish currently produced in Scotland are pisciverous; they eat other fish. To provide food for them requires a large volume of fish meals and fish oils.

If aquaculture is to expand at the rate the aquaculture industry intends, alternative sources of meals and oils will be required because the world supply of fish meal from current sources cannot keep up.

Research is being done to test food derived from alternative fish species, such as squid and krill. In addition, plant based oils and meals derived from soya bean, canola, peanut and cotton seed meals or other protein concentrates are being investigated.

Disease and parasite control

Diseases and parasites can be a significant problem and can cause losses in production and harm wildlife close to the sites where aquaculture operation takes place. Sea lice are a significant parasite problem in salmon farming, and much effort is needed to manage and control their numbers – this is achieved by applying licensed treatments or using cleaner fish, such as wrasse or lumpsuckers. Some diseases, such as infectious salmon anaemia (ISA), can significantly affect farmed salmon. The effort to control parasites and prevent disease in aquaculture is demanding, and controls need to be developed that are acceptable in terms of protecting the environment, while keeping fish healthy and productive.

Climate change

Climate change is projected to result in temperature changes in our marine and inland waters and this could put pressure on aquaculture operations. These pressures could include:

- the spread of existing pests and pathogens, or the introduction of new ones;
- thermal stress for fish and shellfish, resulting them becoming more vulnerable to disease;
- an extended sea-lice season;
- more frequent incidences of shellfish toxicity.

It is also possible that increased storminess could damage cages and other aquaculture equipment, particularly in coastal waters.

Global trade and economic development

The Scottish aquaculture industry competes with producers from around the world and is constantly under pressure from countries where production costs are lower. Strategies and actions to make the Scottish aquaculture industry more sustainable must combine marketing to international consumers with resilience to climate change and environmental conservation.

What is being done

Scotland's coastal and inland waters provide excellent conditions for further growth of the aquaculture industry.

The Scottish Government is fully supportive of the sustainable growth of aquaculture alongside a thriving recreational fisheries sector.

Both are key sectors underpinning sustainable economic growth that supports employment and economic wellbeing of many fragile rural communities across Scotland.

As part of its policy to increase sustainable economic growth, the Scottish Government has identified the food and drink sector as a key area for development. The key industry targets for sustainable aquaculture growth by 2020 highlighted in Scotland's National Marine Plan Consultation document are:

- to increase marine finfish production sustainably to 210,000 tonnes (from 164,380 tonnes in 2012);
- to increase shellfish production to 13,000 tonnes (from 6,525 tonnes in 2012).

A Fresh Start - the renewed Strategic Framework for Scottish Aquaculture was published in 2009. The Ministerial Group for Sustainable Aquaculture (MGSA) has been established to help the industry achieve these sustainable growth targets and includes representation from industry, wild fish interests, environment non-governmental organisations (NGOs) and regulatory bodies.

MGSA builds upon the Aquaculture and Fisheries (Scotland) Act 2013 and further enhances the existing regulatory framework in Scotland to strike the right balance between growing the aquaculture sector and protecting the environment.

Policy and legislation

A fish farm must gain planning permission before it can start producing. This involves a significant application, with an environmental statement at its core. The outcome of the application is considered by the local council planning department, taking into account any comments made during the consultation process.

If an application is successful and development takes place, the business must obtain a licence (issued by SEPA) that determines the volume of fish that may be farmed and the medicinal treatments that may be used. The business has to be authorised by Marine Scotland for disease-control purposes, and will require a sea-bed lease provided by The Crown Estate. During the course of its operation, the site is monitored by all relevant regulators, with regular inspection visits.

Regulators seek compliance with many statutes controlling a range of issues. These include, for example, SEPA's role in controlling environmental impacts under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 and the requirement to monitor sea-louse numbers under the Aquaculture and Fisheries (Scotland) Act 2007, regulated by Marine Scotland.

A failure to comply with the requirements of legislation can lead to regulators taking action against operators.

Sustainable aquaculture

The aquaculture industry has invested significantly in Scotland. To protect the industry in the long term, sustainable development continues to be at the centre of its values. The industry must protect and enhance the environment in which it operates, minimising the unavoidable impacts. The Code of Good Practice for Scottish Finfish Aquaculture has been developed by the industry to help make sure

it has a long-term future by following disease and parasite-control strategies that also contribute to protecting the environment.

Compliance with the code of practice will help protect the environment surrounding aquaculture sites and demonstrate that the industry is committed to being a good neighbour and looking after Scotland's natural resources.

4.7 Estuaries and Coastal

Scottish coastal and estuarine habitats are full of rich, diverse and fragile sea life that is under considerable pressure and shows signs of damage, but may be recovered through sustainable management.

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Summary

Key Messages

- Scotland has 18,672 km of coastline, with a wide variety of coastal and estuarine habitats that provide places for thousands of species to live.
- These habitats and their wildlife are a major asset for Scotland, but they have been severely affected by a variety of human activities.
- A number of industries, including fishing, tourism and aquaculture, rely on healthy coasts and estuaries.
- It is essential to recognise our dependence on this ecosystem and manage our coasts and estuaries sustainably to reduce damage and promote recovery of our inshore wildlife.

State and trend

A summarised assessment of the state and trend has not been made for this topic.

Please read the topic for more information; if you have any questions about Scotland's estuaries and coastal waters please feel free to contact us via the contact us facility on the website.

Overview

Scotland’s inshore and coastal resources are enormous. Scotland has an estimated 18,672 km of coastline, which makes up 8% of Europe's coast. The sea areas less than three nautical miles from the coast are known as coastal waters (Figure 1). These range from brackish (slightly salty) to full salinity, and reach a depth of 120 m.

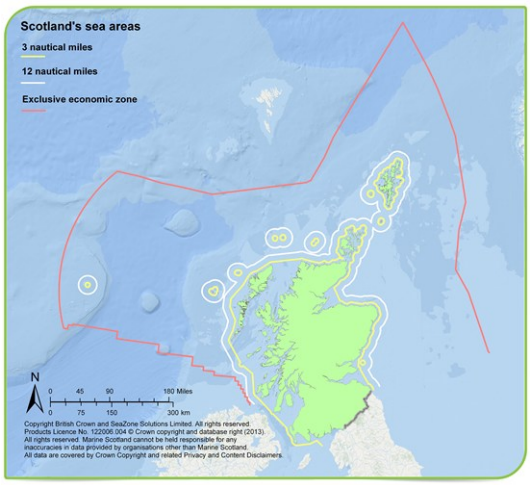


Figure 1: Scotland's coastal and estuarine waters

Scotland’s coasts and estuaries have been extensively described in Scotland’s Marine Atlas and in a video clip. The vast array of habitats helps us understand the biological richness of our inshore waters. Our coasts

include estuaries, bays, sea lochs, voes and cliffs. Underwater, this complexity continues, with underwater cliffs and mountains, valleys, boulder slopes, and vast areas of gravel, sand and mud. Scottish coasts have extremes of temperature, wave exposure and salinity. The coastal waters vary from the clear blue found around the Hebrides, where light penetrates to 50 metres deep, to the dark and green-tinged waters of the east-coast estuaries.

A number of industries rely on healthy sea life – including fishing, tourism and aquaculture. Estuaries and coasts provide us with many benefits, including a source of food, educational interests, and a place for recreation and quiet relaxation. Many people spend their recreation time on inshore waters and surrounding shores, such as the seaside or on coastal footpaths. Whether it is simply for views of the sea, wildlife watching or taking part in fishing and water sports, people enjoy the sea and the nature it sustains.

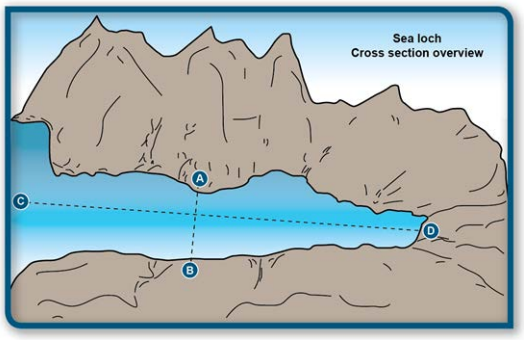


Figure 2: Cross section overview of a sea loch

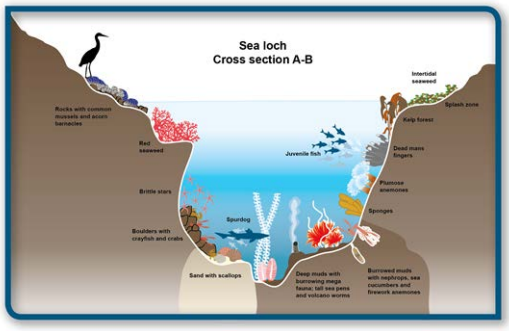


Figure 3: Cross section A-B of a sea loch

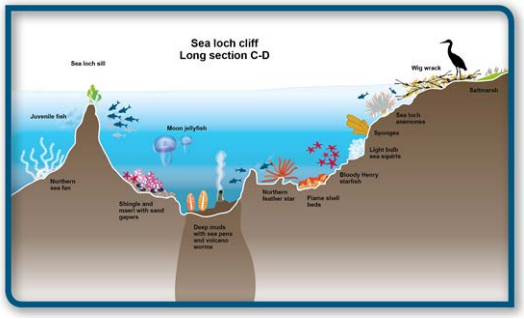


Figure 4: Long section C-D of a sea loch cliff

Scottish sea lochs are mostly found on the west coast of Scotland and are sheltered habitats that can host fragile species such as Serpulid reefs, flame shell beds and brittle stars. Their deep waters close to the shore are host to species such as the northern feather star, the wispy sea-loch anemone and the tall sea pen. Their deep, soft sea-loch muds are home to burrowing animals such as Norway lobsters, sea cucumbers and the firework anemone. These deep inlets are sheltered nurseries to many juvenile fish, including the endangered spurdog and the thornback ray. Follow this link to experience a simulated dive in Loch Sunart to see where some of these species live (this may take a few seconds to load).

- **Fish** live and breed in Scotland's estuaries and open coasts. The many different fish species include common species like butterfish and sand eels; northern species such as wolf fish; colourful fish such as leopard-spotted goby; familiar commercial species, such as mackerel, cod and herring; demersal (sea-bottom dwelling) fish like flounder, gurnard and dragonet, and fish caught by sea anglers, such as tope, wrasse and skate.
- **Invertebrates** (animals without backbones) make up the most colourful and prolific proportion of creatures found in Scottish inshore waters. Coastal and estuarine invertebrates burrow in sediments, hide in rocky crevices or are attached to man-made objects, such as piers and moorings. Examples include breadcrumb sponges; sea anemones; candy-striped worms; sea urchins; crabs and lobsters; starfish; sea-slugs; scallops and octopuses.
- **Birds** also find shelter on the Scottish coastline. Many are transient, resting onshore or rafting (floating in groups) on sheltered waters during their migration. Some species come specifically to breed. For example, gannets have formed the largest single-rock colony in the world on the Bass Rock in the Firth of Forth.
- **Reptiles**, such as leatherback turtles, have been reported all round our coasts.
- **Marine mammals** are seen more frequently than reptiles. Twenty-three species of cetaceans (whales, dolphins and porpoises) have been recorded in Scottish waters over the last 25 years. Of these, 11 species are regularly sighted and are the focus of a thriving coastal-wildlife tourism industry. Resident mammals, such as grey seals and harbour seals live in Scottish waters and haul out on shores for breeding and moulting.
- **Seaweed** (marine algae) is the most obvious marine **plant** and various types are found on shores and in shallow waters. Seagrasses and tasselweeds are mostly found in coastal lagoons and, like all sea plants, they provide food and shelter for many marine animals.
- **Plankton** is a mixture of **Phytoplankton** (microscopic plants) and **zooplankton** (made up of small creatures, such as copepods, and larval forms of marine animals). These microscopic plants and animals drift in water or settle on estuarine and coastal sediments. They are the basis of the sea's food webs and oxygen cycles, and are the food source for large species like herring and basking sharks and filter-feeders such as oysters and tubeworms.

Estuarine and coastal ecosystems are complex and changes can have consequences far beyond inshore waters. Scotland's estuaries and coastal waters have been identified as important spawning and nursery areas for important commercial species; loss or damage to their habitats affects the fishing industry and local coastal communities, and consequently affects Scotland's economy. The loss of living habitats such as kelp forest would not only be biologically and economically damaging, but may also be physically damaging. For example, on the west coast of Scotland this would lead to a reduction of physical shelter from prevailing westerly storms that damage Scottish coasts.

State

There are many concerns about Scotland's inshore sea life due to the pressures on their habitats and their supporting food webs.

The overall assessment within Scotland's Marine Atlas for species and habitats shows the poor state of marine biodiversity. On the whole, Scotland's inshore biology has suffered a decline in status. Figures 5 and 6 show the assessments for inshore waters from Scotland's Marine Atlas, and the prevalence of orange and green labels indicates there is concern for the species and habitats in these waters.

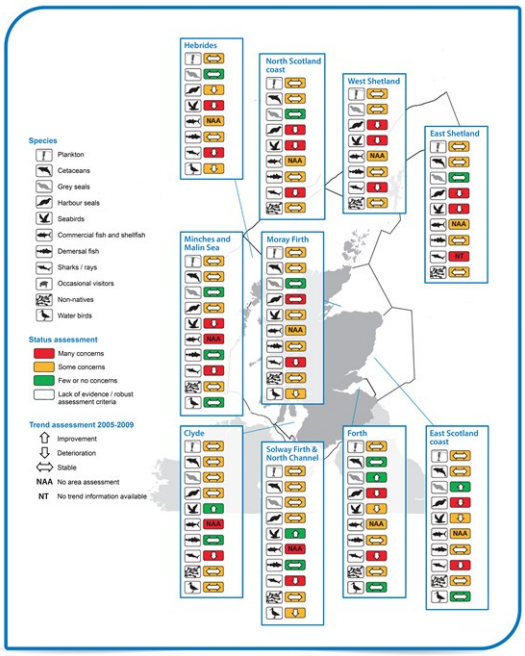


Figure 5: Species assessment

Source: Scotland's Marine Atlas overall assessment

The assessment for species in inshore Scottish waters highlights declining trends for many inshore populations of seals, seabirds, sharks and rays. These trends include lower numbers of harbour seals in haul-out areas, lower bird numbers attaining breeding success and fewer, or total absence of, shark and ray species reported during tagging exercises. In particular, seabirds have continued to decline in 2012, falling to 46% of the population seen in 1986. All 10 areas assessed have species that are declining to a point that it is of concern. In some cases (for example, demersal fish and plankton) the trend stabilised, and yet there is still concern; this is because their states are still poor, but the trend has stabilised at this level. Of particular interest in this assessment is that nine of the 10 areas have non-native species present, although this trend has stabilised – possibly due to better public knowledge and biosecurity measures. Populations of wading birds in the Firth of Forth, east coast, Minches and the Malin Sea appear to be stable, and populations of seabirds in the Solway and Clyde Firths appear to be improving.

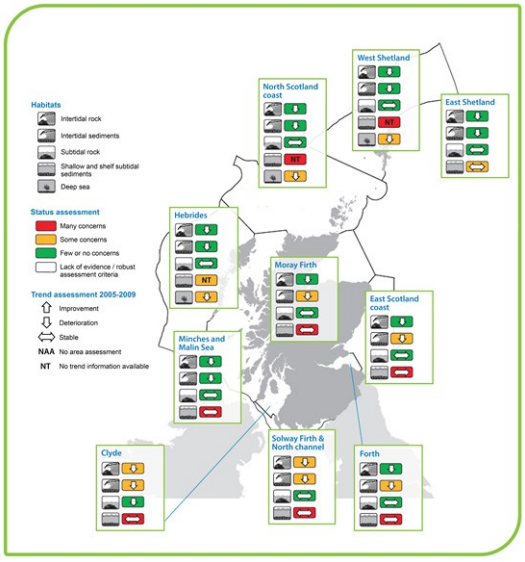


Figure 6: Habitat assessment

Source: Scotland's Marine Atlas overall assessment

The overall condition of Scotland's inshore habitats is declining. Inshore sediment habitats directly support particularly fragile assemblages of species that live on them, as well as provide food and nursery areas for more mobile and wider ranging species. Habitats within Scottish inshore waters are declining, or are stable but still of concern. For example, there is concern about their ability to recover from damage and return to a condition that will support all their associated species. Of the 10 areas assessed, no habitats are improving. In all 10 areas, intertidal rock and sediment is declining and sediments are damaged.

Damage to habitats means that they lose the capacity to support species; when the condition of habitats declines, this is reflected in a decline of species. Therefore, the decline of species seen in Figure 5 may be related to the poor habitats available to support them rather than pressures that affect the species directly. The recovery of Scotland's sea life is dependent on the recovery of these habitats.

Pressures affecting wildlife in estuaries and coasts

The decline of estuarine and coastal species and habitats is directly related to human activities putting pressure on particular areas of inshore waters. The degree of impact from the pressures varies and has been summarised in the overall assessment in Scotland's Marine Atlas.

Pressures on estuaries come from activities associated with urban and coastal development that cause permanent loss of vulnerable habitats. Some pressures have a high impact, but can be recovered from if the pressure is removed or sustainably managed. Other, long-term pressures tend to affect the environmental health of estuaries and coasts. Species and habitats can be affected by individual pressures or by combinations of pressures.

Many pressures on Scotland's seas are being managed and this is contributing to a better quality environment, but species and their crucial habitats are still being lost. Estuarine and coastal habitats can be particularly at risk because these areas are used more.

The main pressures on estuarine and coastal habitats are:

- fishing;
- aquaculture (farming of marine species);
- litter;
- development;
- pollution;
- non-native species.

Fishing

Within Scotland's coastal waters there has been a move towards sustainable methods of fishing that reduce damage on the marine environment. However, fishing activities still remove non-target species (species not being fished for), and damage the habitats of species that live on the sea bed by scouring and smothering them.

Aquaculture

Scotland has a large-scale industry of commercially farming shellfish, crustacea and fin-fish. Although the industry is moving towards sustainable and low-impact methods, aquaculture can still put pressure on coastal sea life, particularly fin-fish farming. The impacts come from licensed discharges of nutrient and waste products and contamination from veterinary chemicals. There is biological contamination from sea lice and micro-organisms that thrive in cage systems, and species and diseases could be introduced into the wild if they escape from cages or are accidentally transported into Scotland by aquaculture operations.

Litter

On Scottish beaches, litter from land and marine sources is a persistent, long-term problem and is mostly made up of non-biodegradable plastics that blow around, float on the water surface, drift in the sea, and get entangled on shores and on the sea bed. Damage caused by litter to Scottish species and habitats includes smothering and abrasion, and it can indiscriminately choke and kill species that ingest it.

Coastal development

A vast amount of infrastructure is required to develop, maintain and allow access to coastal activities and marine industries. This includes shipping and navigation facilities; oil and gas pipelines; renewable-energy cabling and connectors; and support for a range of small and local industries associated with ports, jetties and harbours. Noise from coastal development can affect wildlife. It also affects wildlife through disturbance and complete loss of habitats, as well as pollution and chemical contamination from accidental spills.

Pollution

Pollution can have a long-term impact on inshore wildlife, which can be seen in subtle changes in species occurring in impacted areas. Although improvements in the condition of estuarine and coastal waters are reflected in the Water Framework Directive monitoring results and Clean Seas Environment Monitoring Programmes, concentrations of hazardous substances from contamination in the past still exist, and increased concentrations of nutrients (nitrogen and phosphorus) continue to be released into Scotland's coastal waters. Nutrient inputs from aquaculture are predominant on the west coast, whereas on the east coast run-offs from agriculture and urban wastewater discharges are the main sources of nutrients.

Non-native species

Non-native species represent the biggest threat to biodiversity worldwide, and in Scotland non-native species are reported as widespread and established, resulting in subtle changes in species composition. Marine non-native species can be invasive and alter entire ecosystems, affect fish farming and destroy inshore fisheries, causing serious problems to the environment and the local economy.

Combinations of pressures

Decreased numbers of a top predator species from individual pressures could lead to a change in the dominant species in local marine ecosystem. It is thought that jellyfish swarms are due to a decrease of large fish that prey on the planktonic stages of jellyfish. Jellyfish swarms affect industries such as tourism and aquaculture and have disrupted power generation.

If the ecosystem becomes imbalanced (for example, due to nutrient inputs), this can cause exaggerated seasonal increases in particular species. For example, increased nutrient inputs and certain weather conditions can cause algal blooms, which can be a danger to human health and reduce levels of light and oxygen in the water, poisoning other marine species.

What is being done

Marine planning for Scottish waters, including estuaries and coasts, aims to make sure they are clean, healthy, safe, productive and biologically diverse.

Under the new marine planning regime, wildlife in coastal and estuarine waters will be given more protection in areas classified as Marine Protected Areas. There are also 80 priority marine features that have been identified as being important for conservation. These have been proposed for the focus of wider conservation policy and planning.

We are responding to pressures on our wildlife in coastal and estuarine waters on three levels:

- national and international;
- sectoral;
- local and individual.

National and international responses

Under the EU Marine Strategy Framework Directive, Scotland has been working with other countries on a strategy to achieve or maintain Good Environmental Status (GES) in Scottish seas by 2020. Because of the nature and use of the Scottish marine environment, there is a strong emphasis on international co-operation.

- The Marine (Scotland) Act 2010 introduces a new marine planning system to balance the many competing demands on Scotland's seas, taking an ecosystem-based approach to promote development that is sustainable for the economy, society and the environment.
- The Marine Strategy Forum, established in July 2009, allows members of the public to contribute to the planning process. The forum considers the needs of marine leisure, conservation, aquaculture, fishing, transport, industry and public-sector organisations.
- Marine and coastal sea life will be protected through Marine Protected Areas, actions to protect particular species, and wider measures to make sure that the development in Scottish waters is done in a way that protects biodiversity.
- There is an overlap of protection measures within Scotland's estuaries and coasts. Many features of Scotland's estuarine and coastal habitats and species are included in protected areas with land elements, such as Sites of Special Scientific Interest (SSSIs), national nature reserves and European Natura sites, (Special Protection Areas (SPAs) and Special Areas of Conservation (SACs)). These sites have been designated to help protect fragile coastal habitats that support important marine species, and include important haul-out areas for seals or loafing and feeding areas for seabird species.

Sectoral response

In Scotland some of the biggest responses by society have been by sectoral groups working with the government.

Fishing

Within Scotland's coasts and estuaries the Scottish Inshore Fisheries Groups are a strategic framework for inshore fisheries that enables this sector to work with others to develop plans for sustainable inshore fisheries. There are Inshore Fishery Groups covering all the Scottish coast (except Shetland which has its own management arrangements). The groups are taking forward and developing inshore fisheries management plans for their area within the context of the Scottish marine plans.

Aquaculture

Although aquaculture can impact on the marine environment, it is generally localised. The Scottish Government has updated its Locational Guidelines, which helps decision makers to manage fish farm pressures. This advice is based on the capacity of inshore waterbodies to assimilate impacts on the seabed and nutrient enhancement from this industry. Within the aquaculture industry, codes of conduct have been adopted to reduce damage. Good practice includes decreased stocking densities, as well as longer, or even synchronised, fallow periods in some sea lochs. More consumers are choosing to buy organically grown fin-fish, but there is still debate around whether feeding farmed fish with protein feed made from fish caught in the wild is acceptable.

Marine litter

Marine litter has been raised as an issue under the EU Marine Strategy Framework Directive and the Scottish Government is finalising a Scottish marine litter strategy to co-ordinate action on this complex issue. Groups,

such as Surfers Against Sewage (SAS), have long promoted awareness of sewage and sewage-related debris found on UK beaches. The Marine Conservation Society (MCS) runs the Beachwatch project to record levels of rubbish on beaches, and the information gathered by this project has provided the evidence for policy and anti-litter campaigns.

Marine non-native species

The Wildlife and Natural Environment Act (2011) has introduced legal measures for controlling non-native species in Scotland. Marine Scotland is working with other UK organisations such as the GB Non-Native Species Secretariat to co-ordinate the management of non-native species in the UK. The best way of preventing non-native species from spreading is by making sure everyone who uses the marine environment, for business or pleasure, follows certain biosecurity advice. Good examples of biosecurity advice include the Green Blue advice for boat owners and alien invasive species and the oil and gas industry advice, and local biosecurity plans have been drafted at local levels by the Solway Firth partnership and the Firth of Clyde Forum.

Local and individual response

Through volunteering, many individuals and groups are improving our knowledge about marine and coastal biodiversity and protecting it. There are organised projects staffed by volunteer experts, and informal reporting of sightings and incidents by individuals.

Monitoring wildlife

Many people give up their weekends and evenings to take part in organised recording projects to monitor wildlife. Examples include:

- the Scottish Sea Angling Conservation Network (SSACN) Shark Tagging programme;
- the MCS's lead in Scotland for the UK's Seasearch programme;
- the British Trust for Ornithology (BTO) bird surveys for volunteers, including the Bird Atlas, the Wetland Birds Survey (WeBS) and, with the RSPB, the Breeding Bird Survey, which all include coastal bird counts as well as observation of the impacts of marine litter on coastal and marine birds;
- an international appeal by JellyWatch for the public to report and photograph sightings of jellyfish swarms;
- Sealife Tracker, published by the British Sub Aqua Club and UK agencies is a tool that enables the public to submit information on marine non-native species and species likely to be affected by changes in sea temperature caused by climate change.

Many people actively report on wildlife seen during recreational activities, such as walking, or scuba-diving in the St Abbs& Eyemouth Voluntary Marine Reserve. People can ask experts to help identify findings via forums like i-spot and i-record. The Marine Conservation Society records sightings of basking sharks, marine turtles and jellyfish in Scottish waters by the public through their Wildlife Sightings initiative.

Responsible recreation

Skippers can follow Green Blue's boat protocol, Prevention of spread of marine non-natives. The marine-wildlife-watching industry follows the Scottish Marine Wildlife Watching Code, and canoeists and kayakers have a code of conduct. Sea anglers have handling and tackle advice to reduce the impact of fishing on fish returned to the sea.

Management and conservation

Local communities of marine users have set up conservation management measures for their local marine and coastal areas; for example, the Community of Arran Seabed Trust (COAST). Scottish Local Biodiversity Action Plan groups are made up of the public and local officers, who create local plans and projects on biodiversity. Where possible, they work with local coastal forums to put these into place.

The Scottish Coastal Forum is a national group of local coastal forums that act as co-ordinated central points of communication for people living and working in marine and coastal areas, and where people can give their opinions on marine and coastal issues. Local coastal partnerships include: Coast Hebrides, the East Grampian Coastal Partnership, the Firth of Clyde Forum, the Forth Estuary Forum, the Moray Firth Partnership, the Solway Firth Partnership and the Tay Estuary Forum.

4.8 Rivers and lochs

Scotland's freshwaters provide a range of habitats for plants and animals. Overall, freshwater habitats and species are in good condition. However, while some individual habitats and species are improving, others are still under pressure.

Summary

Key Messages

- Scotland has significant freshwater resources: 125,000 km of rivers, 27,000 lochs, 198,000 ponds and 220 km of canals.
- This provides a range of habitats for wildlife, such as otters and freshwater pearl mussels.
- Overall, the habitat of wildlife in Scottish rivers and lochs is considered to be in a good condition, although large numbers of ponds have been lost in the past.
- Freshwater wildlife is largely in a good condition, but a number of individual species are declining.
- Some high-profile species are still struggling (e.g. pearl mussels), although others are recovering well (e.g. otters).
- New statutory controls and other approaches have been introduced to protect and restore wildlife.
- The predicted impacts of climate change pose significant challenges.

State and Trend

State: Good - high agreement, high evidence

Trend: Improving/stable - high agreement, high evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- These assessments are of the current "average condition"; some aspects are in a worse condition, and others are in a better one. Equally, some wildlife is declining, while other wildlife is improving.
- Making any overall assessment is necessarily a simplification.
- We have taken account of the scale of any damage to the environment in these assessments; impacts can be locally damaging, but may have little effect on a national scale.
- The condition of freshwater wildlife is improving, but considering the likely scale of future risks and challenges, the assessment is 'improving/stable'.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

Scotland has significant freshwater resources: 125,000 km of rivers, 27,000 lochs, 198,000 ponds and 220 km of canals.

We receive many benefits from freshwater ecosystems, habitats and wildlife. Freshwater is used for drinking, irrigation, transport and food processing. Freshwater habitats can help control flooding, naturally treat or break down human and industrial waste, and support plant and animal life.

Rivers, lochs, canals and ponds

Rivers, lochs, canals and ponds cover about 2% of our land area. Together, they make up around 70% of the total surface area of freshwater in the UK, and contain 90% of the volume of freshwater in the UK.

When in a good condition, rivers, lochs, canals and ponds can support a wide range of plants and animals, many of which are important enough to be listed in the UK Biodiversity Action Plan. Our freshwater includes:

- a considerable number of relatively unmodified and unpolluted river systems with natural physical, chemical and biological diversity;
- many deep, unpolluted lochs, with wildlife that lives in nutrient-poor waters;
- a large proportion of the world's blanket-bog pools and lochans, which are rare elsewhere;
- unique groupings of freshwater plants, which naturally include species found in both North America and Europe;
- several internationally rare invertebrate species, including some of the world's largest surviving populations of freshwater pearl mussel.

The importance of Scotland's freshwater environment is described in the topics on water. Freshwater wildlife makes its own distinctive contribution to the benefits from nature provided by Scotland's natural resources, which were valued at between £21.5 and £23 billion a year[1] in 2010.

Lochs alone were estimated to contribute between around £1.4 and £1.5 billion a year to Scotland's economy.

Reference

[1]*Williams, E. (2010). Preliminary exploration of the use of ecosystem services values in a regulatory context. Environmental and Resource Economics Project Report for the Scottish Environment Protection Agency (SEPA).*

State

The overall ecological condition of Scottish rivers is generally good, with healthy populations of many mammal, bird, fish, invertebrate and plant species. The condition has improved over the last few decades, but some problems remain. Our freshwater wildlife is affected by high levels of nutrients, water abstraction (removal), physical modification of freshwater habitats, invasive non-native species, and climate change.

Despite improvements in water quality over several decades, some habitats and species are still affected. For example, water vole and freshwater pearl mussel populations continue to decline, and high nutrient concentrations threaten plants like river jelly lichen and slender naiad. Some habitats and species are affected by river engineering (for example, dams and flood defences) and water abstraction, and climate change and invasive non-native species have introduced new challenges.

Rivers

Habitats

Just over half of our rivers are in good condition or better, as assessed by the Water Framework Directive, with many being less affected by human activity than most rivers elsewhere in the UK and Europe. Many rivers have been affected by changes to physical habitat, such as straightening, dredging and loss of natural vegetation.

In 2011 only half of the 12 habitat features of designated river and stream habitats were found to be in 'favourable or recovering condition'.

Animals

Most monitoring information is available for larger animals, such as mammals and birds.

In Scotland, otters are found in many rivers, lochs, coasts and estuaries. Otters need good-quality water environments with plenty of food, and they are good indicators of healthy freshwater habitats.

In 2011 all the sites protected for otters were in favourable condition. The data shows that otters have greatly increased their spread since 1979, with otters now found even in urban rivers.

Water voles live in burrows near freshwater. They are one of Scotland's most threatened mammal species; their numbers fell dramatically in the second half of the 20th century due to habitat loss and the introduction of the predator, the American mink. Water voles in Scotland are now mainly restricted to smaller upland watercourses, although they can also be found in patches of undeveloped land in large urban areas, notably Glasgow.

Scotland's rivers support a diverse range of birds, including waterfowl, waders and songbirds. Their populations fluctuate; for example, the reed bunting population increased by 58% between 1995 and 2008. Meanwhile, although found in many areas, dipper numbers are falling.

Scotland's rivers naturally support a lower diversity of native fish species than rivers in southern Britain. Annual statistics on the catches of Atlantic salmon and sea trout provide the only long-term national report on freshwater fish populations in Scotland.

The total rod catch (retained and released) in 2012 was similar to the previous five-year average. Since 1952, when records began, annual rod catch has increased and is currently at the high end of the ranges that have been observed. Although several factors affect fish populations, this could be evidence of the numbers of fish entering freshwater increasing and, given the high levels of reported catch and release, escaping to spawn.

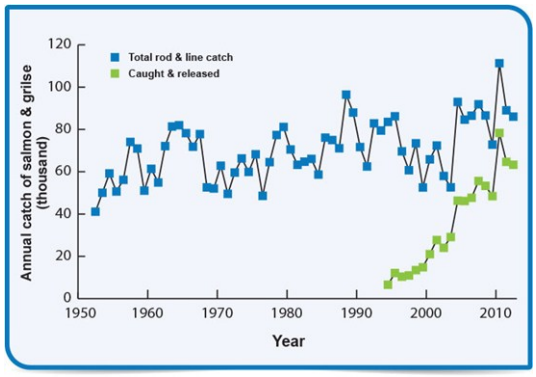


Figure 1: Total number of salmon reported to have been caught by rod-and-line fisheries in Scotland 1952-2012

Like salmon, sea trout migrate between the freshwater and the sea. The total reported sea-trout catch (retained and released) in Scotland as a whole in 2012 was 22,051. Catches have declined over much of the period since 1952; the total reported catch in 2012 was 3% lower than the previous five-year average and was the fifth lowest in 61 years.

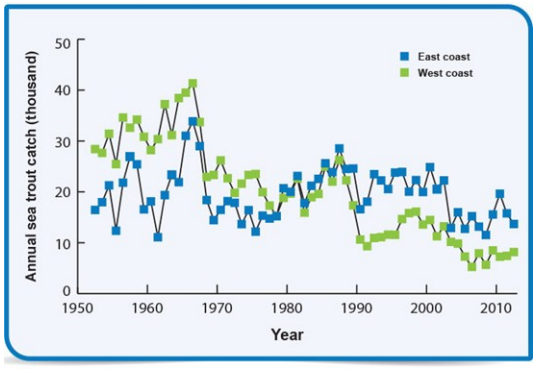


Figure 2: Annual reported catches of sea trout by rod-and-line fisheries in Scotland 1952-2012

Invertebrates sensitive to water quality changes are monitored at least twice a year (in spring and autumn) at a network of over 250 river sites. The average number of species varies between years but increased between 1981 and 2008.

Many Scottish rivers and burns are designated for protection because they are home to important populations of rare and declining species. In 2010, mixed fortunes were reported for designated river species (Table 1).

The main issue causing sites to be in poor condition was poor water quality.

Table 1: Summary of the condition of features for four protected river species

Species	Number of features assessed	Features assessed in favourable or recovering condition, 2005 (%)	Features assessed in favourable or recovering condition, 2011 (%)
European otter	27	100	100
Atlantic salmon	19	95	100
Lampreys (brook, river and sea)	16	67	68
Freshwater pearl mussel	24	33	33

Scotland has internationally important populations of freshwater pearl mussel, and has many of the world's remaining populations of this rare mollusc. However, in 2006 only 62 of 106 Scottish populations were assessed as viable (i.e. producing enough young mussels to be likely to keep the population going in the future).

In 2005 and 2011, there were concerns about freshwater pearl mussel populations in designated sites, as there were low densities of adult mussels and poor populations of juveniles. Licensed pearl fishing in the past, and recent, illegal, pearl fishing was assessed as a negative influence on 21 of the 24 sites designated for freshwater pearl mussels.

Scottish rivers support a range of submerged and emergent plants: flowering plants and simpler algae, mosses and lichens. Some particularly important species have been given protected status, such as water crowfoot in the River Tweed.

Nutrient levels in Scotland's rivers usually naturally increase as they flow downstream. Consequently, the lower reaches tend to support a higher abundance of aquatic plants.

Riverbank plants are important to the ecology of rivers, as they provide an important habitat and are a source of shade, cover and nutrients for the river. The variety of species of streamside plants was 12% lower in 2007 than in 1998. Since 1990, riverside vegetation has changed to include more tall species, with more woody plants. This increase in bushes and trees is partly the result of widespread efforts to prevent livestock from entering rivers, which helps to reduce the effects of diffuse pollution in rivers and lochs.

Lochs

Habitats

In March 2010 Scottish Natural Heritage (SNH) reported that, of 203 lochs monitored, 164 (81%) were in a favourable condition or were regarded as recovering, which is an improvement from the 2005 figure of 75%.

The 2012 Water Framework Directive classification found that of the 334 assessed, 64% were in good or better condition.

Animals

Many lochs in Scotland are important bird habitats that are protected. In 2011 70 out of 86 freshwater breeding bird features (81%) were in favourable or recovering condition. Most of the sites in unfavourable condition were designated for the black-throated diver and Slavonian grebe.

Scottish lochs are home to a number of fish species, some of which are rare or threatened (e.g. Arctic charr, powan and vendace). Species of coarse fish, such as pike and perch, have been introduced to a number of Scottish lochs, a practice which is now illegal without a licence. Designated features for protected loch-fish species were reported generally to be in favourable condition in March 2010 – only one Arctic charr population was reported as being in unfavourable condition.

A small trial reintroduction of the European beaver, formerly extinct in Scotland, is underway in lochs in Knapdale in mid-Argyll to assess the feasibility and effects of reintroduction.

Several rare invertebrate species are recorded in Scottish lochs, including the medicinal leech, found in a few shallow, weedy, nutrient-rich lochs.

Plants

Scotland's lochs support a wide range of flowering plants, mosses, algae and lichens, but no overall assessment of the state of loch plants has been undertaken. The slender naiad is the only loch plant species protected under the designation of Special Areas of Conservation. Only three out of six sites protected for slender naiad were in favourable condition in March 2011.

Based on the water quality of lochs and the reported condition of designated site features, the condition of animals and plants in Scottish lochs is generally good and, in many remote lochs, is likely to be relatively undisturbed by human activity.

Ponds

Although very small, ponds can support a surprising diversity of wildlife, and are particularly good habitats for amphibians (frogs, toads and newts), and invertebrates, such as dragonflies, snails and water beetles. They are also known to support rare plant species, such as the aquatic fern pillwort.

Animals

Some animals are particularly associated with ponds, and some, such as the great crested newt and natterjack toad, are given legal protection wherever they occur in Scotland, with a number of sites specifically designated for them. In 2011, 10 out of 11 features for amphibians in Scottish designated sites (90.9%) were either in favourable condition or recovering from unfavourable condition.

Invertebrates are an important part of Scottish pond life. Not enough is known, however, to assess their state or the trend in their condition.

Plants

In 2007 Scotland's ponds had an average of 10 wetland plant species each. Overall 10% of the ponds surveyed were of high enough quality to meet the UK Biodiversity Action Plan's 'Priority Habitat' status, based on the number of plant species. Across all 81 ponds surveyed in 2007, 137 different plant species were recorded.

Canals

Scotland's canals provide an important habitat for plants and animals, with 22 Sites of Special Scientific Interest (SSSIs) on or within 500 m of our canals. An abundance of invertebrates, fish, birds and plants as well as a range of amphibians and mammals is found, including bats.

Pressures affecting rivers and loch wildlife

Nutrient enrichment

Nutrient input (e.g. nitrogen and phosphorus) to freshwater can lead to a change in the species found as well as the population numbers of animals and plants. Excessive inputs of nutrients can result in extreme events such as algal blooms. These can deprive the native plants of light and oxygen, and can be toxic, resulting in decline or loss of fish species.

Extensive studies have been undertaken over several decades into the effects of, and more recent recovery from, nutrient enrichment in Loch Leven in Perth and Kinross.

Acidification

Acid rain affected populations of plants and animals in and around many freshwaters in the 1970s and 1980s. Invertebrates living in rivers and lochs were affected by the more acidic water, and the reduced numbers of invertebrates had a knock-on effect on animals that depend on them for food, such as the dipper, causing their numbers to fall, too. Many areas affected are now recovering, although some sites still show the impacts of acidification.

Water use and physical modification of habitats

Abstraction of too much water can be a problem for river and loch wildlife. Changing water levels too rapidly or too often through removing and then returning water can destroy shallow water habitats for plants and animals. In extreme cases, riverbeds can dry up. Dams and weirs, which modify or regulate river flows, often built to support water abstraction, can also cause problems. In addition, the dams may restrict or prevent fish migrating to breeding areas.

Aquatic habitats are often modified physically by engineering; for example, installing flood defences or agricultural drainage schemes. These can directly remove or destroy habitats or can affect them indirectly by changing the natural flow or sediment in freshwaters.

Invasive non-native species

There are many non-native species in Scotland, but only a small number of these have spread, causing damage to the environment, the economy, our health and the way we live – these are called invasive non-native species (INNS).

The threat from INNS is growing, and is made worse by increased global movement of people and goods; the UK National Ecosystem Assessment identifies INNS as one of the most important direct causes of biodiversity loss. that INNS cost the Scottish economy almost £245 million each year. Examples of INNS affecting Scottish freshwaters include rhododendron, American mink and New Zealand pygmy weed.

Climate change

By the 2080s, Scotland is likely to be several degrees warmer than it is today, especially in summer, and with less snow, wetter winters and drier summers. These changes, along with increased flooding, will affect the wildlife of freshwaters, with some long-term changes in rivers and lochs already being observed. The winter flow in the River Teith has increased by 91% over the last 40 years, while the average spring temperature in Loch Leven increased by 1.5 ºC between 1970 and the year 2000.

Wildlife in rivers can be negatively affected by rising temperature, low water levels, changed flows and flash floods, making conditions less hospitable. The timing of some seasonal events has already changed significantly: since the 1970s dippers have been laying eggs 3 days earlier each decade, on average (or four days earlier for every rise in temperature of 1 ºC).

What is being done

Practical implementation of regulation, and the development of best practice guidance, is helping to address pressures on freshwater wildlife.

Policy and legislation

The main mechanism for controlling development, Town and Country Planning legislation, was not designed to provide the specialised protection required for freshwaters. Consequently, many barriers to fish migration have been installed (bridges, weirs, etc.) as part of developments. Conservation legislation controls some impacts by licensing operations likely to damage designated conservation sites.

A policy response to the pressures on freshwater in Scotland was provided through the Water Framework Directive (WFD). The Water Environment and Water Services (Scotland) Act 2003, and its Controlled Activity Regulations (CAR) regime, regulates physical modification of, and water abstraction from, rivers, canals and lochs.

Under the WFD, river-basin management plans (RBMPs) were published for Scotland and the Solway Tweed River Basin Districts in 2009. These plans will ensure that public-sector organisations, businesses and individuals co-ordinate the way water is managed to make sure a balance is found between protecting our water environment and wildlife, and the interests of other water users.

The Wildlife and Countryside Act 1981 has been amended (by the Wildlife and Natural Environment (Scotland) Act 2011) to introduce more consistent and preventative legislation on INNS, and a Non-Native Species Code of Practice, including a framework of responsibilities for certain bodies (SNH, SEPA, the Forestry Commission Scotland and Marine Scotland) has been put in place.

Sustainable management

In general, pollution levels in Scottish freshwaters have been falling over time, and conditions have improved for wildlife following significant investment in better treatment of waste along with strengthened regulation. Sometimes, however, specific action is required to protect the environment from pollution. For example, during the 1960s and 1970s, when acidification of Loch Doon in south-west Scotland threatened the loch's unique population of Arctic charr, Loch Doon Arctic charr were moved to two reservoirs elsewhere in the Scottish Borders where acidification was not a problem.

When wildlife is threatened by diffuse pollution, action must sometimes be taken at a catchment level. In response to a threat from nutrient enrichment to rare loch plants in Tayside, SEPA initiated a lochs partnership, with funding from the Tayside Biodiversity Fund for measures to protect the plants. The project included an audit of farms in the catchment, soil nutrient budgets, advice to land managers, and funding to create buffer strips around lochs to trap nutrients.

Public funding is available for work that aims to restore water bodies to good ecological status, in line with the aims of the WFD RBMPs.

Invasive non-native species (INNS)

The is working with a range of partners to minimise the risk of invasion and damage caused by INNS in Scotland, following the principles set out in the INNS Framework Strategy for Great Britain. Two popular campaigns give advice on good practice relating to biosecurity – Be Plant Wise (for plants) and Check, Clean & Dry (for water sports). The Rivers and Fisheries Trusts of Scotland are leading on biosecurity in many

Scottish river catchments, eradicating species such as Japanese knotweed, giant hogweed, Himalayan balsam and rhododendron. The Scottish Mink Initiative aims to protect nationally significant populations of water voles, salmonids, ground-nesting birds and other native riparian wildlife from mink.

Climate change

As part of its policy response to climate change, the Scottish Government has developed a Climate Change Adaptation Framework with sector action plans to help make Scotland more resilient to the unavoidable consequences of a changing climate. The Biodiversity and Ecosystem Resilience Sector Action Plan sets out what action is being taken to adapt, and what this sector can do to help other sectors and our wider society adapt.

5 Land

Scotland's land is a fundamental asset. We grow food and timber on it; we build our houses and roads on it; much of our water filters through and is purified by it; it stores carbon and it supports a range of habitats and species, some of which are internationally important.

Scotland's land is a fundamental asset. We grow food and timber on it; we build our houses and roads over it; much of our water filters through and is purified by it; it stores carbon; and it supports a range of habitats and species, some of which are internationally important. Wetlands are found all over the country, with around 1,600 million tonnes of carbon stored in their peat soil.

Most of our land is used for more than one purpose. For example, 80% of our land is used for agriculture, but some of this land is rough grazing, which may also support deer and grouse populations and contain areas of water.

Almost all of our land has been shaped by human activity, over many centuries.

State

Scotland's rocks, landforms and soils are the foundation of our wildlife, landscape and cultural heritage. Due to the diversity of rock types and environmental conditions, Scotland has a wide range of soils. These are a vital natural resource, providing a range of benefits, such as growing food and trees, filtering impurities from water and storing carbon (over 3,000 million tonnes).

The condition of habitats in Scotland varies. Two-thirds of farmland habitats are in favourable or recovering condition, and many upland habitats are beginning to improve as action is taken to protect and manage them. Numbers of some farmland birds and insects are falling, and some species associated with upland habitats are also declining.

Most wetlands within protected sites are in favourable condition, except for lowland raised bogs, of which 59% are in unfavourable condition. We have little information about wetlands outside protected areas.

By 2013, 18% of Scotland was covered by woodland – an increase from only 4.5% at the beginning of the 20th century. As a result of human influence and climate change, no woodlands in Scotland can be considered truly natural. Likewise, most of the uplands have been modified through grazing, drainage, forest planting and deposition of pollutants from the atmosphere, and near-natural habitats are now rare.

Scotland's land is very important to the economy; agriculture, forestry and tourism based on the enjoyment of Scotland's landscapes and its historic environment make significant contributions. Agriculture is vital to our rural communities, providing much-needed jobs and contributing to the rural economy, although many agricultural activities are only economically viable because of external support payments.

In the last five years the biggest transformation of our landscapes has taken place through wind-farm development and gradual changes as a result of built development. Changes in farming and forestry practice are also altering our landscape.

Challenges

The main challenges relate to:

- land use – what we decide to use the land for;
- land management – how we manage, maintain and, where possible, improve the land.

Response

Our land requires careful management: ensuring it is kept in a good state is vital for the sustainability of the environment as a whole. The Land Use Strategy provides a framework to help balance the many demands on our land, and we need to involve local communities more in making decisions about how we use the land.

You can also find out about Scotland's land with our animated infographic.

Land topics

What is it?

Landscape - Our landscapes provide a range of benefits. Our wild upland and coastal landscapes are internationally renowned and inspire people who live here as well as visitors. Not all of our landscape is such high quality, and it all requires careful management

Rocks and Landforms - Scotland's rocks and landforms provide a range of benefits and help us to understand how the Earth has evolved. Our protected Earth science features are almost all in good condition, but we know little about the **state** of rocks and landforms outside protected sites.

Soils - Scotland's soils are diverse and rich in carbon; they are a vital natural resource providing a range of essential benefits and need to be protected. We have good information about some soil properties in some parts of the country. However, there is a lack of trend data.

Wetlands - Scotland's wetlands are home to a wide range of plants and animals. They also provide important environmental functions such as storing carbon and sustaining the supply of clean water.

Benefits and uses

Crops and Livestock - Scotland produces a range of crops and livestock. Our agricultural industry provides the basic ingredients for our food and drink industry, and is important for our health, environment and economy – particularly in our rural communities.

Fossil fuels and minerals - Scotland has a wide range of geological resources that make a major contribution to the economy. They are used in the energy, construction and manufacturing industries and need to be carefully managed to ensure they are available for future generations.

Timber and forestry products - Our forests and woodlands provide a range of benefits, such as wood for construction and fuel, removing $CO_2$from the atmosphere, rural employment and a space for recreation.

Wildlife

Farmland - Scotland's farmland is highly varied and contains a wide range of habitats for wildlife. However, populations of some birds and insects are in decline. Intensive land management is the main challenge to farmland wildlife.

Mountains and uplands - Scotland's uplands contain our wildest places and some of our rarest plants and animals. The condition of many upland habitats is beginning to improve as action is taken to protect and manage them.

Woodlands and forests - Scotland's woodlands and forests support a wide range of important plants and animals. For wildlife, our woodlands are in a moderately good condition now and are likely to improve in the future.

5.1 Landscape

Our landscapes provide a range of benefits. Our wild upland and coastal landscapes are internationally renowned and inspire people who live here as well as visitors. Not all of our landscape is such high quality, and it all requires careful management.

Summary

Key Messages

- Scotland's landscapes make an important contribution to public health and well-being, economic development, biodiversity and the historic environment.
- Tourism based on Scotland's landscapes is estimated to be worth £420 million a year to our economy; around 90% of visitors rated our landscapes as a 'very important' or 'important' influence on their decision to visit.
- Scotland's landscapes are still evolving in response to natural processes and the demands of society. In the last five years, wind-farm development has caused the most significant change to our landscapes. Gradual changes caused by building housing and changes in farming and forestry practice are also occurring, but these are more difficult to monitor.
- Nearly three-quarters of the Scottish public believe our finest landscapes are being well looked after. In contrast, only one-third are positive about changes to their local landscape, and less than half feel well informed about proposed changes or have an opportunity to influence them.
- To avoid damaging our landscape and losing what we value about it, we need to manage change to get the most public benefits. We also need to involve local communities more in these issues.

State and trend

A summarised assessment of the state and trend has not been made for this topic.

Please read the topic for more information; if you have any questions about Scotland's landscape please feel free to contact us via the contact us facility on the website.

Overview

Scotland is famous for its distinctive landscapes, especially its mountains, coasts and wild open spaces. Our landscapes are incredibly diverse for a small country – from the urban areas and managed countryside of central and eastern Scotland to the less intensively managed uplands and coasts of Southern Scotland, the Highlands and the Islands.

Scotland's landscapes make a significant contribution to our well-being and the country's economic performance. There are many reasons for this:

- The quality of our surroundings can improve our health by providing a place for us to exercise and to recover from physical and mental stress.
- Attractive, accessible landscapes, including urban greenspace, can make an important contribution to our quality of life.
- Our landscape is a living history of Scotland, and an inspiration for art and culture, contributing to our sense of place and belonging.
- For the vast majority of visitors (from the UK and abroad), our fine scenery is the main reason for choosing Scotland as a holiday destination. Around 66% of visitors rated it as 'very important' and 24% as 'important' in influencing their decision to visit.
- It is estimated that tourism based on Scotland's landscapes is worth £420 million a year to our economy.
- Landscape is an important part of Scotland's image. It helps to promote Scotland as a desirable business location, attracts inward investment and adds value to Scottish brands and products.

Our landscapes have evolved over thousands of years as a consequence of natural and cultural forces, and they are still changing. Some of these changes are welcome, and others less so. Our emotional responses to these changes are important in understanding the public benefits we get from the landscape. Indeed, the European Landscape Convention defines landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and human factors". Landscape includes the physical elements of the environment surrounding us – natural (such as lochs, rivers, woodlands, mountains and hills) as well as cultural (such as buildings, and patterns of past and present land use). But it is our understanding and perception of these elements and their interaction that gives us an understanding of their meaning and value.

Landscape Character Assessment (LCA) is used in the UK to describe, classify and map landscape. It helps explain what makes one landscape different from another and illustrates how many different landscapes we have. A complementary process of Historic Land-use Assessment (HLA) has also been developed, which provides more insight into the historic aspects of landscape. To increase understanding of the diversity of Scotland's landscapes and the relationship between people and places, a new map of the Landscapes of Scotland has been produced.

State

Landscape character assessment (LCA) has been used to categorise the entire area of Scotland. In total, there are 372 unique types of landscape character, which can be grouped into 53 general types of landscape.

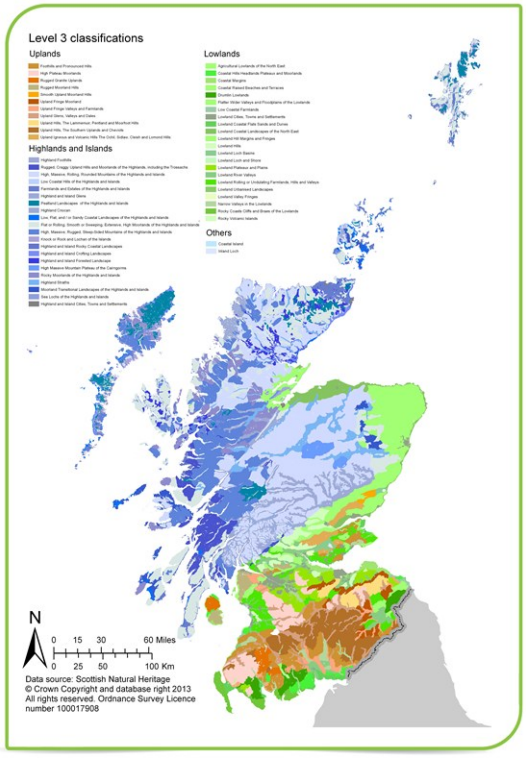


Figure 1: Landscape types in Scotland

Using the national assessment of Scotland's landscapes, the main elements of Scotland's landscapes include the following.

Built heritage and settlements

The visible remains of early human settlements are an inseparable part of the lowland and upland landscapes. The form and historical associations of these settlements, castles and monuments vary across the country. The far northern and Western Isles boast the earliest surviving habitations, such as at Skara Brae in Orkney. The Antonine Wall, a World Heritage Site, is a landscape-scale reminder of the Roman period, two millennia ago. Early Christian associations are strongest in the south and west, including Iona and Whithorn, while evidence of centuries of skirmishing with England is visible in the fortified Peel towers, such as Hermitage and Smailholm, in the Borders.

Early settlement patterns often reflect physical boundaries and constraints on land use, while development from the industrial age onwards increasingly imposed itself on the landscape. In the 18th and19th centuries many people migrated from rural areas to the rapidly expanding industrial cities and towns connected by canals, rail and shipping links, prompting rapid urban expansion. Glasgow became the 'second city of the Empire', where entrepreneurs imported goods and cultural influences from around the world. Scotland's rich built heritage displays these influences in its ever-changing architectural style. Every part of Scotland has its own vernacular style, which is partly influenced by the availability and nature of the local building materials. All these things create a strong sense of place.

Rural character

Ninety-four percent of Scotland is classified as rural. Between the mid-18th and late 19th centuries, a mosaic of fields was created across the fertile lowlands, interspersed by gardens and designed landscapes laid out as the formal settings for grand country houses. In the uplands a new landscape of sporting estates was created, with its distinctive architecture and extensively managed grouse moors and deer forests. In some parts of the Outer Hebrides and North-West Highlands, wind-blown shell sand has helped to create the unique cultural and agricultural landscape of the machair and its crofting townships.

A common feature of Scotland's rural landscapes is the distinct transitions in character that occur where the hills and mountains meet cultivated lowlands, and where the land meets the sea. A good example of transitional landscapes is the land on either side of the Highland Boundary Fault or along the margins of the Southern Uplands, and around the coast, where the exposed, often treeless, landscapes contain pockets of richer agricultural land.

Cultural and natural associations

There is a strong sense of Scotland's past within its landscape. This is strongest where ancient monuments dominate the landscape, or where castles and great houses with planned grounds form part of a view. However, it is also evident in the traces of cultivation and habitation found high on hillsides, or in now unpopulated glens and coastlines. Many of the extensive industrial landscapes of the lowlands have now been lost, as derelict areas have been regenerated.

Scotland's varied geology provides an abundance of natural features – from individual hills, such as the volcanic features of the Lothians, to mountain ranges, dramatic coastal stacks and arches, and high waterfalls. Natural features are often emphasised by nearby defensive structures or monuments, such as Edinburgh and Stirling castles.

Large areas of semi-natural landscapes in Scotland, particularly in the north and west, show few signs of human influence. These areas include mountains and moorland, stretches of undeveloped coast and large areas of peat bog. A relative wildness map has recently been produced covering the whole of Scotland.

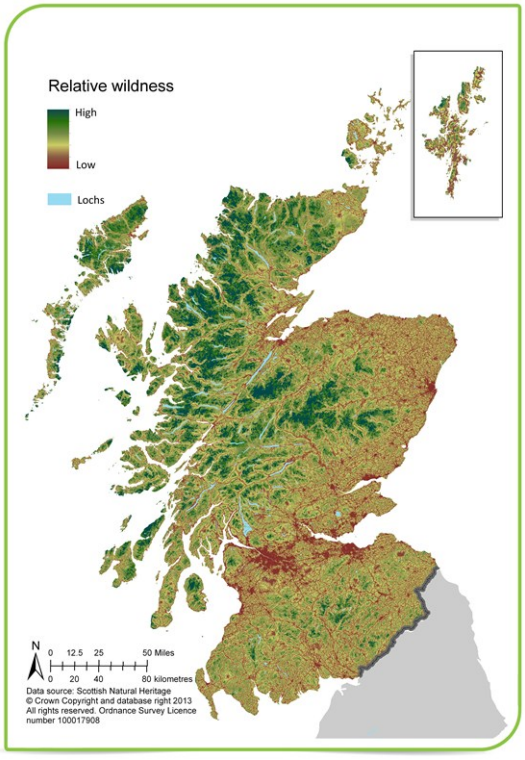


Figure 2: Relative wildness throughout Scotland

Changes in the landscape

Data on landscape change are often poor, incomplete or difficult to interpret. A landscape monitoring framework is currently being established to provide a more thorough and systematic approach to this topic.

A review of the LCA programme suggests that landscape change has not resulted in any types of landscape character being lost or significantly changed. Nevertheless, important changes to some of the physical elements of landscapes are resulting in the following trends:

1. Regional and local landscapes are becoming less distinct as a result of more similarity in building form, settlement patterns and agricultural practices;
2. The distinctive landscape settings of many towns and cities is being lost as a result of settlement expansion and associated infrastructure, such as roads and railways;
3. The development of renewable energy technology, in particular wind farms, is affecting the extensive views and strong natural character of many of Scotland's rural landscapes.

At present, the best evidence we have is on the last of these trends. Data indicate that the area of Scotland from which it is possible to see one or more types of built development increased to 70% in 2010, which is an increase of 1% since 2009 (and 5% since 2008). The largest change in visual influence comes from wind farms; with the area of Scotland within which a wind turbine can be seen increasing from 31.6% in 2009 to 35.6% in 2010. All of the other components showed either no change or a change of less than 1%. As more wind farms are built or proposed, public opinion surveys suggest that fewer people in Scotland believe the country's wind farms are well located and designed – 52% in the latest polling, as opposed to 75% five years ago.

Pressures affecting landscape

Scotland's landscapes continue to evolve in response to natural processes and as a result of society's demands.

Natural processes, such as the movement of coastal sand dunes and the erosion of river banks, often happen at such a slow rate that the landscape change only becomes clearly visible over decades. However, these processes can also happen very quickly and change our landscapes dramatically in the space of a few hours; for example, as a result of severe weather.

Climate change

Since the end of the 20th century, the effects of climate change on Scotland's landscape have become noticeable. The policy response to climate change creates additional pressures, particularly in terms of the emphasis on onshore renewables. The national target for increasing forest cover will also have a significant impact on many parts of Scotland.

Recent research has also explored how Scottish landscapes will be affected by the direct impacts of changing temperatures, rainfall, weather events (such as storms and drought) and sea-level change. It is likely that some land will be lost to the sea, that flooding will increase, and that the patterns of natural and semi-natural habitats will change. Higher temperatures may also allow new crops to be grown and extend existing growing seasons. More subtle changes in our climate might also result in landscape change. For example, the spread of destructive pests or pathogens could lead to the loss of plant species from the landscape.The research concluded that the combined effects of these changes are likely to be most noticeable in lowland and coastal areas. These tend to be the more populated parts of Scotland, so the effects of climate change on the landscape are likely to have a disproportionate impact on people. In the uplands, apart from developments such as wind farms, landscape change may be less sudden or obvious.

Development and land use

Two main direct pressures caused by humans will continue to influence the character of the landscape. These are as follows:

1. land use, and intensification of land use and management;

For example, in agriculture there has been a focus on maximising yields and producing food more cheaply. This has prompted a move towards **monoculture,** where only the most profitable and productive crops are grown, at the expense of a more diverse landscape of field types and hedgerows;

Commercial forestry expanded rapidly in post-war Scotland, focused mainly in economically marginal upland areas. Since the 1980s, a more diverse range of native woodland and forestry has been planted;

2. incremental and ongoing development.

The main employment opportunities in Scotland have shifted from manufacturing and heavy industry to new service-based providers, many of which are located in retail and business parks around the fringes of settlements. In rural areas, upgrading roads and developing hydro schemes has altered the landscape, and alterations have also resulted from builders using more similar housing styles across the countryside, and the development of the fish-farming industry. Other development includes:

- infrastructure projects;
- housing;
- expansion of towns and villages;
- quarrying;
- upgrading roads;
- wind farms;
- hydro schemes;
- telecommunications masts.

The changes to landscape that these pressures cause are perceived by different people in different ways. For many, it can result in the damage to, or loss of, valued qualities. However, others may view changes more positively and place value on the new elements of the landscape. The range of factors influencing this response are complex. Despite the opportunities for community involvement in influencing development, public opinion polling suggests that at present only a third of the Scottish population view changes to their local landscape positively.

What is being done

National and local policies and plans highlight the importance of Scotland's landscape and the need to consider it when making decisions about development management and land use. Positive management strategies and projects have been developed to set objectives for landscape and guide investment in its management.

Policies and legislation

The Scottish Government is encouraging more sustainable and better care of Scotland's landscape. Recent policy statements on planning, architecture and place confirm the important role of the landscape in green infrastructure (the network of green spaces), place-making (how buildings and places are made, the quality of their design and of the built environments they help to shape) and biodiversity conservation. The Land Use Strategy and new marine-planning laws give importance to managing landscape change in a positive and sympathetic way. Legislation for national parks and National Scenic Areas was passed by the Scottish Parliament in 2000 and 2006 respectively to strengthen the protection and management of these special areas. The European Landscape Convention, published in 2006, provides a framework for managing change in Scotland's landscapes in a planned way that protects the landscape and involves people and communities.

The Town and Countryside Planning Act was put in place soon after the Second World War and has been frequently amended since, always with landscape as one of the most important environmental considerations within the planning system in Scotland.

Strategic Environmental Assessment and Environmental Impact Assessment now ensure landscape is considered when relevant policies, plans, strategies and projects are developed and approved.

Influencing development and land-use change

Town and country planning

The planning system directs development and influences the design of buildings in rural and urban areas. As a result, most development is regulated by local development-management decisions, although agriculture and forestry operations are regulated in other ways (see below). Some forms of development that are closely associated with agriculture and forestry, such as hill tracks, are also considered as "permitted development", which does not need formal planning permission.

Local authorities are responsible for managing development, and are guided by national advice set out in the National Planning Framework, Scottish Planning Policy and Planning Advice Notes (PANs). Planning policy recognises that it is important to consider the character of the landscape when looking at the effect a proposal would have. Landscapes with special qualities, such as designated scenic or recreational areas or areas of wild land, must also be considered.

Agriculture and forestry

Over the last 40 years agricultural activity has been strongly influenced by the European Common Agricultural Policy and its various financial support mechanisms. Since 2000 support has shifted away from production towards environmental protection and enhancement. More recently, the character of the landscape and protected landscapes have been considerations in how funding is prioritised under the Scottish Rural Development Programme.

Since the 1980s the visual quality of landscape has been an important consideration when assessing the environmental effects of proposals for planting new woodlands and restructuring existing forests by felling and replanting. All forestry activities in Scotland must meet the UK Forestry Standard and follow the Forests and Landscape guidelines when applying for project approval and support payments from the Scottish Rural Development Programme.

Where new woodlands and forests are planted is informed by the forestry and woodland strategies drawn up by local authorities in partnership with key stakeholders. These strategies supplement development plans and consider the effects of woodland expansion on the character of the local landscape.

Area-based approaches

Protected areas

Scotland has two main types of areas that are protected because of their landscapes – National Scenic Areas and national parks. These cover almost 20% of Scotland's land area and have special protection in planning policy. National park authorities have to prepare plans that include objectives for how they will positively manage the landscapes, and a similar approach is being taken in the National Scenic Areas in Dumfries and Galloway. The following map shows the locations of the National Scenic Areas in Scotland.

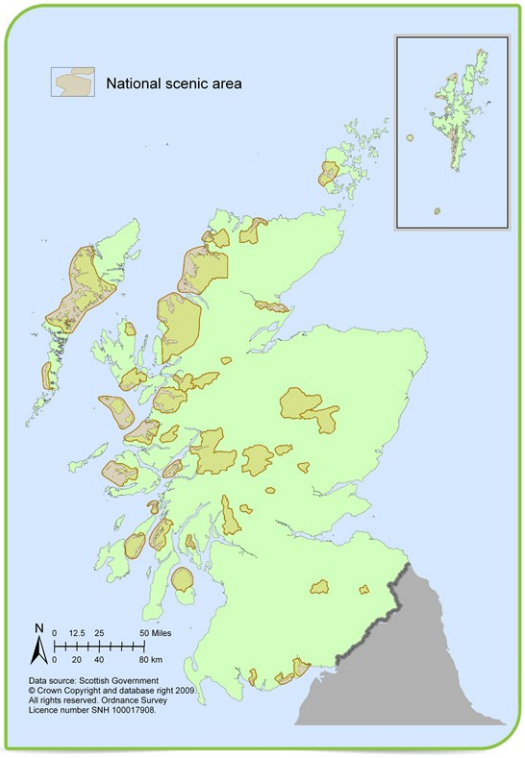


Figure 3: National Scenic Areas in Scotland

Other protected areas, such as regional parks, National Nature Reserves, Conservation Areas and World Heritage Sites, also contribute to landscape protection and management, even though their main focus is on other aspects of natural or cultural heritage. Local authorities can also designate special landscape areas within their development plans, and these help guide where new development is constructed and how it is designed.

Landscape projects and initiatives

Scotland's Landscape Charter helps ensure Scotland's landscapes are passed on to future generations in the best possible condition. The charter aims to increase awareness of the benefits that landscape can provide. It also sets out actions for communities, developers, land managers and the public sector to look after our landscape

Over 10 landscape partnerships funded by the Heritage Lottery have been established in Scotland in recent years, and there are other initiatives, such as the Galloway and Ayrshire Biosphere Reserve and the Central Scotland Green Network. These projects all take action to enhance landscapes and the benefits they provide for people and nature.

Involving people in considering landscape change

A critical factor in planning and managing Scotland’s landscapes is the awareness and involvement of land managers, developers, local authorities, public agencies, and government departments. Individuals, communities and non-governmental organisations are also very important. Landscape strategies for specific areas are one way of achieving this, although these are largely restricted to the national parks and the three National Scenic Areas in Dumfries and Galloway.

The regional land-use pilots in Aberdeenshire and the Borders also provide opportunities to develop objectives that protect landscapes.

More emphasis is being put on place-making techniques that focus on people’s needs and the way the components of a place (such as buildings, transport infrastructure or greenspace) come together to meet

them. The Talking about Our Place toolkit has been developed to help local communities think about issues specific to their local landscapes and get involved in decision-making that affects them.

5.2 Rocks and Landforms


©Laurie Campbell/SNH

Scotland's rocks and landforms provide a range of benefits and help us to understand how the Earth has evolved. Our protected Earth science features are almost all in good condition, but we know little about the state of rocks and landforms outside protected sites.

Summary

Key Messages

- Scotland's rocks and landforms are of national and international importance for demonstrating key geological processes and events in the Earth's history.
- Understanding how rocks and landforms change over time will help us understand and adapt to current issues, such as climate change and rising sea levels.
- Our geodiversity is the foundation of our biodiversity, scenery, and cultural heritage. It provides economic resources and naturally regulates hazards such as flooding.
- Mismanagement of our rocks and landforms could reduce our ability to adapt to the impacts of climate change.
- Some of our rocks and landforms are protected by legislation, and most of these are in favourable condition; however, this is only a fraction of the wider resource.

State and trend

State: Good - high agreement, low evidence

Trend: Stable/declining - high agreement, low evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- Assessments are of the current "average condition"; some rocks and landforms are in a good condition whereas others are in a poor condition. Equally, the condition of some rocks and landform features is improving, while others are declining or stable.
- Making any overall assessment is necessarily a simplification.
- We have taken account of the scale of any damage to rocks and landforms in these assessments; impacts can be locally damaging, but may have little effect on a national scale.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

Scotland has a remarkable diversity of rocks and landforms (geology and geomorphology), created by natural processes over the last 3 billion years.

Rocks and landforms are part of Scotland's rich geodiversity – the variety of rocks, minerals, fossils, landforms, sediments and soils, and the natural processes that form and alter them (known as geomorphological processes).

The geodiversity found across Scotland, including its sea bed, has led to many globally significant discoveries about how the Earth, and life on it, has evolved. Geodiversity also supports biodiversity, providing the foundation on which plants, animals and humans live.

The distribution of rocks and landforms has shaped human activity in Scotland, influencing land use, settlement sites, water sources and architectural style. Scotland's geodiversity is also the foundation of our varied landscapes and spectacular scenery that today attracts visitors from home and abroad, and provides the background for many recreational pursuits. Additionally, geology provides valuable resources, such as coal, oil and metal ores, which continue to be important to Scotland's economy.

Rocks and landforms, therefore, contribute a wide range of ecosystem services, providing important economic, social and environmental benefits.

Many rocks and landforms are unique and, having formed over very long periods, are effectively irreplaceable. Therefore, appropriate protection and conservation measures must be put in place so that they continue to provide benefits in future.

The geological record

Scotland is made up of a wide variety of rocks and sediments of different ages including:

- rocks formed from sediments (such as sand and mud) and by volcanic activity throughout geological time;
- some of the oldest rocks in the world (hard rocks deformed by heat and pressure deep inside the Earth over 3 billion years ago);
- deposits left by glaciers a few thousand years ago;
- river, lake and coastal sediments, some still accumulating today;
- fossils, some of which are internationally important;
- economic resources, such as coal and oil, and rare and precious minerals.

Scotland's landforms have been shaped over time by water, wind, waves, ice and landslides.

- The advance and retreat of glaciers have created many of the landforms we see today, such as mountain corries, deep lochs and the crag-and-tail hills on which Edinburgh and Stirling Castles sit.
- Our varied coastline was formed by many processes, including sea-level changes caused by the last ice age. Today, we have the highest cliffs and some of the largest sand dunes in the UK, as well as important mudflats and salt marshes.
- There are many different river features formed by a range of river types, from steep mountain torrents to meandering channels in the lowlands.

Current processes

Our landforms are still evolving. Water, wind, waves, and freeze-thaw weathering, continually shape the land and coast. Minor earthquakes occasionally shake the ground, and landslides and flooding rivers periodically alter the landscape.

Flooding and changes in the course of river channels are most characteristic of Highland rivers. Lowland rivers also flood, but their channels are generally more stable. The River Tay discharges the largest volume of water of any British river and, along with other large rivers, carries significant amounts of sediment out to the coast.

Scotland's coasts are made up of 70% rocks and cliffs (hard coasts); 29% gravels, sand and silts (soft coasts); and less than 1% harbours and sea walls. Our coasts are affected by a range of natural processes such as sea level rise and the natural addition or removal of sediment. There is evidence that these key coastal processes are changing more rapidly than they did in the last century. For example, Scotland is experiencing sea-level rise, which is already increasing the frequency of coastal flooding, and projections suggest that this will continue at an increased rate over the next few decades. Coastal sediment supply is at an all-time low, partly due to hard riverbank and coastal defences that prevent the erosion of fresh sand and gravel. This affects the stability of soft coasts.

Scotland has a long history of minor earthquakes. The earliest recorded occurred in the 13th century, and the largest, measuring 5.2 on the Richter local magnitude scale, was on 28 November 1880 in Argyll. In 2013, 46

earthquakes, with magnitudes between 0.4 and 2.9 on the Richter local magnitude scale, were detected in Scotland and surrounding waters.

Many recent landslides on steep slopes have been initiated during prolonged or extreme rainfall. Old landslides can also be reactivated during extreme rainfall, sometimes because the slope has been made unstable due to undercutting by rivers, coastal erosion or even human excavation of the slope. Recent landslides reported in the news include those affecting the A83 at the Rest and Be Thankful in Argyll.

State

Scotland's protected Earth science features are mostly in good condition or being managed to return them to good condition. There are no data available on the state of rocks and landforms outside protected sites.

The principal method of protecting a geological feature or landform of national or international importance is through notification within a Site of Special Scientific Interest (SSSI).

There are around 895 important rock and landform sites in Scotland (identified by the Geological Conservation Review, GCR). Around 75% of these are protected as notified Earth science features in SSSIs, and their condition is monitored under Scottish Natural Heritage's (SNH's) Site Condition Monitoring (SCM) programme, which was initiated in 1998. For SCM assessment, the following are considered damaging to Earth science features.

- Physically altering, moving or removing all or part of an Earth science feature (including chemical contamination of the feature).
- Obscuring Earth science features so they cannot be studied, as much of our geodiversity's value lies in what we can learn from studying it.
- Constraining or modifying landform Earth science features that are actively forming, such as rivers and coastal systems.

The SCM programme shows that by February 2014:

- 645 (out of 651) features had been assessed, many more than once, and 93% were in favourable condition, with a further 3% being managed to return them to a favourable condition;
- nine of the current 651 features had suffered some form of irreversible damage, and two formerly notified features had been entirely destroyed.

The condition of Scotland's geodiversity not protected in SSSIs is not routinely monitored. Therefore, there is not enough information to make an accurate assessment of its overall state. However, expert opinion and anecdotal evidence indicates that some aspects of our geodiversity are improving while others are declining, and suggests an overall state of good with an overall trend of 'stable or declining'.

There is no monitoring of the many benefits that rocks and landforms provide, nor of how these benefits may be affected by the many pressures on them. While locally there have been devastating impacts on geodiversity, these are not thought to be sufficiently widespread at present to influence the overall benefit that Scotland's rocks and landforms provide.

Pressures affecting rocks and landforms

Loss and damage to rocks and landforms leads to the loss or reduction of the benefits they provide. This can include:

- loss of evidence of past processes, which reduces our ability to understand the impacts of processes happening today (e.g. climate change, sea-level rise, and flooding);
- loss of educational sites and opportunities for outdoor education;
- less tourism and fewer recreation-based activities, which may affect economic development and people's well-being;
- loss of aesthetic value and our sense of place;
- damage to or loss of plants and wildlife that depend on them;
- reduced ability to regulate natural hazards, such as flooding, and adapt to the impacts of climate change.

Development

Urban and rural development, changes in land use and demand for resources can all put pressure on our rocks and landforms. Some activities that put pressure on our geodiversity may also be beneficial. For example, road cuttings can damage rock outcrops and sediments, but may also provide new evidence of how the area evolved by exposing new rock or sediment sections. In contrast, some activities that are generally considered good for the environment, such as river restoration schemes, may damage our geodiversity if they are not appropriately planned.

Global processes

Global processes, such as climate change and rising sea levels, can also damage rocks and landforms (e.g. through accelerated coastal or river erosion, more frequent landslides and flooding), as can measures put in place to prevent such direct impacts (e.g. flood-prevention schemes). These changes may also have economic and social consequences. For example:

- more frequent landslides may increasingly disrupt transport routes or damage property;
- more frequent river and coastal flooding may mean that development in flood plains and coastal margins becomes less viable;
- the cost of maintaining flood and erosion defences will increase.

The severity of these consequences can be reduced if they are taken into account during the planning process.

Specific pressures recorded on Earth science features

The main pressures on notified Earth science features as recorded by SNH's SCM programme are:

- vegetation growth (through neglect or planting);
- dumping of waste material;
- quarrying, mining and gravel extraction;
- coastal protection and river engineering;
- specimen collection (minerals more so than fossils).

Other recorded pressures include the impacts of climate change (e.g. warmer winters affecting the formation of freeze-thaw features) and damaging activities permitted for overriding reasons such as public safety (e.g. safety netting permanently obscuring important rock features but necessary to avoid rock-fall). In these latter cases, damage to rocks and landforms can often be minimised with careful planning.

Pressures on rocks and landforms outside of SSSIs

It is likely that similar pressures apply to rocks and landforms outside SSSIs as those in SSSIs. However, legislation only provides limited protection to geodiversity outside SSSIs for the following activities:

- housing, commercial and industrial development;
- mineral extraction, landfill and quarry restoration;
- renewable energy developments;
- flood-prevention schemes, riverbank protection and coastal defences.

Therefore, our geodiversity resource outside SSSIs will experience pressure from these activities.

What is being done

Most of our documented nationally and internationally important geodiversity is protected through 'protected sites' legislation. Geodiversity conservation is also promoted through Scotland's Geodiversity Charter, codes of good practice, and action plans that encourage good management of Scotland's rocks and landforms, now and in the future.

Despite its importance, geodiversity does not have as high a profile as biodiversity. No international legislation covers geodiversity.

Scotland's Geodiversity Charter

Published by the Scottish Government in June 2012, Scotland's Geodiversity Charter encourages everyone to work together to raise awareness of, and manage, Scotland's geodiversity; and to ensure its better integration into policy and guidance to meet Scotland's economic, social, cultural and environmental needs.

Site protection

SSSIs are the main statutory mechanism for protecting rocks and landforms in Scotland. The total number of Earth science features in SSSIs changes over time; features are added or removed for reasons such as scientific review, update of SSSI citations, and the total destruction of features. In February 2014 there were 651 notified Earth science features in Scottish SSSIs. This represents only a small fraction of the national resource, however, and there is currently no programme to incorporate the remaining 200 or so nationally and internationally important Earth science sites into the SSSI network.

Geoparks, national parks, National Nature Reserves and local nature conservation sites also help protect rocks and landforms and, in future, marine protected areas (MPAs) will help protect important sea-bed features.

Codes of good practice

The Scottish Fossil Code, published in 2008, aims to help protect Scotland's fossils while encouraging public interest and responsible use. Early indications are that most people follow the code when at a fossil site. However, few people ask permission to visit sites or collect fossils, and three incidences of reckless damage have been recorded since the code was published.

The Scottish Core Code, published in 2011 to combat the growing problem of core holes defacing rock outcrops, provides guidance on responsible and environmentally-acceptable rock coring.

Action plans

At a UK level, the UK Geodiversity Action Plan (UKGAP) provides a broad framework for geological conservation and related activities.

In Scotland, the following areas have completed geodiversity audits:

- Edinburgh;
- West Lothian;
- East Dunbartonshire;
- Glasgow.

An audit of Dumfries and Galloway is ongoing.

As yet there are very few local geodiversity action plans (LGAPs) in Scotland. The City of Edinburgh Council has an LGAP within its local biodiversity action plan; West Lothian has a draft LGAP; and both our national parks have committed, in their current park plans, to produce an LGAP.

Sustainable management

In cases where rock and landform features may be affected by development, extraction, landfill, landscape restoration or other activities, early communication between all interested parties can help ensure that rocks and landforms are recognised and appropriately incorporated.

Managing active landforms, such as rivers and coasts, appropriately is likely to become increasingly challenging with the prospect of more frequent flooding and rising sea levels (see the National Flood Risk Assessment and draft National Marine Plan for Scotland). Building on flood plains is likely to become less viable as the cost of protecting such developments increases. Demand is also increasing for adaptive management to reduce the cost of protecting developments vulnerable to flooding.

5.3 Soils

Scotland's soils are diverse and rich in carbon; they are a vital natural resource providing a range of essential benefits and need to be protected. We have good information about some soil properties in some parts of the country. However, there is a lack of trend data.

Summary

Key Messages

- Scotland has a diverse range of soils, formed from a number of different rock types under a variety of environmental conditions.
- Soils are a vital natural resource. They provide a range of benefits, which include growing food and trees, filtering impurities from water and storing carbon.
- It is difficult to assess if, and how, soil is changing because of a lack of comparable data, especially trend data, from which evidence of change can be found.
- The main pressures on soils are the impacts of climate change and changes in land use and land management; these can damage soil, which can lead to wider environmental and socio-economic harm.

State and trend

State: Good - medium agreement, low evidence

Trend: Insufficient data to determine trend

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- The wide diversity of soil types and their broad range of properties mean that soils can provide a number of different benefits. Some soils can provide a variety of benefits while others may only be able to provide one or two. Therefore it can be difficult to make an overall assessment of the state of soil.
- Soil can be in a whole range of conditions, from excellent to very poor, depending on what benefit we expect it to provide. For example a soil that is accumulating peat and in a good state for storing carbon is unlikely to be in a good state for growing crops. Here we make an assessment of the "average" condition.
- We have several sets of soil data in Scotland which can give us some information on some aspects of the state of soil, however these datasets are not always comparable.
- It is difficult to assess whether, and if so, how, Scotland's soils are changing, because there is hardly any trend data.

Overview

Soil develops on the earth's surface as the climate (temperature and moisture), plants, and animals (from tiny bacteria to people) break down the underlying rocks over time. The way soil develops is also influenced by topography – the slope of the land, which direction the land faces and how high it is. The rocks from which soils form are known as the 'parent materials'.

Scotland has a complex geology (rocks and landforms), so it has a wide range of parent materials and soils. In fact, for a country of its size, Scotland's soils are amongst the most varied in Europe.

Soil is made up of mineral and rock fragments, water, gases and living and dead organic material from plants and animals. The relative amounts of these materials in soil and what they are made of determines the

properties of the soil. Soil changes slowly all the time as materials are added and removed. Figure 1 shows the main factors that shape soil properties.

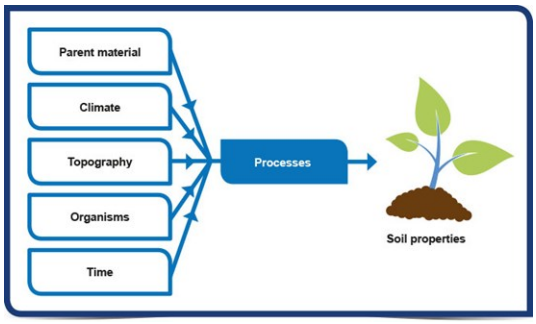


Figure 1: Factors influencing soil formation.

It takes hundreds of years to create a few centimetres of soil. Most of Scotland's soils have formed since the end of the last ice age, so they are relatively young compared with soils in other parts of the world.

The combination of geology and climate means that Scotland's soils tend to be acidic, carbon rich and nutrient poor. For example, Scotland has large amounts of peat soil, which is formed by plant material decomposing in cold, wet conditions.

People have greatly influenced soils by the range of land use and management practices carried out over time; for example, by creating artificially thickened (plaggen) soils. People have also damaged some soils by continuously cultivating them, depleting them of organic matter.

Figure 2 shows the distribution of the main soil types in Scotland.

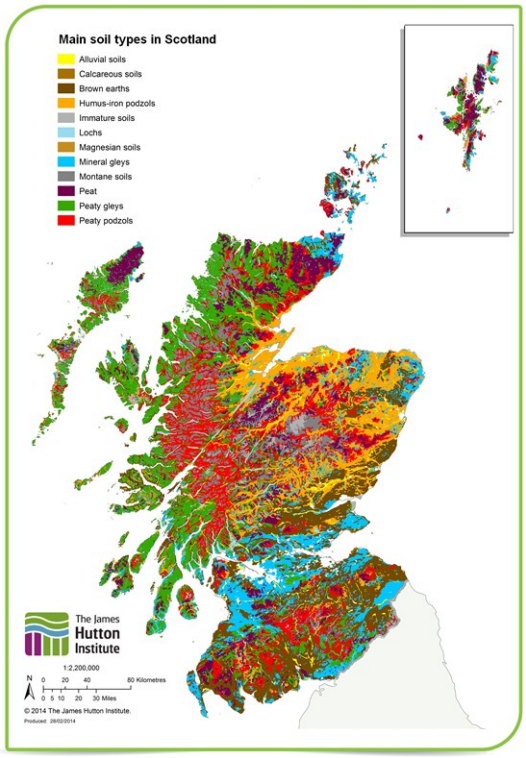


Figure 2: Main soil types in Scotland.

The key characteristics and functions of the main soil types found in Scotland are presented in Table 1. More detailed information about Scotland's soil types can be found on the Scotland's soils website.

Table 1: Key characteristics and principal benefits of the main soil types found in Scotland.

Soil type	Main characteristics	Principal benefits
Brown earth	Brown in colour. Well or reasonably well drained.	Provides good-quality agricultural land, used for growing crops in the east and for grazing and forestry in the hills and uplands.
Humus-iron podzol	A thin, dark organic surface layer, overlying a grey layer, overlying a brown subsoil. Sharp boundaries between layers. Well or reasonably well drained.	Used for mixed agriculture or supporting semi-natural habitats and species, such as pinewoods and heather.
Peaty podzol	Dark, organic surface layer, up to 50cm thick, overlying a grey layer, overlying a brown subsoil. Sharp boundaries between layers. Well or reasonably well drained.	An important carbon store. Supports heather and much of the grouse population.
Surface-water gley	Drab, greyish colour Poorly drained.	Supports improved grassland managed for livestock grazing (meat and milk production). Also supports wetland habitat and species.
Peaty gley	Drab, greyish colour with a dark, organic surface layer up to 50cm thick. Poorly drained.	Supports large areas of coniferous woodland and wet heath habitat. Extensively used for deer management. Important carbon store.
Montane soil	Similar to podzols, but is very loose because of intermittent freezing and thawing.	Supports rare mountain habitat and species.
Regosols	Sandy soils with only weak (if any) layering.	Supports sand-dune habitat and species, including machair.
Alluvial soils	Found along rivers. Weak (if any) layer structure.	Some are very productive, others support our valuable wetland habitats.
Peat	An organic soil with an organic surface layer more than 50cm deep. Can often be much deeper.	Valuable carbon store. Supports internationally important blanket bog habitat and rare bird species, such as hen harriers, merlins and golden plovers.

Importance of soil

The main benefits that soils provide include:

- growing food and trees;
- controlling water flow and quality;
- storing carbon and maintaining the balance of gases in the air;
- supporting valuable habitats, plants and animals;
- preserving cultural and archaeological heritage;
- providing raw materials;
- providing a platform for building on.

Soils can carry out more than one function at a time, providing a range of benefits in the same place. Soil quality is defined in terms of its ability to provide these benefits.

Soil degradation

Soil quality can be improved or damaged by a range of natural and human processes. The main degradation processes that damage soils are:

- loss of soil organic matter;
- covering soil with an impermeable material, e.g. tarmac (soil sealing);
- the addition of contaminants or loss of essential nutrients;
- erosion;
- compaction;
- a change in soil biodiversity.

These degradation processes are caused by a range of pressures.

Soil degradation can affect the wider environment. For example, the loss of organic matter in soils can increase the amount of greenhouse gases (GHGs) in the atmosphere, contributing to climate change. We have so much carbon in our soils that the loss of just 0.5% of our soil carbon in one year could double Scotland's annual GHG emissions.

The relative impacts of soil-degradation processes

The State of Scotland's Soil report developed methods to compare the environmental and socio-economic impacts of soil-degradation processes. The report combined these and concluded that the degradation processes with the greatest potential impact are:

- loss of soil organic matter;
- changes in soil biodiversity;
- soil erosion and landslides;
- soil sealing.

Figure 3 shows the main human activities that damage soil quality.

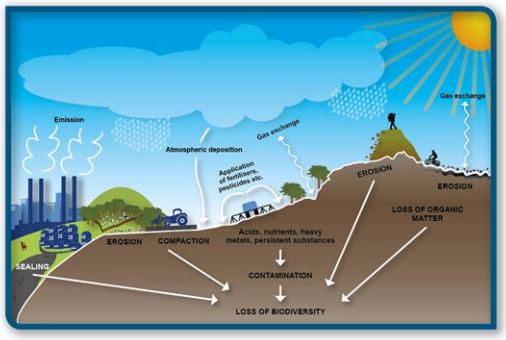


Figure 3: Human activities causing soil degradation.

State

The state of soil – that is, soil quality – is measured by the soil's ability to provide a range of benefits. Here we discuss the main soil properties that affect the state of soil.

We have several sets of soil data in Scotland. These can give us some information about the state of the soil, but it is not always possible to compare the data because they have been collected in different ways for different reasons. It is also difficult to assess whether, and if so, how, Scotland's soils are changing, because there is hardly any trend data available.

You can find more details on the range of soil data and information available in the State of Scotland's Soil Report and on the Scotland's soils website.

The main pressures on soil are caused by the impacts of climate change and changes in land use and land use management.

Soil organic matter

Soil organic matter is found in nearly all soils. It is formed from broken down plant and animal matter that is incorporated into the soil. Organic carbon is the largest component of soil organic matter (around 50%). This is the material that gives soils their dark colour.

Scotland's soils contain approximately 3200 million tonnes of carbon. The location of soils rich in organic matter is shown in Figure 4. You can find more information on the carbon richness of soils in Scottish Natural Heritage's Identification of carbon-rich soil mapping units and on the Scotland's soils website.

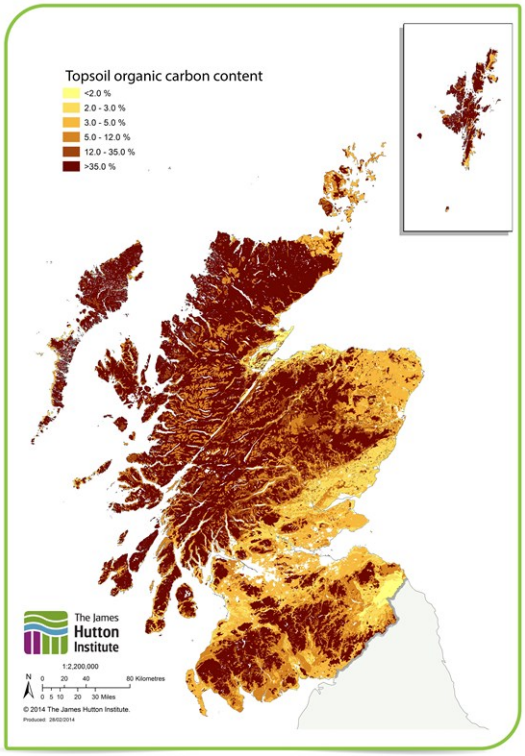


Figure 4: Soil organic carbon concentration in the surface layer of soil.

A partial resurvey of the National Soils Inventory of Scotland (NSIS) has shown that the amount of carbon stored in the top metre of soil within different habitats in Scotland has not changed significantly in the last 25 years, except for in woodland soils. However, this does not tell us anything about the effects of changes in land use on overall losses (or gains) of soil carbon.

This is consistent with Countryside Survey data for Scotland, which shows no overall change in carbon concentration in the top 15 cm of soil between 1978 and 2007.

Soil chemistry

The chemical make-up of the soil affects a range of properties and processes. The pH value (a measure of acidity) and concentrations of nutrients and trace elements (e.g. metals) in a particular soil partly determine what functions that soil is most suited to. For example, whether it is most suited to growing crops, supporting rare habitats or preventing water pollution. Adding, or removing, elements outwith the optimum range can result in losing some or all of the soil function.

Soil acidity and nutrients

In large areas of Scotland, there is so much acidity and nitrogen already in the soil that it is unable to absorb any more. Soils in these areas may not be able to provide certain benefits, potentially resulting in poorer water quality or damage to habitats, for example.

International agreements to reduce industrial emissions has led to a reduction in acid deposited from the atmosphere onto land over the last 30 years, which is reflected in a decline in the extent of habitats affected by acidification. In contrast, nitrogen deposition has not declined to the same extent, resulting in continuing damage to vulnerable habitats.

Results from the Countryside Survey show that the top 15 cm of soils in Scotland across all habitats became less acidic between 1998 and 2007, continuing a trend observed between 1978 and 1998.

Countryside Survey data also show that while in some habitats there were no significant changes in soil nitrogen concentration in the top 15 cm, in others significant decreases were found.

However, the resampling of the National Soils Inventory of Scotland has shown no overall change in the last 25 years or so in the pH or nutrient nitrogen levels of soil across the country as a whole.

The differences in results between the National Soils Inventory of Scotland and the Countryside Survey show that it is difficult to compare data for soils sampled for different reasons and sampled, analysed and reported in different ways: while the results averaged across the country (in the National Soils Inventory of Scotland) show no significant change, results within specific habitats (in the Countryside Survey) do show change. This illustrates that the variability between different types of soil can be greater, and thus mask, any change within specific soils or habitats.

The amount of phosphorus in agricultural soils available for plant growth has remained relatively stable in the last 10 years, and is generally satisfactory. In some fields, however, very low, or excessively high, levels are found. If there is more phosphorus available than plants require, it can find its way into watercourses and lead to environmental harm.

Metal concentrations in soils

A wide range of metal concentrations are found in soils, reflecting the diversity of rock types and materials from which soils have been formed. While some metals in soils are beneficial in trace amounts, if there is too much then they can become toxic to plants, soil organisms and, ultimately, to humans via the food chain.

Metal concentrations in Scottish soils are generally low. However, in some areas, naturally high concentrations exist and can damage crops. For example, high nickel concentrations can be found in soils formed from volcanic rocks (Figure 5).

In contrast, metal deficiency (e.g. copper) can also be a problem in some soils, leading to health problems for plants and animals (Figure 6).

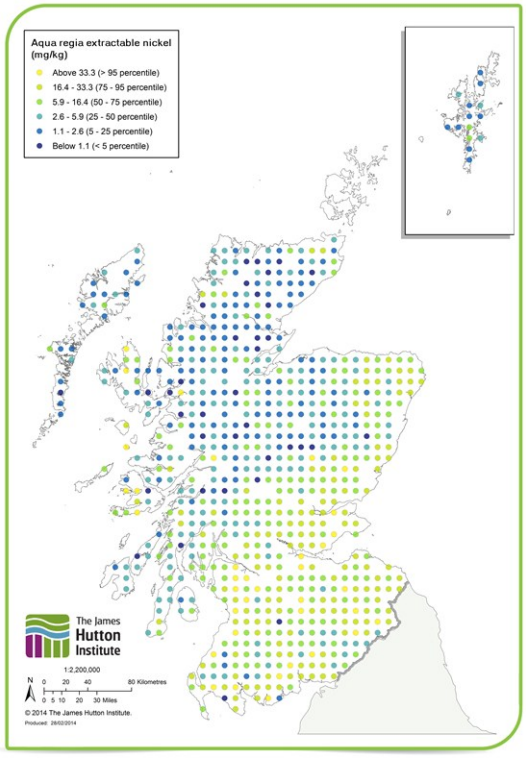


Figure 5: Nickel concentrations in soils across Scotland, as determined from the James Hutton Institute (JHI) National Soil Inventory of Scotland dataset (NSIS_1). Maps supplied by JHI.

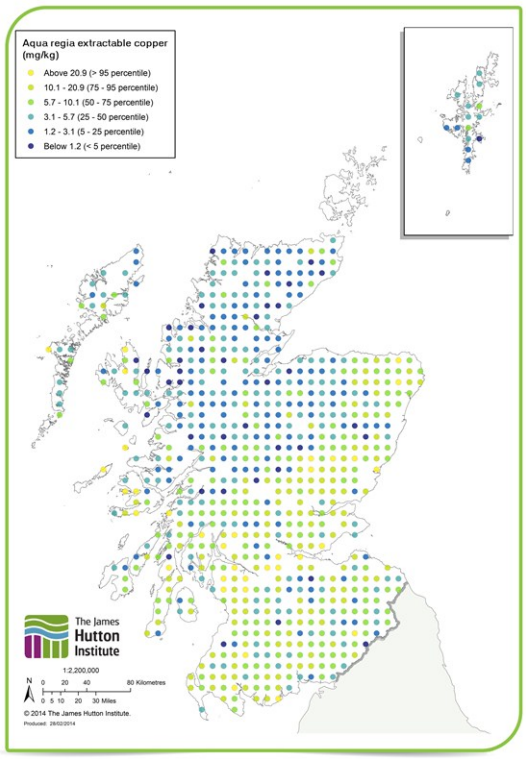


Figure 6: Copper concentrations in soils across Scotland, as determined from the James Hutton Institute (JHI) National Soil Inventory of Scotland dataset (NSIS_1). Maps supplied by JHI.

Increasingly applying organic materials (e.g. sewage sludge, animal wastes or compost) to land in order to recycle nutrients may result in gradual increases in soil metal concentrations if these materials contain metals. However, these activities are monitored to protect human health and the environment.

Organic chemicals

A wide range of organic chemicals is found in the environment. However, their concentrations in soils are not routinely measured.

The use of many long-lasting organic chemicals has declined. Results from the UK Soil and Herbage Pollutant Survey show that concentrations of polychlorinated biphenyls (PCB) in soils have declined by 800% in the last 30 years – restrictions on their production were introduced in the mid-1970s. The concentrations of dioxins in soils have also dropped by around 70% in the last 30 years. However, there are many other organic compounds used that are not being measured.

Man-made radioactive substances

Concentrations of man-made radioactive substances in soils across Scotland are generally low and trends are difficult to determine. More information can be found in the Radioactivity in Food and the Environment report.

Contaminated land

Land is defined as 'contaminated' if hazardous substances are present in concentrations that could pose a threat to human health, ecosystems or water bodies. What level is considered acceptable depends on the land use and soil type. More information can be found in the Dealing with land contamination in Scotland report.

Soil biodiversity

Soil biodiversity is the variety of all living organisms found within soil.

Although the amount of data and knowledge on soil biodiversity in Scotland has increased considerably in recent years, it is still not yet possible to assess the current 'state', and it is impossible to comment on historical trends. The resurvey of the National Soils Inventory of Scotland indicates that microbial diversity varies significantly with different soil types and land uses. You can find more information about soil biodiversity in the State of Scotland's Soil report and on Scotland's soils website.

Erosion and landslides

Soil erosion by water or wind is a natural process that can be made worse by poor land management. The consequences of soil erosion, such as the loss of fertile topsoil from fields, can damage a range of soil functions. There is no systematic assessment of soil erosion on a national scale in Scotland, so we do not know how much soil is being lost from our fields or uplands or whether it is a widespread problem or not.

It is estimated that in some arable areas of eastern Scotland, erosion rates caused by water are double natural rates.

Although less frequent and widespread, wind erosion can occasionally have severe consequences; for example, in Moray in spring 2013, when roads became blocked by wind-blown soil and had to be cleared using snowploughs.

In upland areas, it is estimated that around 35% of Scotland's peatlands show signs of erosion. This has important implications for loss of soil carbon, as well as for soil biodiversity.

It is estimated that approximately 3% of Scotland is highly susceptible to debris flows (a type of landslide). However, it is not known how much material is lost in each debris flow. Several roads have been blocked by these events in recent years, causing considerable disruption and expense. The most frequently blocked road has been the A83 at the Rest and Be Thankful – which was closed four times in 2012.

Predictions of more frequent and intense rainfall in the future suggest that we may see higher levels of erosion and more frequent landslides.

Compaction

Soil compaction occurs when soil is squeezed by something heavy (e.g. a tractor or a herd of cows), causing the particles that make up the soil to move closer together. This means that there is less space in the soil for water and air to move through, making it harder for plant roots to grow and find nutrients. Heavier farm machinery is likely to increase soil compaction in Scotland.

A number of small-scale studies elsewhere in the UK have found local increases, but there has been no systematic study of the national extent or severity of soil compaction in Scotland. Therefore, it is not possible to provide figures showing the current state or trend.

Sealed soils

The land surface is said to be sealed when it is covered by an impermeable material, such as tarmac.

There is no systematic collection of data on the extent and quality of land being sealed. A possible indication of sealing is the area covered by 'urban land'. Around 2.5% of Scotland is classified as urban land, but not all 'urban' land is sealed – we still have greenspace, such as gardens and parks, in our urban areas.

Based on best estimates, about 1,200 hectares of land is sealed every year (approximately 0.02% of Scotland).

Pressures affecting soils

Soils are damaged by a variety of processes caused by a range of pressures. These pressures result from a number of global drivers which include:

- more demand for food;
- the need to ensure the availability and supply of food;
- population change;
- climate change.

Pressures on our soils can be grouped into two key areas:

1. those caused by climate change;
2. those caused by changes in land use and land-management practices.

Pressures caused by climate change

Climate change is potentially the greatest pressure on our soils, as the climate is one of the main factors affecting soil formation. The climate also affects a range of processes occurring in soils because it influences how wet the soil is, how warm the soil is and rainfall patterns. Therefore, a significant change in Scotland's climate could have a major effect on the benefits our soils provide.

A change in climate may lead to:

- a gradual or sudden loss of soil organic matter;
- changes in soil biodiversity;
- increased rates of soil erosion and landslides;
- increased soil compaction.

Pressures caused by changes in land use and land-management practices

These pressures include:

- development (e.g. building new houses and roads);
- cultivation of soils for agriculture or forestry;
- application of chemicals in agriculture or forestry (e.g. fertilisers, pesticides);
- expansion of agriculture or forestry;
- changes in grazing (i.e. more animals on farms).

These pressures can directly influence the state of our soil by changing its properties. For example, urban expansion leads to more soil being sealed, meaning rain cannot drain away slowly through the soil and instead may flow over land directly into rivers, potentially leading to more flooding and water pollution.

It is important to remember that because soils can carry out more than one function at a time, some of the pressures, while damaging one soil function, could at the same time improve another soil function. For example, applying fertiliser to soil can increase GHG emissions and pollute watercourses; however, it will almost certainly result in increased plant growth and greater crop yields.

What is being done

There is increasing recognition that soils require protection in the same way that air and water do, and policy developments are beginning to reflect this. There are a number of practical soil-management options that, if implemented, will not only protect our soils but also protect the wider environment.

Policy and legislation

Soil protection

In Scotland and the wider European Union, soil has not been given the same level of protection as the water and air. In 2006, the European Commission published a Thematic Strategy for Soil Protection and proposed a Soil Framework Directive, similar to the Water Framework Directive. However, it has not been possible to reach agreement on this and in April 2014 the Commission decided to withdraw the proposal. The Commission remains committed to protecting soil and will look at the best ways to do this.

Scotland, however, has gone ahead and published two main policies/strategies with soil protection at their core. The first of these is the Scottish Soil Framework, which was published in 2009 to co-ordinate existing policies that relate to soils. A number of actions to help protect soils and encourage sustainable soil management were also agreed. Progress made under the Scottish Soil Framework up to December 2013 has included publication of the State of Scotland's Soil report, the Scotland's soils website and the soil monitoring action plan (Soil MAP). These initiatives provide the best evidence of the state of Scotland's soils, increasing access to the data that this evidence is based on, increasing soil awareness and starting to meet the requirement for new data.

The second main response is the land use strategy, published in 2011 as part of the Climate Change (Scotland) Act 2009. The management and protection of carbon-rich soils to reduce the effects of climate change is a key element of the land use strategy. These are some of the proposals in the strategy that can help protect soils.

- **Identifying which land is best for woodland planting.** Planting trees on peat soil may result in more carbon being lost from the soils than the amount of carbon likely to be stored in the trees and vegetation. Therefore, proposals for new woodland creation are not approved by Forestry Commission Scotland if they include the planting of trees on deep peat (more than 50 cm in depth).
- **Improve understanding of the benefits that may be obtained from peatland restoration.** In October 2012 the Scottish Government launched the Green Stimulus Peatland Restoration Project. This sets out to reduce the amount of carbon released into the atmosphere by helping to restore degraded peatlands. As well as preventing more carbon from being released, and increasing the amount of carbon taken out of the atmosphere by peatland vegetation, restoring peatlands can help to increase biodiversity, improve water quality and reduce the impact of flooding.

There are a number of other policies that relate to soil protection from a range of different sectors – agriculture, waste management and planning, for example. These are listed in full in the Scottish Soil Framework.

Environmental protection

There are a number of practical management options that land managers can adopt to help protect the environment, and indeed they are increasingly obliged to do so. The Farming for a Better Climate initiative provides practical support to farmers and land managers to help reduce GHG emissions and adapt to a changing climate. Most of our nitrous oxide emissions (an important GHG) come from fertilised agricultural soils. The Farming for a Better Climate initiative aims to help farmers reduce GHG emissions by using nitrogen fertiliser more efficiently. As well as reducing GHG emissions, this can help prevent nitrogen pollution of watercourses.

The Farm Soils Plan recognises the role that soils play in day-to-day farm management and the key problems that can damage soils. It provides practical advice about how to repair damaged soil and how to avoid damage in the first place. The PEPFAA (Prevention of Environmental Pollution From Agricultural Activity) Code has a section on soil protection and sustainability, which offers similar advice.

SEPA has produced a number of guidance documents for sustainable soil management; for example, about how to reduce the risk of diffuse pollution. These are often linked directly to specific parts of the legislation, and practical steps are offered to help farmers adhere to them. Scottish Natural Heritage has also produced a range of guidance documents, with an emphasis on upland semi-natural soils. The Forestry Commission has produced guidelines on forests and soil that support the UK Forestry Standard.

5.4 Wetlands

Scotland's wetlands are home to a wide range of plants and animals. They also provide important environmental functions such as storing carbon and sustaining the supply of clean water.

©Scottish Natural Heritage

Summary

Key Messages

- Wetlands are found all over the country - from the coastline to mountain tops.
- Most wetlands within protected sites are in favourable condition, with the exception of lowland raised bogs where 59% of sites are in unfavourable condition.
- We have little information about wetlands outside protected areas.
- Peat is associated with many wetlands, and stores huge quantities of carbon. It is estimated that around 1,600 million tonnes of carbon are stored in peat soils in Scotland.
- Wetlands can help reduce flooding, and provide valuable grazing.
- Areas of damaged wetland are being restored, and new ones are being created.

State and trend

State: Poor - high agreement, medium evidence

Trend: Stable/declining - high agreement, low evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- Although the state is shown as poor, it's on the boundary between moderate and poor.
- Wetlands are very diverse, with a range of habitats and a range of conditions.
- Assessments are of the current "average condition"; some wetlands are in a worse condition, and others are in a better one. Equally, the condition of some wetlands is declining, while others are improving.
- Making any overall assessment is necessarily a simplification.
- We have taken account of the scale of any damage to the environment in these assessments; impacts can be locally damaging, but may have little effect on a national scale.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

Scotland's climate has been cool and wet for much of the last 10,000 years – since the end of the last ice age. Over centuries the wet weather has been ideal for the development of a wide range of wetland types. Today wetlands cover large areas of Scotland where poorly draining soils, high rainfall and low temperatures create permanently or frequently waterlogged areas, which support a wide diversity of species adapted to these conditions. Wetlands range from coastal salt marshes and wet dune slacks, to fens, marshes and wet woodlands in river valleys and loch edges, to the springs and flushes, wet heath and blanket bogs on mountain slopes and plateaux (Figure 1).

Wetland types

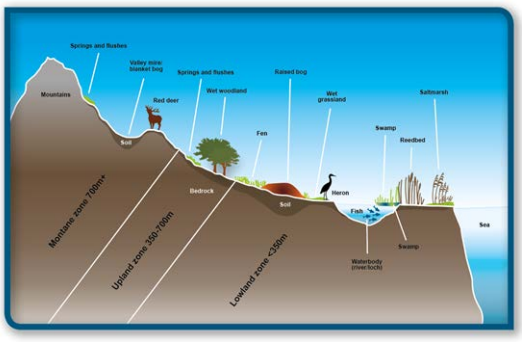


Figure 1: Typical setting of wetlands in the Scottish landscape

Source: A Functional Wetland Typology for Scotland

Peatlands are wetland areas in which peat has accumulated and can support vegetation that is able to form new peat. Bogs (a type of peatland) are one of the most extensive semi-natural habitats in Scotland, covering 23% of our land area (just over 2 million hectares). Although relatively common in Scotland, blanket bog is a globally rare habitat. Scotland has a significant proportion (60%) of the total blanket bog in the UK, and this hold 4% of Europe's peat carbon store.

There are several ways to describe the range of wetland types; to make it easier to identify wetlands, a wetland typology has been developed. Wetlands can be broadly categorised using the Scottish Wetland typology. The variation in vegetation types and the supporting water supply, as well as the chemistry of the water and soil, are all assessed to classify a wetland.

The type of wetland that develops depends on where it sits in the landscape (e.g. at the bottom of a hill or in a steep valley), the underlying geology and the way in which the land is managed. Often, several wetland types can exist in the same location (known as a habitat ‘mosaic’).

Starting at the seashore, salt marshes provide a nursery habitat for fish, food for birds and natural protection from coastal erosion and tidal flooding. Between some sand dunes, 'wet dune slacks' form in the hollows; these are flooded in different seasons and create a unique, rare habitat that supports plants such as sedge, moss, cross-leaved heath and creeping willow.

Further inland, bordering rivers and lochs and across the floodplain, swamps, fens, wet grassland and wet woodland provide feeding and breeding habitats for birds and animals. These wetlands also support a wide range of plants, such as the greater tussock sedge, a variety of mosses and early marsh-orchid. They also provide rich grazing for livestock and can store water during floods.

Blanket bog is found where the climate is cool and wet. It can develop on gentle slopes near the top of hills and across large areas of the far north (such as the Flow Country, Caithness) and the islands (particularly Lewis and Shetland). These extensive areas of rain-fed bog support plants like cotton grass and many species of *Sphagnum* moss and heather. Blanket bogs are often interspersed with groundwater-fed fens and flushes. They store and accumulate large quantities of carbon in peat. Land-management practices in these upland catchments, in particular artificial drainage, can reduce the bogs’ ability to slow down floods and provide clean drinking water.

Wetlands are sensitive habitats, and provide living space for a wide range of animals and plants that are not found elsewhere, such as the highly adapted, carnivorous Sundews. The more remote areas of wetland support rare breeding birds like the common scoter, as well as more common wading bird species such as golden plover and dunlin.

The location of wetlands in Scotland

Although so much of Scotland's land area is covered by wetlands of different types, we are only just beginning to understand the way in which they function and where they lie in our landscape. Wetlands can be mapped on the Scottish Wetland Inventory (Figure 2).

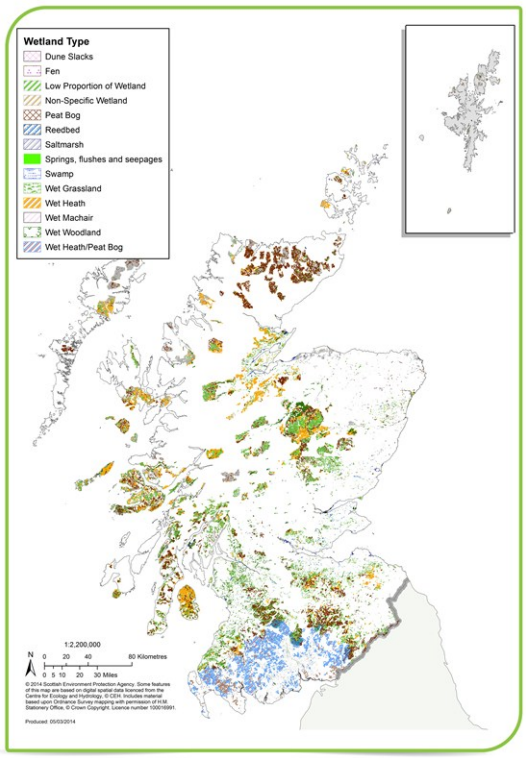


Figure 2: Locations and extent of wetlands (areas not yet surveyed have been left blank; they may contain wetlands).

Please note: the area of Dumfries and Galloway was surveyed using a different methodology to the rest of the country.

Wetland use

In the past, wetlands close to human habitation were used by local people to provide food and refuge for livestock and themselves (e.g. crannogs), for building materials (e.g. reed, rush and turves for roofs) and for food and warmth (peat and firewood). The value humans have attached to wetlands is closely linked to the biological communities that have developed on particular wetlands and people's ability to exploit those communities or replace them with something perceived as having greater value. For example, after World War II technology became widely available that allowed people to drain large areas of blanket bog to cultivate land for agriculture and forestry. These changes in land use were supported by successive governments in an era when producing food and timber was seen as more important than wildlife conservation. However, since the 1980s the biodiversity value of Scotland's wetlands and their ecological function (see Table 1) have been given greater recognition and protection. Current projects to restore the best examples of these wetlands, because of their species diversity and carbon storage, demonstrate the extent to which the value placed on a habitat can change in just a few decades.

Table 1: Functions of wetlands and associated benefits.

Function	Benefit
Carbon storage and accumulation	Wetlands that create peat (such as fen, raised bog, blanket bog and some types of wet woodland) can store large quantities of carbon for thousands of years. Some management practices (e.g. drainage) can trigger the release of carbon (methane, carbon dioxide, particulate and dissolved carbon).
Water purification	Wetlands often form between land and open water, and can prevent pollutants (suspended solids, nitrogen and phosphorus) getting into rivers and lochs. Some artificially created wetlands (e.g. in Sustainable Drainage Systems (SuDS)) are constructed primarily to remove pollutants from run-off in towns and cities and retain flood water.
Flood management	Wetlands slow the flow of rain water into rivers and lochs, which can slow down flooding. This is known as 'attenuation' of floodwaters. Wetlands can store floodwater in the floodplain, reducing the peak of the floodwater that passes through our towns and cities. On the shorelines of lochs and on the coast, wetlands act as a natural defence against coastal erosion.
Water supply / groundwater infiltration	Wetlands collect and store water, which replenishes groundwater and therefore the water supply. Most Scottish drinking water has passed through a wetland before it reaches a reservoir. How these wetlands are managed affects the quality of the drinking water and the costs of purification treatments that may be needed. Artificially created wetlands play an important role in local water management where chemical or mechanical means would otherwise be needed to treat the water; for example, in sewage management.

Wetlands provide a range of important functions.

For example, fens:

- provide rich grazing land;
- store floodwater by slowing down and filtering water moving through the fen;
- store carbon by forming peat soils.

Coastal salt marsh habitats provide:

- a nursery habitat for fish and shellfish;
- flood protection, through the absorption of wave energy which could otherwise damage sea defences;
- wild foods, such as sea samphire.

State

Scottish wetlands have developed since the end of the last ice age and have continued to change as a result of natural processes and human activity. Sea-level changes since the end of the last ice age have resulted in a complex pattern of overlying marine and peat deposits, such as those found in the Carse of Stirling (e.g. at Barnyards). Future changes in weather patterns, especially severe storms, may alter the location and extent of other wetland types like bogs, and rising temperatures are predicted to slow down the rate of peat accumulation and carbon storage. Historic changes are also, in part, the result of human pressures. For

example, felling trees from the hills changed the vegetation structure of the blanket bog, grazing on common land has influenced the fens around villages, and peat-fuel extraction has changed some raised bogs into fens.

Protected sites and species

From an environmental perspective, data are available for the state of wetlands that are protected for nature conservation or are a UK Biodiversity Priority Habitat or contain a protected species. Table 2 gives an overview of the state of wetlands protected for nature conservation (as determined by Scottish Natural Heritage's Site Condition Monitoring programme). Changes in the status and condition of a wetland's features allow us to assess what may be having a negative effect on the quality of the wetland and what may be leading to improvements.

Table 2: Current state of wetlands protected for nature conservation (as determined by Scottish Natural Heritage's Site Condition Monitoring programme).

Designated habitat type	Number of designated features assessed (March 2010)	Number of designated features in favourable condition (and percentage of total wetland features) (March 2010)
Lowland fen marsh and swamp	224	155 (69%)
Lowland raised bogs	111	64 (58%)
Upland bogs	188	117 (62%)
Upland fen marsh and swamp	67	40 (60%)

Pressures affecting wetlands

Pressures upon a habitat can be direct, indirect or sometimes both. An activity in one land area may negatively affect wetlands in other areas. The main pressures on wetlands include:

- land-use change and land-management practices;
- development;
- long-term changes in weather patterns;
- pollution;
- water management.

Many of the changes to wetlands are due to historic activities or land management priorities, for example, widespread draining of wetlands occurred in the 1970s, in response to financial incentives to increase the amount of land used to produce food.

Land-use change and land-management practices

What society wants from a wetland, and how it is appreciated, changes over time – sometimes very quickly. The type of land-management regime alters the range of species that are supported by the wetland. For example, installing drainage ditches has a major impact on the water table and could disrupt groundwater flows, which can change the vegetation. As part of the management regime for livestock and game species like grouse, land managers sometimes carry out controlled burning of the plants on a moor or wetland (known as 'muirburn'). If the burning is too frequent or too severe, this can damage wetland habitats and species.

Development

Developments (for example, transport infrastructure, housing estates, wind turbines and hydropower schemes) can involve covering wetland with surfaces that water cannot penetrate, or installing drainage systems that deprive wetlands of their water source. This can result in a loss of species diversity.

Flood management

There has been a shift towards using wetlands as a natural tool to help manage flooding rather than using hard landscaping and engineered solutions. This approach to flood management could alter the character of some wetlands. For example, long-term changes in the duration, frequency and magnitude of flood peaks could affect the diversity of wetland species. New wetland areas have been created to manage flooding and wetland vegetation has been planted, which helps to improve the function and connection between natural wetlands that have become fragmented. However, using wetlands as flood-management areas often results in extended periods of soil saturation, which can eventually change a fen to a wetter type of wetland, such as a swamp. Although the altered wetland will provide valuable habitat, it is likely to support a different range of species. This may result in rare species found in the original wetland type being lost or displaced.

Changing weather patterns

The projected impacts of climate change in Scotland include warmer, drier summers and milder, wetter autumns and winters. We can also expect to see an increase in summer heatwaves, extreme temperatures and drought, as well as more frequent and intense extreme rainfall and less frequent frost and snowfall.

These changes are likely to affect different wetland habitats in different ways depending on the sensitivity of the wetlands to seasonal drying. In some locations, the following might occur:

- increased average surface temperatures are likely to encourage vegetation growth in fen peatlands and, with it, the accumulation of carbon in peat. However, the rates of peat accumulation in *Sphagnum* bogs is likely to reduce;
- heavier rainfall could lead to erosion and the loss of carbon-rich soils with sediment deposits downstream. This deteriorates the wetland's function as a carbon store and could reduce species diversity in the downstream water environment. Once dried out, peat does not become wet again easily and it is prone to erosion;
- an increase in dissolved and particulate carbon, which could be partly attributed to climate change, has been observed in some Scottish rivers;
- habitats such as blanket bog rely on receiving rainwater all year round. Changing rainfall patterns are likely to increase the frequency of seasonal drying, which will affect the function and diversity of the habitat.

Pollution

Pollution can alter the chemical balance (e.g. acidity) and concentration of nutrients (in particular nitrogen and phosphorus) in wetlands. Certain events and activities pose a particular threat to wetlands:

- land drainage that leads nutrient-rich surface water directly into wetlands;
- feeding and watering livestock;
- flooding, and the resulting deposits of sediments in the wetland;
- air pollution from some industrial processes and transport;
- groundwater pollution from landfill sites and illegal dumping.

Adding nutrients to wetlands changes the species present and reduces the habitat's ability to perform important functions. For example, nitrate pollution in fens will result in tall vegetation growth and invasion of reeds and nettles. This can lead to permanent changes in the wildlife that lives in the wetland; for example, typical reed-dwelling birds are absent when nettles take over.

Water management

Wetlands are very sensitive to the volume of water that flows in and out of them, so any water-management practice that changes the water flow can damage wetlands. For example, the removal of groundwater, or intensive 'gripping' (cutting drainage channels in a wetland to increase run-off) can lead to lower water tables and less frequent waterlogging, which will change the character of a wetland and the range of species it can support. Changing the depth and frequency of flooding could result in a change from swamp or reed bed to a fen. If peat dries out as a result of water-table management, carbon can be released into the atmosphere as greenhouse gases or to surface waters as particulate or dissolved carbon.

What is being done

Policy

The recent focus on an ecosystem services-based evaluation of land use as highlighted by the National Ecosystem Assessment has meant that wetlands are now more widely recognised for the functions they provide.

Wetlands in the wider countryside (non-designated sites) are being protected through legislative and regulatory mechanisms established under the European Water Framework Directive, Nature Conservation (Scotland) Act 2004 and Habitats Directives for Natura sites.

Land management

Development

SEPA and Scottish Natural Heritage (SNH) are statutory consultees in the planning system. In both SEPA and SNH, a risk-screening approach is taken when assessing developments and activities close to wetlands, and an assessment of the impact is made as part of the licensing or planning application. In some cases, measures are put in place to protect the wetland habitat and its supporting hydrology.

Conservation

Conservation funding is becoming more widely available for restoring and improving wetlands in the wider countryside. The Scottish Government has recently allocated funding for the restoration of peatlands through projects such as the Green Stimulus Peatland Restoration Project and incentives through the Scotland Rural Development Programme. Similar schemes also encourage the creation or expansion of wetland areas to improve the ecosystem in an area or to improve the environmental status of a water body; for example, the creation of reed bed or wetland infiltration or treatment systems to reduce the concentrations of agricultural nutrients entering rivers.

In addition to wider national protection of wetlands, management strategies are also employed to improve the conservation status of statutory protected sites; for example, Sites of Special Scientific Interest (SSSIs) local nature reserves (LNRs) and reserves managed by other organisations such as the Royal Society for the Protection of Birds, Scottish Wildlife Trust and Buglife. If wetland sites are found to be in an unfavourable or declining condition, active management is often needed to improve the wetland, such as removing scrub or blocking drains to raise the wetland's water-table levels.

Sustainability

Although the restoration of damaged wetlands improves wetland function and can restore some aspects of ecosystem functions, many wetlands will require ongoing management to maintain their restored condition. Wetlands that have been severely damaged in the past rarely recover to a completely natural state. Scotland's resource of pristine wetlands should continue to be protected to ensure of these valuable environmental functions are not lost in the future.

5.5 Crops and Livestock

Scotland produces a range of crops and livestock. Our agricultural industry provides the basic ingredients for our food and drink industry, and is important for our health, environment and economy – particularly in our rural communities.

Summary

Key Messages

- Agriculture is the main land use in Scotland, affecting nearly 80% of our land area.
- Scotland's climate, soils and topography affect the types of agriculture the land is able to support.
- Our best-quality land, capable of producing a variety of crops, is found along the east coast.
- Nearly 10% of our agricultural land produces crops, while almost 60% can only support rough grazing.
- Despite the small area of crops, its relative economic significance is high, accounting for 34% of our agricultural output.
- Scotland is famous for the quality of its livestock products, and maintaining quality is as important as quantity for the future health of the livestock industry.
- Scotland's agriculture is vital to our rural communities, providing much-needed employment and contributing to the rural economy.
- Much of Scotland's agriculture is only economically viable because of external support payments.
- Agriculture has an impact on the wider environment and it is important that land is managed sustainably so that it can continue to produce food in the future.

State and trend

State: Moderate - medium agreement, high evidence

Trend: Stable/declining - medium agreement, low evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- Our climate, topography and soils all affect what types of agriculture the land is able to support Some land is suitable for growing crops, while some is suitable only for rough grazing.
- However, some agricultural sectors are in a better state than others. The state is assessed as 'moderate', which is an average of all sectors – crops and livestock.
- In the short term, from year to year, agricultural output is greatly affected by the weather. However, the longer term trend is assessed as stable / declining – again, this is across all agricultural sectors.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

Agriculture is the predominant land use in Scotland, with about 80% of our total land area used for this purpose. Scotland's climate, soils and topography (the slope of the land, which direction the land faces and how high it is) influence the distribution of different farming systems across the country. Most of our agricultural and horticultural crop production is located in the east of the country in coastal areas, while most of our dairy production is located in lowland grassland areas in the south-west. Large parts of the uplands are only suitable for rough grazing. These natural constraints, along with environmental and economic factors, affect the ability of Scottish farmers to increase food production while protecting our environment and landscapes.

Agriculture in Scotland

The total agricultural area in Scotland, including common grazings (areas of open land where the sheep and cattle owned by a number of different farmers or crofters graze together), totalled 6.19 million hectares (ha) in 2013, which is 79% of the total land area of Scotland.

Land capability

Our climate, topography and naturally acidic soil all affect what we are able to use the land to grow. All of these factors vary across the country, which results in a naturally diverse range of conditions suitable for different types of agriculture. Under the Land Capability for Agriculture (LCA) system, we classify land by taking into account what it could grow (its cropping flexibility) and how well it could grow it (its potential productivity) based on its physical characteristics (that is, its soil, the climate and its topography). There are seven classes, class 1 being land capable of producing a wide variety of crops and class 7 being land of very limited agricultural value. Some of these classes have sub-classes to further distinguish the quality of the land. Figure 1 shows the distribution of different classes of land across Scotland and illustrates that although poor-quality land (classes 5 to 7) covers most of the country, there is an area of high-quality land (classes 1 to 3.1) in the east of the country that provides many agricultural options.

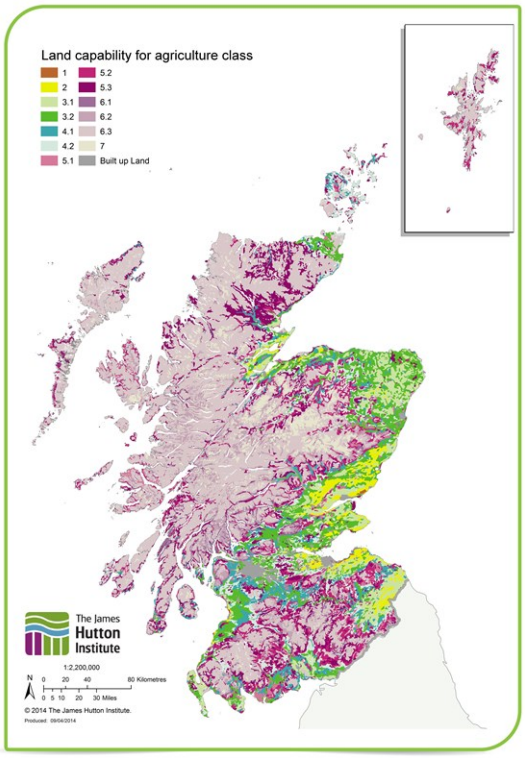


Figure 1: Land capability for agriculture in Scotland

There is a strong relationship between LCA and actual agricultural land use. Figure 2 shows that:

- cereals, other crops and horticulture are prevalent in land classes 1 to 3.1;
- grassland-based farming is more common in class 3.2;
- grassland-based farming dominates classes 4 to 5.1;
- rough grazing becomes increasingly more important in classes 5.2 to 7.

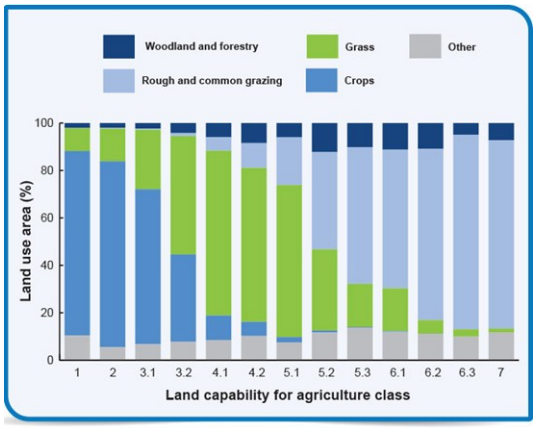


Figure 2: Agricultural land use in different land capability classes

Source: (modifed from) The James Hutton Institute.

In essence, land is being used in line with, or close to, its agricultural capacity.

Land use

The proportions of various agricultural land uses in Scotland is shown in Figure 3. Nearly 60% of agricultural land in Scotland is covered by rough grazing (e.g. heather heathlands and grassy moorlands) and common grazings.

'Managed' grassland (that is, sown grassland, including permanent pasture and land used for grazing but not rough grazing) covers about 20% of our agricultural land. Most of this is found in the lowlands in south-west Scotland, where the majority of dairy farms are located. Crops cover about 10% of our agricultural land.

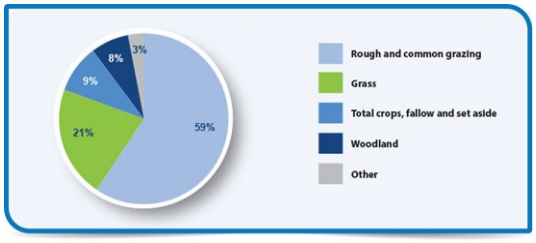


Figure 3: Agricultural area of Scotland by land use, June 2013

Economic importance of Scottish agriculture

Figure 4 shows how important each land use is in terms of its contribution to Scotland's total economic output from agriculture. While a large proportion of our economic output comes from livestock, we also have significant cereal, horticulture and potato sectors. So despite the relatively small area of land used to grow arable crops, its relative economic importance is high; 10% of the land produces 34% of the output.

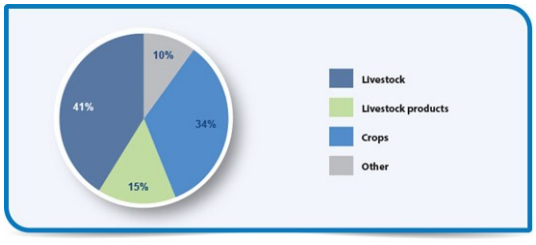


Figure 4: Relative importance of each sector to total economic output of agriculture in Scotland (2012)

Scottish agriculture had a gross output of £2.78 billion in 2012. Agricultural gross value added (GVA) is a measure of the contribution of agriculture to the Scottish economy. Agriculture accounted for 0.8% of Scottish GVA in 2012. However, this does not account for the fact that agriculture is the first stage of production for other industries, such as the food and drink industry. For example, exporting food and drink products added £4 billion to the Scottish economy in 2010. Without domestic agriculture, this additional value could not be achieved.

In addition, in 2012 Scottish farmers spent some £2.7 billion on inputs such as animal feed (£549 million), hired labour (£325 million) and fertilisers (£233 million). This also has a direct impact on other industries, such as road haulage, meaning the final contribution of agriculture to the Scottish economy is much larger.

There were a total of 67,400 people working on agricultural holdings in June 2013, accounting for around 2.5% of the active Scottish workforce. However, nearly 40,000 of these were occupiers and their spouses (employed full time and part time). The remaining jobs were distributed between full-time employees (13,500), part-time employees (7,500) and temporary positions (6,800). Nonetheless, this is a significant source of employment in rural communities. Agriculture, forestry and fishing accounts for 15% and 10% of employment in remote rural and accessible rural areas, respectively.

State

Scotland grows a wide range of crops and produces high-quality livestock and livestock products. However, not all of the land used for agriculture is cultivated; it includes large areas of moorland used as rough grazing for sheep and cattle. The areas and types of crops grown and livestock numbers have changed over time for reasons that include consumer preferences and changes in agricultural support payments. The main pressures on our agricultural industry are the impacts of climate change, the need to protect the environment from the effects of agriculture, and changes in agricultural support payments.

State

Not all of the 6.19 million ha of agricultural land in Scotland is cultivated. According to the Scottish 2013 June Agricultural Census, in June 2013:

- arable and horticultural crops cover about 10% (586,800 ha) of Scottish farmland;
- about 80% of the crops grown were cereals, with nearly three-quarters consisting of barley (339,100 ha), as well as considerable amounts of wheat (86,800 ha), oilseed rape (33,700 ha), oats (31,700 ha) and potatoes (29,100 ha);
- strawberries (912 ha), grown mainly under cover, generally provided the largest source of income in Scottish horticulture;
- grassland covered about 20% (1.32 million ha) of our agricultural land;
- nearly 60% (3.65 million ha) of our agricultural land is covered by rough grazing and common grazings;
- there were 1.8 million cattle; 40% of which were beef cattle and 15% dairy; 6.57 million sheep, 319,400 pigs and 14.17 million poultry.

Crops and livestock numbers fluctuate, and there have been some dramatic changes over time for reasons such as technological changes (such as new machinery), new cereal varieties, new crops and responses to changes in policy and incentives.

The amount of agricultural land in Scotland has declined from 6.39 million ha in 1982 to 6.19 ha today. There have also been changes in land use within the agricultural areas. For example, since 1982 the area used for arable farming has shrunk by about 120,000 ha and rough grazing has declined by about 880,000 ha, while the area of permanent grassland (sown grassland more than five years old) has increased by 290,000 ha.

Within the arable sector, there has been a large increase in wheat and a decline in spring and winter barley since 1982. Nevertheless spring barley remains Scotland's main arable crop. Oilseed rape was virtually unknown in 1982 in Scotland, but by 1994 it was sown in up to 70,000 ha; however, by 2013 this dropped back to just under half this figure. The area of potatoes has remained relatively stable at around 30,000 ha. Until the

mid-1950s, oats were the dominant cereal in Scotland, occupying around 75% of the arable land; whereas now it only occupies 5%. The introduction of autumn-sown crops (such as winter wheat), changes in dietary preferences and responses to the market are responsible for these changes (Figure 5).

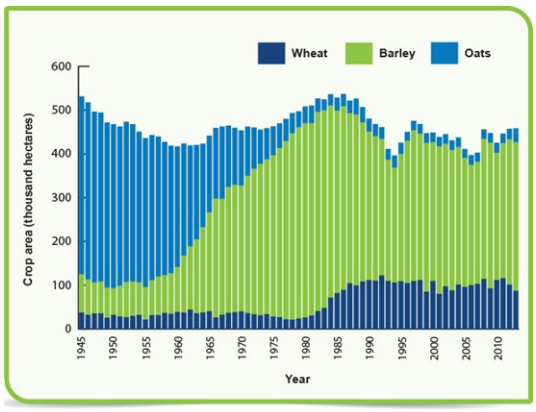


Figure 5: Changes in cropping areas from 1945 to 2013

Source: Scottish Government Agricultural Statistics

Cereal yields

Cereal production has been relatively stable over the last 20 years, varying between 5 and 7 tonnes per hectare per year depending on the weather. Despite recent poor yields, there is a long-term trend of increasing yields, with the recent 10-year average of 6.5 tonnes per hectare being 7% higher than the previous 10-year average. This long-term increase is likely to be due to more efficient farming practices as well as the development of higher-yielding crop varieties.

Livestock numbers

Scotland is famed for the quality of its meat and livestock production, and this takes up a much larger proportion of Scotland than crop land (Figure 3). Between 1982 and the present day, cattle numbers have fallen by around 500,000 to 1.8 million. Dairy cattle account for much of this figure, with numbers falling by 40% to around 265,600 in 2013. However, dairy production has not necessarily fallen by a similar amount due to factors such as cattle weight increasing and better feed.

The most significant change has been in sheep numbers, which have fallen from almost 10 million in 1991 to 6.57 million in 2013. Longer-term trends are shown in Figure 6.

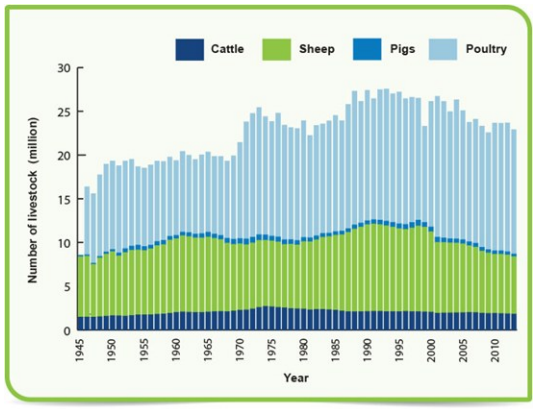


Figure 6: Changes in livestock numbers from 1945 to 2013

Source: Scottish Government Agricultural Statistics

There has been an acceleration in the decline of livestock numbers in Scotland since 2005, when the amount of agricultural support received by farmers was no longer tied to the amount of crops they grew or the number of livestock they kept on their farms.

This was particularly noticeable in the uplands and islands. In some areas there has been an almost complete removal of livestock. Figure 7 illustrates the reductions in sheep numbers across the country between 1997 and 2013.

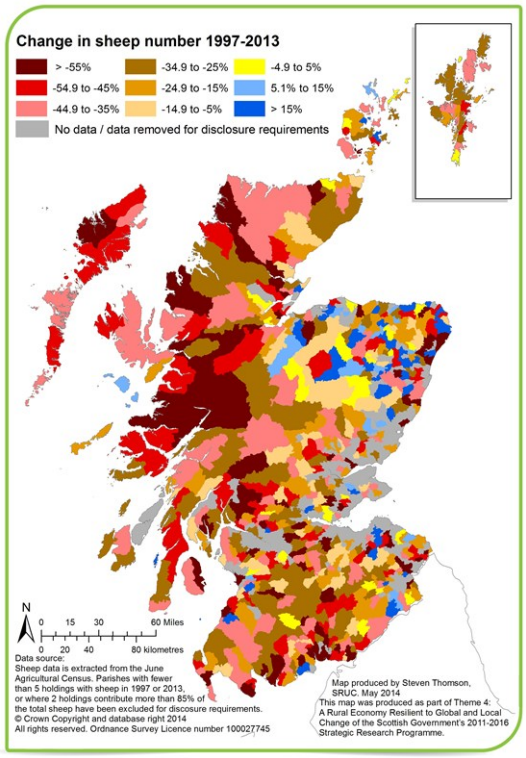


Figure 7: Change in sheep numbers across Scotland between 1997 and 2013

Production

The amount of meat produced from cattle, sheep and pigs has remained relatively stable over the last 10 years; however, the amount of poultry meat has decreased. Beef accounted for more than half of the production by weight (around 180,000 tonnes), which is twice as much as poultry and three times as much as lamb and pork. At the same time, the value of these products has increased, with the output value of cattle increasing from just over £300 million to just over £600 million.

Milk production has been fairly steady over the last 10 years, but has increased in value.

Pressures on Scottish agriculture

There are environmental, social and economic pressures on the production of crops and livestock in Scotland, including changing weather patterns, the need to protect the environment, and changing support payments.

Climate change

Scotland's climate has changed over the last century and is projected to change in future. We can expect to see:

- hotter, drier summers;
- milder, wetter autumns and winters.

There could be a number of benefits to agriculture, such as:

- a longer growing season;
- improved grass and crop growth leading to higher yields;
- opportunities to grow a wider range of crops.

However, there may also be a number of damaging effects, such as:

- reduced field access for grazing, manure spreading and cultivation, due to wetter soils in autumn;
- reduced crop and grass yields due to drought in spring and summer;
- more crop disease and damage from insects due to milder winters failing to kill these insects and microorganisms;
- new and more aggressive pests and diseases in crops and animals; for example, liver fluke in cattle and sheep;
- the introduction and spread of non-native plant species;
- increased soil erosion.

For example, over the past 20 years liver fluke disease in cattle and sheep has increased 10-fold in Scotland and is now a significant cause of loss of livestock. This increase is partially due to increasingly mild, wet winters, and current projections are for the risk to become more widespread with climate change.

Environmental protection

Agricultural activities can affect water, air quality and the climate, as well as the land itself and the wildlife it supports. Increasingly, farmers must balance agricultural production with environmental protection.

Regulations and codes of practice are in place to ensure the environment is protected from any potentially damaging impacts of agricultural operations. These can limit crop and livestock production; however, in general they ensure that the environment is managed in a sustainable way that makes sure we will be able to produce food in future.

Agricultural subsidies

Much of Scotland's agriculture is only economically viable because of European support payments. These payments allow livestock production in areas that otherwise would not be economically viable; however, changes to these payments can affect crop and livestock production. For example, the dramatic reduction in sheep numbers in the uplands was a direct result of changes to support payments in the mid-2000s.

Other pressures

Pressure for land, which is often high-quality land, continues around our towns and cities, and loss of high-quality land could reduce the amount of land available for crowing crops. There is a target to expand woodland by 10,000 ha each year over the next 10 years, and this is likely to lead to the loss of some agricultural land. Scotland has ambitious renewable-energy targets, and any future expansion of crops grown for energy could reduce the number of crops grown for food.

There are a range of other factors that don't necessarily affect our ability to produce food, but can affect how and what is produced. For example, supply chains, consumer pressure and the need to be able to trace crops and livestock can all affect how and what food is produced.

What is being done

For Scotland to continue to produce enough good-quality food, we must maintain our agricultural production. At the same time, we have to manage our land sustainably so that it will continue to provide food in the future. We also have to protect human and animal health, as well as the wider environment. Legislation and policies are in place to help us achieve these goals.

Policy and legislation

The main policy intended to protect food production and encourage sustainable land management is the Common Agricultural Policy (CAP). The CAP provides a programme of agricultural support throughout the European Union (EU). Without the support of the CAP, few of Scotland's farms would be viable and much of Scotland's land would be unproductive. The rural economy would also suffer significantly.

There are two main parts to the CAP. The first (Pillar 1) provides direct support payments, such as the Single Farm Payment Scheme, which is currently worth about £0.5 bn a year to Scotland's farmers. The second (Pillar 2) supports the Scotland Rural Development Programme.

The Single Farm Payment is a direct payment linked to meeting environmental, public, animal and plant health and animal welfare standards and the need to keep land in good agricultural and environmental condition.

The Scotland Rural Development Programme (SRDP) is a programme of economic, environmental and social measures designed to develop rural Scotland. It includes the Less Favoured Area Support Scheme and is partially funded under Pillar 2 of the CAP.

Much of Scotland is designated as a Less Favoured Area (LFA) – that is, an area in which agricultural production or activity is more difficult because of natural difficulties; for example, difficult climatic conditions or low soil productivity. These difficulties result in a significant risk of the agricultural land being abandoned, with knock-on effects on the rural economy, degradation of the environment and the loss of rural landscapes.

The SRDP also supports schemes intended to improve the wider environment; that is, water, air and soil quality, as well biodiversity and climate.

These policies ensure Scottish farming can continue to produce high-quality crops and livestock and protect our food supply (and other industries that rely on it, such as the food and drink industry).

Protection of agricultural land

Scottish Planning Policy recognises that prime agricultural land is an important resource and should be protected from development. The policy is currently under revision, and there may be further protection of agricultural land in future.

The importance of agricultural land is also recognised in the Scottish Government's land use strategy, which states that we should continue to ensure that our prime agricultural land retains its capacity for food production. This means that the main focus of woodland creation (one of the aims of the strategy) will be away from prime agricultural land.

Environmental protection

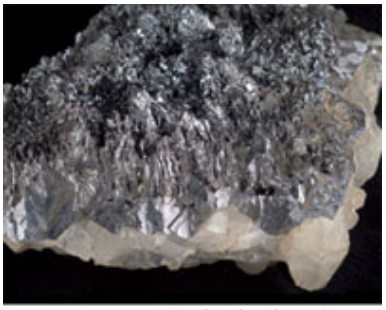
As well as protecting our food supply, we need to ensure that land is managed well and that the wider environment is protected so that we can continue to produce food in the future. Regulations and codes of practice protect the environment from a range of agricultural activities. Some examples of the types of legislation, the activities affected and the protection for the environment are given in Table 1.

Table 1: Examples of regulations and codes of practice in place to protect the environment from potentially damaging agricultural activities.

Regulation or code of practice	Agricultural activity affected	Part of the environment protected and from what
The Action Programme for Nitrate Vulnerable Zones (Scotland) Regulations 2008	Nitrogen fertiliser applications.	Protects groundwater from nutrient input.
The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (incorporating the diffuse pollution general binding rules)	Various – cultivation and livestock management.	Protects the water environment from diffuse pollution.
Pollution Prevention and Control (Scotland) Regulations 2012	Intensive poultry and pig farming.	Protects habitats, land and water from input of nutrients and acids.
Waste Management Licensing (Scotland) Regulations 2011 Sludge (Use in Agriculture) Regulations (1989 and later amendments)	Application of organic materials to land.	Protects soils from accumulations of potentially toxic elements and nutrients (and, thus, human and animal health).
Farming for a better climate	Various land-use and land-management practices.	Reduces the impact of agriculture on climate change.
Prevention of environmental pollution from agricultural activity (PEPFAA) code	Various land-use and land-management practices.	To protect the wider environment from agricultural pollution.

5.6 Fossil fuels and minerals

Scotland has a wide range of geological resources that make a major contribution to the economy. They are used in the energy, construction and manufacturing industries and need to be carefully managed to ensure they are available for future generations.



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Summary

Key Messages

- Geological resources underpin a significant part of Scotland's economy, and are crucial to many aspects of modern life.
- In 2011 the total value of minerals produced onshore in Scotland was over £650 million, more than half of which was from coal.
- In 2011 oil and gas exports from Scotland were valued at £2.4 billion.
- Scotland still has significant coal reserves of almost 30 million tonnes.
- Current estimates suggest that there could be up to 24 billion barrels of oil equivalent still to be recovered.
- Our geological resources are not renewable and, therefore, need careful management to ensure they are available for future generations.

State and trend

State: Moderate - high agreement, high evidence

Trend: Stable - high agreement, high evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- Oil and coal resources continue to be exploited and will thus decline with time.
- Aggregates and mineral resources are also being gradually exploited.
- For all geological resources, there is potential for more usable reserves to be identified as technology improves.

Overview

Scotland's geological resources are all those materials that can be extracted from the earth and used in practical applications. They underpin a significant part of Scotland's economy, and are crucial to many aspects of modern life. They include fossil fuels (coal, oil and gas) for energy; materials used in construction; metallic minerals; and a wide range of other 'industrial minerals' that are used, for example, to make glass and ceramics. In 2011 the total value of minerals produced onshore in Scotland was over £650 million, while in 2011 Scottish Enterprise valued oil and gas exports from Scotland at £2.4 billion. Many of these resources are non-renewable and, therefore, need careful management.

Scotland's geological resources are part of its wider geodiversity, and have been exploited for thousands of years since early inhabitants used local stone for building and tool-making.

Lead and silver have been mined in Scotland since the 13th century, and some of the major deposits were known in Roman times. The Industrial Revolution in Scotland was largely driven by the availability of coal in the Central Belt, and most of Scotland's cities are built from local stone. Since the 1970s, the offshore oil and gas industries have boomed.

The range of geological resources found in Scotland underpins many aspects of our daily lives, being particularly important for energy and construction.

Scotland has abundant fossil-fuel resources, including onshore coal and offshore oil and gas. Some areas may also be suitable for the production of geothermal energy. Widespread areas of sand, gravel and hard rock can provide all the aggregates needed for construction and infrastructure development. There are many areas of rock suitable for use as building, paving and roofing stone, although these are currently only worked to a limited extent due to the availability of cheap imports. Some smaller deposits of certain industrial and metallic minerals also occur in Scotland. Groundwater is also an important resource.

State

Scotland has significant fossil-fuel and mineral reserves. Our land area and the sea bed around the coast are rich in fossil fuels, mainly onshore coal and offshore oil and gas. Extensive coal deposits are found in the Central Belt. Currently all coal mining in Scotland is opencast. At present there is permission for extraction of almost 30 million tonnes of coal at opencast sites. The main resources of oil and gas lie offshore and it is estimated that there could be up to 24 billion barrels of oil equivalent still to be recovered.

Scotland's varied geology provides extensive resources of raw materials for construction. Hard igneous rocks are widely quarried for aggregate. Industrial minerals such as barytes are also quarried. There are no metal mines currently working in Scotland. Important metal deposits (e.g. gold) are known to exist, however at present they are not economically viable.

The majority of Scotland's geological resources are non-renewable, and therefore need careful management to ensure they will be available for future generations.

Energy resources

Scotland’s land area and the sea bed around the coast are rich in fossil fuels, mainly onshore coal and offshore oil and gas. Peat is also worked for fuel on a small scale.

Extensive coal deposits are found in the Central Belt, and have been mined on a large scale since the 18th century. In the past, coal was extracted from underground mines, but all coal mining in Scotland is now opencast. The total annual production of coal in Scotland has been in the range of 5–8 million tonnes since 1995, but has been falling since 2005 and dipped below 5 million tonnes in 2012 (for more information, see the Opencast Coal Survey 2012). Scotland still has a significant coal resource, with almost 30 million tonnes of coal at opencast sites that have permission for extraction, as well as other deposits, including deeper coal seams that are not currently being mined. Extensive exploration in the past means that the location of most coal deposits is well known[1].

In the future, some of Scotland's coal could be exploited through new technologies, such as underground coal gasification (UCG) or coal bed methane (CBM). UCG is a method of converting deep coal into a synthetic combustible gas while it is still underground, which allows energy to be extracted from coal that cannot be mined by conventional means. CBM involves extracting the methane that occurs naturally within coal seams, leaving the coal unaltered. The development of new methods such as these mean that Scottish coal could make a major contribution to the country's energy budget for many years to come. However, the use of coal would need to be balanced with the drive towards a low-carbon economy, for example, through the use of carbon capture and storage (CCS).

Oil was produced onshore in central Scotland from oil shales during the 19th century. Shale in this area may now offer the potential for shale gas extraction, through the use of hydraulic fracturing (‘fracking’). However, the main resources of oil and gas lie offshore, in the North Sea and on the Atlantic margins west of Shetland, and those in the North Sea have been exploited on a large scale since the 1960s. Some 42 billion barrels of oil equivalent have been extracted from the sea bed around the UK since 1970. Although the North Sea is a mature oil and gas province, widespread exploration continues on the Atlantic margins, and ongoing exploration and development are expected to continue to prove new reserves. Current estimates suggest that,

as long as the UK sea bed remains a competitive oil and gas province in which to invest, there could be up to 24 billion barrels of oil equivalent still to be recovered, and the industry will be active beyond 2050.

The longevity of the oil and gas industry will depend on the price of oil and gas, the tax regime and technological developments, as well as exploration and operational costs. Oil and gas are currently Scotland's principal sources of fuel and power, although their contribution to electricity generation will reduce as renewables become more important.

Many oil and gas fields in the North Sea that are approaching or have reached the end of production could potentially offer appropriate locations for CCS. This involves capturing carbon dioxide from large emission sources such as power stations, and storing it in suitable rock deep beneath the earth's surface. Although CCS technology is currently at a developmental stage, research has shown that Scotland has large areas of rock that would be suitable for carbon dioxide storage.

In many areas, geothermal energy for heating can be extracted via ground-source heat pumps from the top 10–15 m of the ground, which is heated by solar radiation. The possibility that substantial reservoirs of geothermal energy exist at deep but accessible levels in some parts of the country is also now being investigated.

Construction resources

Scotland's varied geology provides extensive resources of raw materials for construction. Hard igneous rocks are common throughout much of Scotland, and these are widely quarried for aggregate, particularly dolerite in the Central Belt and granitic rocks elsewhere. Over 19 million tonnes of igneous rock were quarried in Scotland in 2011, with a large proportion coming from Scotland's only coastal superquarry at Glensanda, on Loch Linnhe, which has an annual production capacity of over 9 million tonnes. Smaller amounts of sandstone are also quarried for aggregate and building stone, and limestone and dolomite are quarried in a few localities for construction and agricultural purposes. Some aggregate is also dredged from offshore areas. Scottish aggregate is largely used within the UK, in road building and other infrastructure, but some is exported. Aggregate production was relatively stable during the decade up to 2008, but has since dropped due to the recession. Scotland has an abundance of hard rock for aggregate, which has the potential to supply domestic demand for many decades to come.

Deposits of glacial sand and gravel are common across Scotland, and were the main source of aggregate before the 1970s, but have since been overtaken by crushed rock[2]. They typically form relatively small deposits, and many of those close to urban centres have already been worked out or are not accessible for quarrying. Around 8 million tonnes of sand and gravel were quarried in Scotland each year from 2002 to 2010.

The great diversity of bedrock geology in Scotland is reflected in its substantial and impressive stone-built heritage. The local variations in stone type and architectural style that accompany the changes in local bedrock character – for example the extensive use of Rubislaw granite in Aberdeen and Craigleith sandstone in Edinburgh – provide many of Scotland's settlements with a distinctive identity and sense of place. Much of the stone-built heritage dates from the 19th century, when many hundreds of quarries throughout Scotland produced building stone. Today, only a handful of Scottish quarries supply stone for cladding buildings and paving, and much of the natural stone used today is imported from around the world. Having been out of favour for many decades, the demand for local stone is now rising due to growing interest in using it in modern buildings, increased funding for the conservation of historic buildings and urban regeneration projects, and the need to repair decaying stone buildings. New and varied sources of local building stone will be required in future to meet the growing demand.

Industrial minerals

Relatively small amounts of clay and fire clay are worked for brickmaking. Talc, largely used for roofing felt, is worked in a quarry on the island of Unst in Shetland. Scotland has some deposits of silica sand suitable for glassmaking, largely in the Central Belt, where there are a small number of working quarries. A high-purity silica sand mine at Lochaline was closed in 2009. Around 500,000 tonnes of silica sand was produced in

Scotland each year between 2002 and 2008. Scotland has significant resources of silica sand that could be worked in the future.

Barytes is an industrial mineral, which is principally used as a component of drilling mud in oilfields. Scotland has large deposits of barytes in the area around Aberfeldy, and these are currently worked at the Foss mine, which produced over 30,000 tonnes of barytes in 2011. A larger barytes deposit with measured resources of some 7 million tonnes exists nearby but is not currently worked.

Metallic minerals

No metal mines are currently working in Scotland, despite the country's long history of metal mining, with lead having been worked in the Leadhills area since the 13th century. The principal production of Scottish lead, together with small amounts of silver and gold, was at mines in the Leadhills–Wanlockhead, Tyndrum and Strontian areas. During the 19th and 20th centuries, substantial amounts of chromite were extracted from quarries on Unst, and iron ore from the Midland Valley[3].

Significant gold deposits are known to exist, particularly at Cononish, near Tyndrum, which has been mined on a small scale in the past and is currently being explored. Cononish is thought to have resources totalling 154,000 ounces of gold and 589,000 ounces of silver. Exploration for other gold deposits continues in the area, and other small gold prospects are known in a number of places in Scotland.

It is likely that there will be an increase in demand for the types of metals used in new technologies, such as electric cars and wind turbines. These metals include the rare earth elements, platinum, lithium and tantalum. Some of these metals are currently sourced from only a small number of mines across the world, many of them in central Africa, China or Brazil, and there are concerns about security of supply. There has been little or no systematic exploration for resources of most of these strategic metals in the UK, but potential deposits in Scotland are the subject of ongoing research.

Detailed mineral resource maps are available for some areas in the Central Belt of Scotland.

Figures 1 and 2 illustrate the amount and value of geological resources produced onshore in Scotland in 2011.

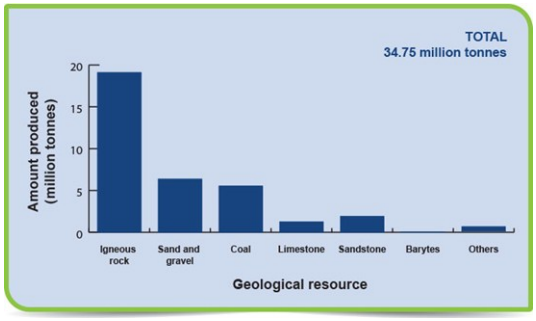

Figure 1: Geological resources produced onshore in Scotland in 2011 (excluding oil and gas)

Source: Based on data from the UK Minerals Yearbook 2012.

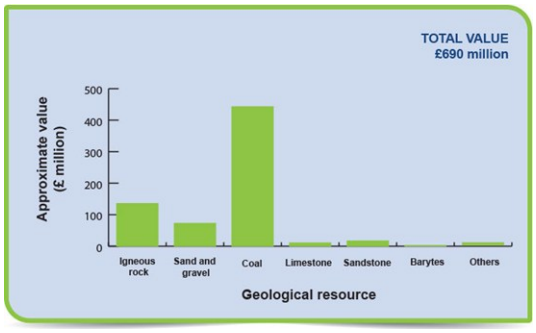

Figure 2: Approximate value of geological resources produced onshore in Scotland in 2011 (excluding oil and gas)

Source: Based on data from the UK Minerals Yearbook 2012.

Wider impacts of extracting resources

Any mining, quarrying or drilling is likely to have an impact on the local environment, economy and people. These impacts may be positive or negative, and may be temporary or permanent. Potential negative impacts include air pollution by dust around quarries, noise pollution, waste, visual effects on the landscape, damage to the area's ecology and increased use of roads and railways. Positive impacts may include jobs and contributions to the local economy, and beneficial changes to the area's ecology.

Extraction is controlled by laws that require appropriate operation and subsequent restoration of all mine and quarry sites. Many mines and quarries have been sympathetically restored after working and some can become sites of importance for geodiversity and biodiversity.

However, mining and quarrying that predates current environmental legislation has left a legacy of environmental change. Some of these changes are negative, such as scarred landscapes, areas of contaminated land and water around mine dumps, groundwater pollution and subsidence above abandoned coal mines. Other impacts are more positive, such as the development of tourist attractions at old mines and the potential for geothermal energy from abandoned mine-waters.

Pressures affecting fossil fuels and minerals

The majority of Scotland's geological resources are non-renewable, and therefore need careful management to ensure they will be available for future generations.

The key pressures can be divided into three main groups:

- exploitation;
- demand and economic factors;
- environmental issues and resource sterilisation.

Exploitation

Many of Scotland's geological resources have been worked extensively, chiefly during the last century. This is particularly true of fossil fuels (coal, oil and gas), aggregates, barytes and lead. In most cases, it will be many years before deposits are exhausted, but it is important to note that their lifetime is finite. Scotland has significant resources of coal, hard rock for aggregate, barytes and silica sand, and exploitation at the current rates can be continued for many years.

Demand and economic factors

A major constraint on the exploitation of any geological resource is the demand for, and market value of, that resource. Mineral producers in Scotland have to compete in world commodities markets with cheaper imports

from abroad, and production from many of Scotland's resources is only economic if the global price of that resource is relatively high. For example, mining for Scottish gold is only economic when the market price is high, due to very high production costs in Scotland.

Demand for energy resources is generally strong, although the recession that began in 2008 led to a notable slowing in demand. Coal produced in the UK has had to compete with cheaper imported coal in the past, but an increase in international coal prices since 2005 has made UK coal more competitive (for more information, download the mineral profile for coal). Demand for barytes is directly linked to the level of exploration for oil and gas on the sea bed around the UK, as almost all Scottish barytes is used in the exploration industry as drilling mud.

Competition from cheaper imported stone has had a negative effect on the Scottish building-stone industry in recent decades. However, this is changing as the demand for natural stone grows, and planning regulations in some areas encourage the use of local stone in building repairs and in new buildings. The closure of so many former stone quarries means that it is often impossible to repair old buildings with the same stone that was used originally, so new or re-opened quarries will be required to repair historically important buildings to high conservation standards.

Increased demand for metals is likely to have some influence on the exploitation of Scottish mineral deposits in the near future. Recent high prices of gold led to a drive to re-open the gold mine at Cononish near Tyndrum, and begin further exploration in the surrounding area.

Environmental issues and resource sterilisation

Drilling, mining and quarrying to exploit geological resources can be damaging to the environment. For this reason, policies are in place to ensure extraction takes place in a sustainable and environmentally acceptable manner. In general, this means that well-planned extraction of the geological resource can be carried out in many areas.

However, the legacy of historic exploitation of mineral resources can result in pollution, for example when polluted water drains from abandoned mines into groundwater in some parts of Scotland.

Some of Scotland's geological resources are effectively sterilised – unavailable for us to use – because they occur underneath towns or areas that are already protected for landscape and environmental reasons. This is the case for many of the stone quarries that have been filled in and built upon as towns have expanded. An example of this is Craigleith Quarry in Edinburgh, which was the source of much of the sandstone for Edinburgh's New Town. The quarry has been built over and is now the site of a retail park.

It is anticipated that the long-term demand for Scotland's fossil fuels will be reduced as we move towards to a low-carbon economy. However, Scotland also offers the geological resources required for the storage of carbon dioxide generated by burning fossil fuels. Development of carbon capture and storage (CCS) would allow continued use of Scottish coal in a low-carbon economy.

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2. *Gribble CD (2002) Bulk Minerals. In: Trewin NH (ed.)* The Geology of Scotland, *pp 455-460. London: The Geological Society.*
3. *Rice CM (2002) Metalliferous minerals. In: Trewin NH (ed.)* The Geology of Scotland, *pp 431-448. London: The Geological Society.*

What is being done

New technologies for extraction of geological resources, and for mitigation of environmental impacts, have the potential to ensure that Scotland's geological resources can be used for many generations to come.

Sustainable development of geological resources is an essential part of modern life. The vast majority of day-to-day objects contain components that have originated, at some stage, in the earth's crust. We rely on

geological resources for energy production, building and construction, clean water, and the raw materials for everything from cars and mobile phones to cups and plates. Sustainable development of these resources means that they are extracted as efficiently as possible, with the minimum environmental impact. We should recycle resources wherever possible. Continued research into technologies for improved exploration, extraction, processing and recycling will improve the sustainability of the fossil-fuel and minerals industries.

Geological resources are mostly finite – that is, they will run out at some point in the future. Scottish planning policy has been developed to ensure that extraction takes place in a sustainable manner with an acceptable impact on the environment.

Scottish planning policy sets out policies relating to all minerals. It explains that:

- sufficient supplies of minerals should be provided to meet society's needs;
- the planning system should be used to encourage development at sites where impacts on communities and the environment are acceptable;
- mineral resources should be protected as far as possible;
- mineral consents will be reviewed every 15 years to ensure that extraction is carried out to modern working standards.

Separate policies apply to surface coal mining.

Further information on Scottish planning policy and how it relates to geological resources, including planning advice notes and fact-sheets on specific resources, can be found on the Scottish Government website.

5.7 Timber and forestry products

Our forests and woodlands provide a range of benefits, such as wood for construction and fuel, removing CO_2 from the atmosphere, rural employment and a space for recreation.


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Summary

Key Messages

- In 2013 18% of Scotland was covered by woodland, compared with 11.8% in 1980 and 5.6% in 1924.
- 76% of the woodland area is made up of coniferous species and 24% by broadleaved species.
- The timber harvest in 2013 was 7.1 million green tonnes. This was about 64% of the total UK timber harvest for 2013.
- The Gross Value Added (GVA) of the forest industries in Scotland including forest-related tourism is £670 million, supporting 31,000 jobs, mostly in rural areas.
- Forest-related tourism alone contributes £209 million to Scotland's economy and sustains 17,900 full time equivalent jobs.
- Over 9 million visits are made to the national forest estate each year.
- In 2013, 57% of Scotland's woodland area was independently certified as sustainably managed, accounting for over 80% of all timber production.

State and trend

A summarised assessment of the state and trend has not been made for this topic.

Please read the topic for more information; if you have any questions about Scotland's timber and forestry products please feel free to contact us via the contact us facility on the website.

Overview

Woodlands and forests deliver many benefits to Scotland. Some of these flow directly into the economy whilst others have an indirect positive impact. Sometimes the benefit is a product which can be taken away from the forest, (like timber), while in other instances the benefit is enjoyed in the forest, like a day spent on a tree-top high wire course or an hour spent dog walking.

Timber is the most obvious direct benefit from woodlands but others include forest based recreation, wild food, and hosting renewable energy installations such as wind turbines. Scotland's forests play a vital part in the efforts to remove CO_2 from the atmosphere and slow down climate change. They also underpin our value-added forest industries and the fast developing wood fuel sector.

The Gross Value Added (GVA) of the forest industries in Scotland including forest-related tourism is £670 million, supporting 31,000 jobs, mostly in rural areas, where jobs are particularly needed.

As well as contributing obvious economic benefits, Scotland's forests are valued as part of the landscape and help to define the unique sense of place which makes Scotland popular as a visitor destination. The capacity to absorb visitor activities such as mountain biking and horse riding, and at the same time nurture wildlife, makes forests and woodlands a very special asset.

Even though there are excellent conditions for growing trees, Scotland has, for historical reasons, significantly less woodland than many other countries in the world. By the beginning of the 20th century, woodland in

Scotland had declined to only 4.5% of the land area. The mid-20th century was a period of rapid replacement of forest cover, initially using fast growing conifer species but from the 1990s onwards a wider diversity of woodland types were planted. The woodland area continues to expand in the 21st century but at a modest pace.

Forestry Commission Scotland (FCS) manages around one-third of the total forest resource (which is referred to as the national forest estate), on behalf of the Scottish Government. The remaining two-thirds is owned mainly by businesses and investment funds. Not-for-profit organisations, community groups and public sector bodies also own significant areas of forest.

State

Large areas of woodland were planted in the 20th century and these now provide millions of tonnes of timber to industry each year. Finding places to plant new forests has become more difficult and producing timber is just one of the management objectives.

Current rates of woodland planting are low compared with the mid 1970's when there were fewer constraints on changing land use to forests. Now there are more intense competing pressures on land, and the tensions between natural heritage conservation and alternative land uses have to be resolved satisfactorily before woodland creation can be approved. Figure 1 shows how the annual rate of woodland planting has changed since the 1970s.

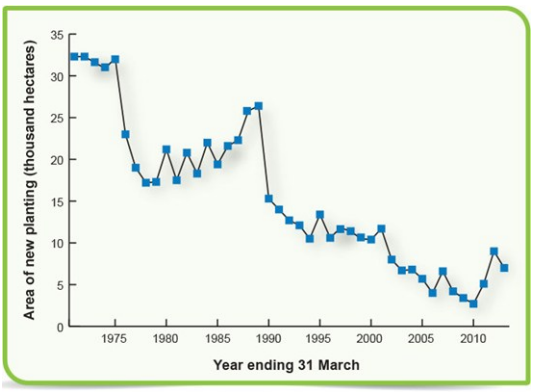


Figure 1: New woodland planting 1971 to 2013

Source: Forestry Statistics 2013

Characteristics of the forest resource

In 2013, woodland in Scotland covered 18% (1.4 million ha) of the total land area, compared with 5.6% in 1924 and 11.8% in 1980.

The current distribution of Scotland's woodland can be seen in Figure 2.

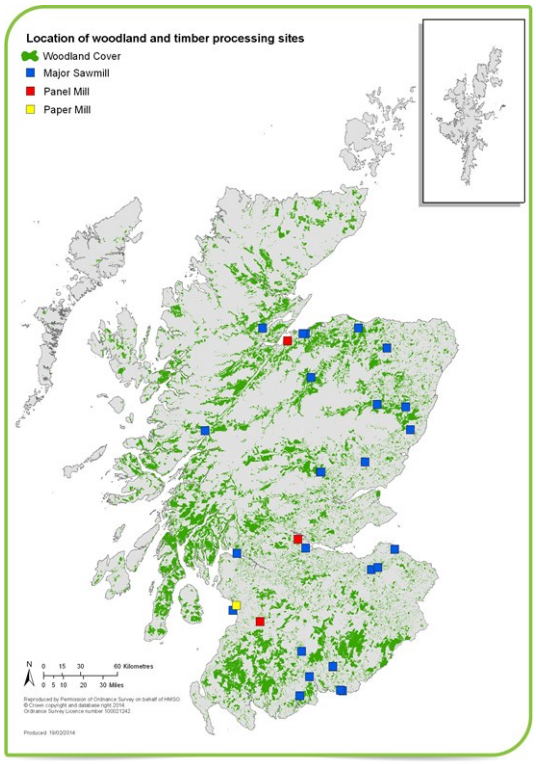


Figure 2: Woodland cover in Scotland and location of timber processing plants

It is estimated that 76% of the woodland area is made up of coniferous species and 24% by broadleaved species. Data from the National Forest Inventory estimates that Sitka spruce makes up 58% of the conifer area with Scots pine following as the second most common at 19% of the conifer area. The most common broadleaved species was birch which accounted for around 45% of the total broadleaved area.

Timber harvest

Scotland's forests provide large volumes of wood fibre for timber processing industries. The timber harvest in 2013 is provisionally estimated to be 7.1 million tonnes (fresh timber weight). This compared with a harvest of 1.9 million tonnes in 1990 and 4.3 million tonnes in 2000 and was about 64% of the total UK timber harvest for 2013.

The National Forest Inventory has quantified the forest softwood resource and the potential availability of softwood fibre over the next 25 years. (volume – thousand m3 overbark standing)

Table 1: UK 25-Year forecast of softwood timber availability (volume – thousand m^3 overbark standing)

Total softwood	England	Wales	Scotland	Northern Ireland	Total UK
2012 - 2016	3,489	1,752	8,363	605	14,209
2017 - 2021	3,810	2,004	9,485	594	15,892
2022 - 2026	3,561	1,901	11,213	554	17,230
2027 - 2031	3,877	1,507	12,436	563	18,384
2032 - 2036	3,621	1,717	11,143	502	16,983

Potential timber availability is expected to continue to increase until around 2031, mainly as a result of increased availability of softwood from forests planted in the 1970s and 1980s. Potential timber availability is likely to be less than the future timber harvest because of access, cost and owner preference issues. A 50 year forecast of potential timber availability will be published by the Forestry Commission in 2014.

Contribution to the timber processing sector

Scotland's forest resource sustains a modern and expanding timber-processing industry. In 2011 there were 65 sawmills (of which 27 produced more than 10,000 m^3 of sawn wood per year), three wood panel mills and one pulp and paper mill primarily using Scottish grown wood fibre. The locations of these processing plants are shown in Figure 2.

In 2012, 1.7 million m^3 of sawn softwood was produced by sawmills in Scotland. The three main markets for Scottish sawn timber are construction, pallets and packaging, and fencing and outdoor products.

The combined annual production of the three wood panel mills is in excess of 1 million m^3 of panels. Scottish-produced wood panels are widely used in construction, interiors and furniture and a significant volume of panels are exported.

Contribution to the wood fuel sector

Scotland has a rapidly developing wood fuel sector. Wood fuel is a renewable form of energy but because the forest area is limited, care has to be taken to use it effectively.

Wood fuel use in Scotland has increased five fold from a relatively low base in 2004, to around 1.5 million tonnes in 2012. Around one-third of this is recycled or waste wood. Additionally, Scotland's five wood-pellet manufacturing plants used over 300,000 green tonnes of wood in 2012.

There are now over 500 plants in the industrial, commercial and public sectors using biomass for energy generation in Scotland. The vast majority are relatively small scale biomass heat only plants although the largest biomass plants use most of the wood fuel. The continued increase in wood fuel demand has been underpinned by the government's Renewable Heat Incentive for these sectors. A similar incentive for households is due to be launched later in 2014.

Contribution to other renewable energy generation

Scotland's forests already host a number renewable energy projects such as wind farms and hydro power installations. These include one of the largest wind farms in Europe at Whitelee Forest in Lanarkshire. There is likely to be an increase in the number of renewable energy projects sited in forests over the next decade.

Carbon sequestration

In 2011, it was estimated that the trees in Scotland's woodlands stored a total of 9.1 million tonnes CO_2 equivalent which is about 0.8 million tonnes more than in 1990. Although carbon sequestration by woodland has increased since 1990, it is important to note that this peaked around 2004. This is because the annual rate of new woodland planting declined from the 1990s onwards and as the trees planted in the 1970s and 1980s become older they store carbon at a slower rate.

Contribution to tourism and recreation

Forest tourism contributes £209 million to Scotland's economy and sustains 17,900 full time equivalent jobs. Over 9 million visits are made to the National Forest Estate each year, providing benefits both to visitors and the local economy, for example over £9 million is being spent annually by 400,000 visitors to the 7 stanes mountain bike trails in South Scotland.

Pressures affecting timber and forest resource

Scotland's forest resource is under pressure from human activity and from pests, diseases and a changing climate. If pressures are not effectively managed then the amount, and quality, of available forest products could decline.

There are a number of pressures on the quantity and quality of the forest resource and, at the same time, consuming forest products can impact on Scotland's wider environment.

Woodland loss

In the last 15 years a significant area of woodland has been lost as a consequence of making improvements in the visual appearance of forest edges, restoring priority habitats, and building windfarms. It is estimated that woodland removal due to windfarm development and habitat restoration in the period 2001–2011 was around 16,000 ha.

Windfarm development is a particular pressure because the upland areas, on which many forests were planted, are also good sites for generating wind energy. Until recently, windfarm developers have insisted on removing all of the trees close to turbines to eliminate potential risks connected with turbine performance. However, it is now accepted that turbines and trees can co-exist in much closer proximity, with appropriate engineering design. This pressure on woodland area is decreasing.

Pests and diseases

Scotland's forest products resource is under threat from pests and diseases, which have the potential to kill trees, slow down their growth or down grade timber quality. Climate change and the expansion of international trade (which can easily introduce pest species) are likely to increase the pressure on woodland in the UK by tree pests and diseases.

Two of the most significant concerns at the moment are *Phytophthoraramorum* on larches and *Dothistroma* (red band needle blight) on pines, which have the potential to cause significant economic damage to Scotland's forest resource.

Climate change

The key climate change trends expected for Scotland are warmer, drier summers and milder, wetter autumns and winters. We can also expect to see an increase in summer heat waves, extreme temperatures and drought as well as increased frequency and intensity of extreme precipitation events and reduced occurrence of frost and snowfall. These changes are likely to affect tree growth and the wider forest resource, for example by reducing the vigour of spruce growing in eastern parts of Scotland, through more frequent flood damage on paths and tracks, or by producing more forage for deer which in turn have greater breeding success.

Increased demand for timber products

International trends in the use of timber and wood fibre will have an impact on demand for Scotland's forest products. As economies expand, and contract, around the world the demand for forest products is expected to fluctuate but with a trend towards increased consumption. Scotland's part in satisfying future global demand will be constrained by the size of our available sustainable annual harvest. Although Scotland has a significant timber processing sector and forestry resource, the UK as a whole was the third largest net importer of forest products in the world in 2011, behind China and Japan.

The UK Government's ambitions for large-scale biomass electricity generation are based on importing significant volumes of wood fuel from other parts of the world due to the relatively small size of the UK wood fibre resource. It is important that the demand for wood fuel from Scotland's forests is matched to the supply potential and the existing timber processing industries continue to be able to source raw materials.

What is being done

There is strong demand for Scottish timber which comes from sustainably managed forests. Legislation, research and government funding are all helping to ensure our forest products harvest is sustainable.

Policy and legislation

The Scottish Forestry Strategy sets out the policy targets for, amongst other things, forest products and includes actions which will deliver those targets.

Forest policy for Scotland features a commitment to an expanding woodland area, with an increased diversity of tree species and forest design, and a diverse range of forest products which benefit our economy and wider society. The mechanism for achieving this is sustainable forest management.

Other policies indirectly impact on forest products such as Low Carbon Scotland - Meeting the Emissions Reduction Targets 2010-2022 which sets out the opportunities for forests and forest products to help slow climate change through storing carbon using more timber in construction and using wood as a renewable fuel.

Expanding the forest area

It is recognised in the Scottish Government's Land Use Strategy that society's increasing demands and expectations, for example for more food, timber, carbon storage and biodiversity, can exert considerable and competing pressures on our finite land resource. For that reason the implementation of the Land Use Strategy will be central to achieving a sustainable and more integrated approach to land use.

This more sustainable approach to land use will accommodate the Scottish Government's targets for tree planting which are part of the plan for reducing carbon emissions by 2022. However it is also important to ensure that the right trees are planted in the right places and it is already agreed that the main focus of future woodland creation will be away from prime agricultural land and will avoid areas of deep peat where the carbon losses from soil disturbance could outweigh the gains from carbon locked up in trees.

In October 2012, the Scottish Government accepted a recommendation from the Woodland Expansion Advisory Group that 100,000 hectares of new woodland should be planted over the period 2012-2022; that this should be carried out in ways that meet or exceed modern standards of good practice and deliver multiple benefits; and that there should be a review, initiated no later than 2020, to set targets for beyond 2022.

Safeguarding forests

Forest policy for Scotland maintains a strong presumption in favour of protecting woodland resources and all but the smallest amounts of tree felling must be licensed. The licence almost always requires that a felled area is regenerated as woodland. Felling trees without a licence, or not following the conditions of a licence, can result in a criminal prosecution. A basic requirement of sustainable forest management is that all timber harvesting is legal and the evidence for this in Scotland relies on issuing licences and detecting illegal felling.

In some circumstances tree felling falls outside the control of the licensing system, most notably when planning permission from a local authority is applied for, and this has been the route by which windfarms have resulted in woodland loss. This unintended consequence of renewable energy development is now being addressed through the Scottish Government's policy on the control of woodland removal.

Sustainable forest management

The UK Forestry Standard (UKFS) sets out the requirements for sustainable forest management across the UK and embodies principles which have been agreed and implemented around the world.

Independent certification schemes for sustainable forest management, such as the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC), have been tailored for the UK with reference to this Standard. In 2013, 57% of Scotland's woodland area (803,000 ha) was certified as being sustainably managed, and this accounted for over 80% of all timber production. 100% of the National Forest Estate has dual certification from FSC and PEFC.

Better information about the forest products resource

A new forecast of potential softwood availability was published in 2012, as part of the National Forest Inventory, which quantified the size of the forest softwood resource and estimated the potential availability of wood fibre over the next 25 years.

The National Forest Inventory, is ongoing and will continue to provide more detailed information about Scotland's forests, including information about the scale and nature of the broadleaved resource.

Expanding the forest area

Most of the woodland creation in Scotland is funded through grant aid available in the Scotland Rural Development Programme and this is supplemented by woodland creation on the national forest estate. All of this woodland expansion is undertaken following the requirements of the UKFS.

Safeguarding forests

The heightened threats from pests and diseases now require a more strategic approach compared with the past. The Forestry Commission's Biosecurity Programme provides the strategic approach to plant health and biosecurity and ensures the delivery of work to exclude, detect and respond to existing and new pests and pathogens of trees, whether of native or exotic origin.

Operating the felling licence system and implementing the woodland removal policy when considering applications for developments, such as wind farms, helps to ensure that the total woodland resource area does not decrease.

Renewable energy from forests

Forestry Commission Scotland is making a concerted effort to maximise wind and small-scale hydro projects on the National Forest Estate. It is estimated that by the year 2020, a total of 2 GW of power could be generated, enough to power 1 million homes.

During 2012, the number of industrial/commercial plants in operation using woodfuel increased by 203 (as compared with 2011) to a total of 505, with the majority of these plants (95%) being heat only installations each using less than 1,000 dry tonnes annually. Woodfuel projects were estimated to save 884 k tonnes $C0_2e$ in 2011; this increased to 1,046 k tonnes of $C0_2e$ in 2012.

Climate change

There are many uncertainties associated with climate change, and the likely impact on the future quantity or quality of forest products. Scotland's forests need to be managed in ways which make them resilient and able to adapt as weather patterns change over the long term. A continuing supply of forest products must also be resilient. This is being achieved by building in diversity to Scotland's forests through broadening the range of genetic material in the most important species for timber, mixing tree species in stands, and adjusting management systems and the timing of operations.

Forests and woodlands also have an important role in contributing to Scotland's ambitious climate change emissions reduction targets through storing carbon. In addition timber can reduce carbon emissions when it is used instead of more carbon-intensive materials such as concrete and steel in construction or instead of fossil fuels in energy production.

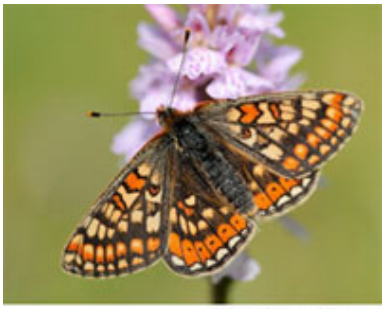
Carbon off-setting takes place when a contract is agreed to allow the CO_2 emitted from one activity to be neutralised by another activity which captures carbon or which leads to a sustained reduction in emissions. The transaction involves payment for a carbon capture project, such as woodland creation, and the registration of the project so that it can be audited and so that the carbon captured cannot be claimed by anyone else in the future. The Woodland Carbon Code has been developed to ensure that the market for this new forest product is well-governed in the UK and becomes internationally respected. At the end of 2013 there were 42

validated projects in Scotland covering an area of 1,901 hectares. These projects are expected to sequester 816 thousand tonnes of carbon dioxide.

The independent report Combating Climate Change – A Role For UK Forests, published in 2009, examines the potential of the UK's forests and forest products to mitigate and adapt to our changing climate.

5.8 Farmland

Scotland's farmland is highly varied and contains a wide range of habitats for wildlife. However, populations of some birds and insects are in decline. Intensive land management is the main challenge to farmland wildlife.



Summary

Key Messages

- Farmland and low-lying habitats consist of arable and grassland fields, crofting land, horticultural areas and lowland heaths and unimproved grasslands.
- The wildlife found in this ecosystem is highly influenced by changes in land use and land-management practices, such as the very recent losses of set-aside land and applications of herbicides and pesticides.
- Around two-thirds of habitats and species have been assessed as being in either recovering or favourable condition, with the remaining third in unfavourable condition.
- Of 61 farmland bird species, nine have declined massively between 1995 and 2011, with some now so scarce that they have almost disappeared.

State and trend

State: Moderate - high agreement, medium evidence

Trend: Stable/declining - high agreement, medium evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- Farmlands are highly diverse, with a range of habitats and varying conditions.
- Assessments are of the current "average condition"; some areas are in a worse condition, and others are in a better one. Equally, the condition of some aspects of farmland wildlife is declining, while others are improving.
- Making any overall assessment is necessarily a simplification.
- We have taken account of the scale of any damage to the environment in these assessments; impacts can be locally damaging, but may have little effect on a national scale.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

Farmland and lowland ecosystems are made up of a wide range of habitats, including arable and horticultural fields, often with hedgerows or stone dykes as boundaries, crofting land, lowland heaths, woodlands, traditional orchards, wood pasture and a range of grasslands (including machair). Many of these habitats have been heavily altered by agriculture through intensive management and decades of intensive cattle and sheep grazing on pasture land. These habitats are widespread in the Central Belt and in much of southern and eastern Scotland, but they are also found on the coastal fringes and in alluvial valley bottoms in the northern and western Highlands. Some pockets of lowland croft land are home to rare birds like corncrakes and choughs. Other common habitats in the lowlands include wetlands and woodlands.

Lowlands and farmland support a diversity of wildlife, but this has been altered by land management over centuries, particularly in recent decades. The abundance of particular species of birds is a good indicator of biodiversity in the lowlands because their presence or absence can reflect changes in the quality of the habitat

and its food supply. Across Scotland, 39 habitats have been identified as amongst the most threatened, and are designated as priority habitats. Several of these are in the lowlands, notably lowland heath, neutral grasslands and fen meadows.

According to the Countryside Survey Report for Scotland 2007, nearly a quarter of Scotland's land area was in arable, horticultural or improved grassland habitats. These habitats occur predominantly in the lowlands, where they occupy 58% of the land area. Farming on the most fertile lowland soils can be as intensive as anywhere in the UK.

Broadly, there are four farmland landscape habitats in Scotland.

Arable fields and horticulture

These are the most intensively managed areas, with regular inputs of fertilisers and pesticides. Scotland's arable crop farming is dominated by cereals and, in some areas, potatoes. The horticultural sector is dominated by the production of soft fruit, which is now mainly produced in polytunnels as a way of controlling the environment so the cropping season can be extended. Very few orchards with fruit trees are still in operation, although there is interest in reviving them.

Field margins and hedgerows

Hedges are an integral part of our landscape and these field boundaries provide an essential habitat and refuge for farmland wildlife. Mistle thrush and wood warbler, butterflies, such as the peacock and meadow brown, bats and hedgehogs all use the shelter and food supplies afforded by hedges. They also act as wildlife corridors, helping animals to move through open farmland while staying under cover.

The uncultivated edges of enclosed fields are often referred to as field margins or 'conservation headlands'. These areas receive little in the way of fertilisers and pesticides and can act as refuges for wildlife. Insects in particular thrive in these areas, providing food for birds and animals. They may also help pollinate crops and prey upon crop pests.

Grasslands

The vast majority of agricultural grassland in rural Scotland has been improved over many years through drainage, fertilisers and re-seeding using the best grass species from livestock grazing and harvesting winter forage.

Unimproved areas of grassland are rare in the lowlands, as most areas have been improved for agriculture to encourage the grass species that are most suitable for livestock to eat.

Applying fertiliser to encourage the fastest growing grasses results in the smaller, slower-growing species being crowded out by the grass. In contrast, unimproved lowland grasslands are usually full of flowers, rushes, sedges, mosses and the great variety of wildlife that is squeezed out of improved grassland. Many colourful flowering plants grow here, such as purple thyme and knapweed, and they support insects that feed on their nectar and pollen. This abundance of insects, including bumblebees and butterflies, attracts birds such as yellowhammers, nesting in nearby hedges, and skylarks, which nest on the ground in open fields.

Scotland also has a rare coastal grassland, called machair, which has developed on shell-sand soils. It is restricted to the Hebrides, the north-west coast and the northern Isles, and outside Scotland it is only found in small areas of north-west Ireland. Centuries of low-intensity livestock farming in these areas, using seaweed rather than chemicals as fertiliser, have created grasslands rich in flowers. The displays of summer wild flowers can be visually stunning, and the habitat supports a wide range of insects and birds. Machair provides a refuge for species that were once widespread in the arable farms of the Scottish lowlands, such as the corncrake and the great yellow bumblebee.

Lowland heath

Below an altitude of 300 metres, and dominated by heather, other dwarf shrubs and gorse, lowland heaths add colour and texture to the landscape. Over centuries activities like grazing have prevented woodland from growing, with many woodlands gradually removed as they were cleared for farming. Lowland heaths were once much more common across Scotland, but many have been changed into grassland as a result of intensive agriculture.

More than 5,000 invertebrate species are found in Britain's heathland, alongside a diversity of other wildlife, ranging from juniper to nesting stonechat.

Other common habitats in Scotland's lowland and farmland include woodlands and wetlands.

Benefits of farmland ecosystems

The UK National Ecosystem Assessment, published in 2011, provides an overview of a range of consequences of a change in biodiversity.

Lowland and farmland has shifted towards intensive use for food production – for people as well as livestock. However, this has resulted in a change in biodiversity that could have major implications for food production. As fields have become larger and the use of agricultural chemicals has increased, evidence points to a potentially serious decline in populations of pollinators, such as bees. As these are essential for crop production, a decline could affect how much we are able to grow and our ability to feed Scotland's population from food grown in Scotland.

Farmland and lowland has cultural benefits as well. It can define many visitors' perceptions of the environmental quality of places away from towns and cities. Lowland heaths, hay meadows and machair are often described as cultural landscapes – reflecting the distinctive nature of the consequences of how these areas are managed. If these habitats were lost, it would have a negative effect on our culture.

As one of the most visible and visited landscapes in Scotland, the changing nature of the farmland and lowland ecosystem may be seen by many as indicative of changes in Scotland as a whole.

State

Between 1998 and 2007, the land area used for arable farming and horticulture declined by 13%, whereas improved grassland expanded by 9%. The length of linear features (hedges, walls, fences, etc.) decreased by nearly 8%. Over the same period the total length of hedges and lines of trees decreased by 5%, and the length of managed hedgerows decreased by 7%. At present, Scotland has about 46,000 kilometres (km) of hedgerows – roughly equivalent to the circumference of the Earth.

Neutral grassland, which has only minimal fertiliser added, covered almost 6% of Scotland in 2007; this is the same area as was recorded in 1998.Unimproved grassland, which has not been re-seeded or fertilised, is now rare in the lowlands. Here, many species of orchids and globeflowers are found in abundance. The species in these grasslands require a moderate level of grazing – enough to ensure the meadow does not become overgrown, but not so much as to prevent wild flowers from seeding. Many grassland plants need small, open spaces to germinate, whereas many invertebrates need tussocks for shelter, so the best grasslands for wildlife contain short and long patches – a variety of micro-habitats for a variety of species.

To measure the condition of habitats and species in protected areas, such as Special Areas of Conservation (SACs) and Sites of Special Scientific Interest (SSSIs), assessments are carried out of the 'notified features' – such as named species or habitat types. Of 160 of these assessments for the lowlands in 2010, 68% were in a recovering or favourable condition. The main reasons for poor condition were over-grazing, invasive species and land management. Figure 1 shows the condition of notified features in lowland and farmland protected areas in 2010.

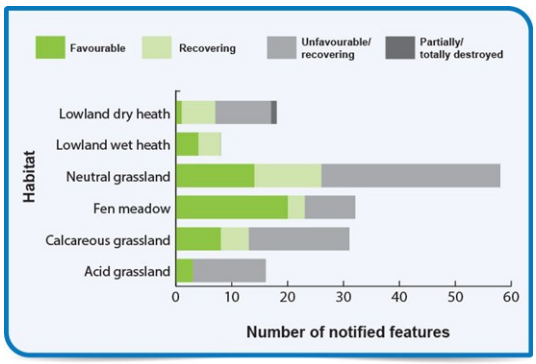


Figure 1: Condition of notified features in lowland and farmland protected areas in 2010

Source: SNH – 30 September 2010, including recovery under remedial action as in the National Indicator

Note: some of these habitats are described in other parts of Scotland's Environment website – such as fens, under Wetlands

Changes in a number of broad habitats and priority species across the wider countryside, as well as protected areas, of Scotland are monitored under the Biodiversity Action Reporting System (BARS). The farmland and lowland habitats include lowland meadows, arable field margins and orchards, and the 108 lowland species include butterflies, moths, birds, flowers, and mosses and lichens. BARS provides details of changes occurring over time.

Wildlife indicators are also used to determine trends. The smoothed long-term (1979-2010) butterfly population trend for all species was classed as stable. However, butterfly species that are restricted to specific and often isolated habitats (known as specialists) declined to 51% of their 1979 populations, although this decline may have levelled off since 2000. Moth numbers among 185 of the more common species fluctuated between 1975 and 2004. There is emerging evidence from the Rothamsted insect survey of long-term declines in common moth species in Britain.

The abundance of terrestrial breeding birds indicator shows the trends for 65 breeding bird species in Scotland between 1994 and 2011, based on data obtained from sampling 300 plots in the Breeding Bird Survey (BBS) and a number of other targeted surveys. Three main terrestrial habitats are represented: farmland, woodland and upland. Although useful for common birds, this indicator is based on a relatively small sample size, so some threatened farmland species, such as grey partridge, tree sparrow and corn bunting, are now too scarce to measure reliably through the BBS.

For 2012, the BBS provides a clearer picture of trends in wildlife condition by providing information on trends for individual species. Of the 61 species for which trends specific to Scotland can be calculated, nine declined significantly between 1995 and 2011: kestrel (-57%); oystercatcher (-30%); lapwing (-56%); swift (-57%); rook (-34%); skylark (-19%) starling (-40%); and meadow pipit (-29%). Graphs showing trends for some of the key farmland species between 1995 and 2012 are shown in Figure 2.

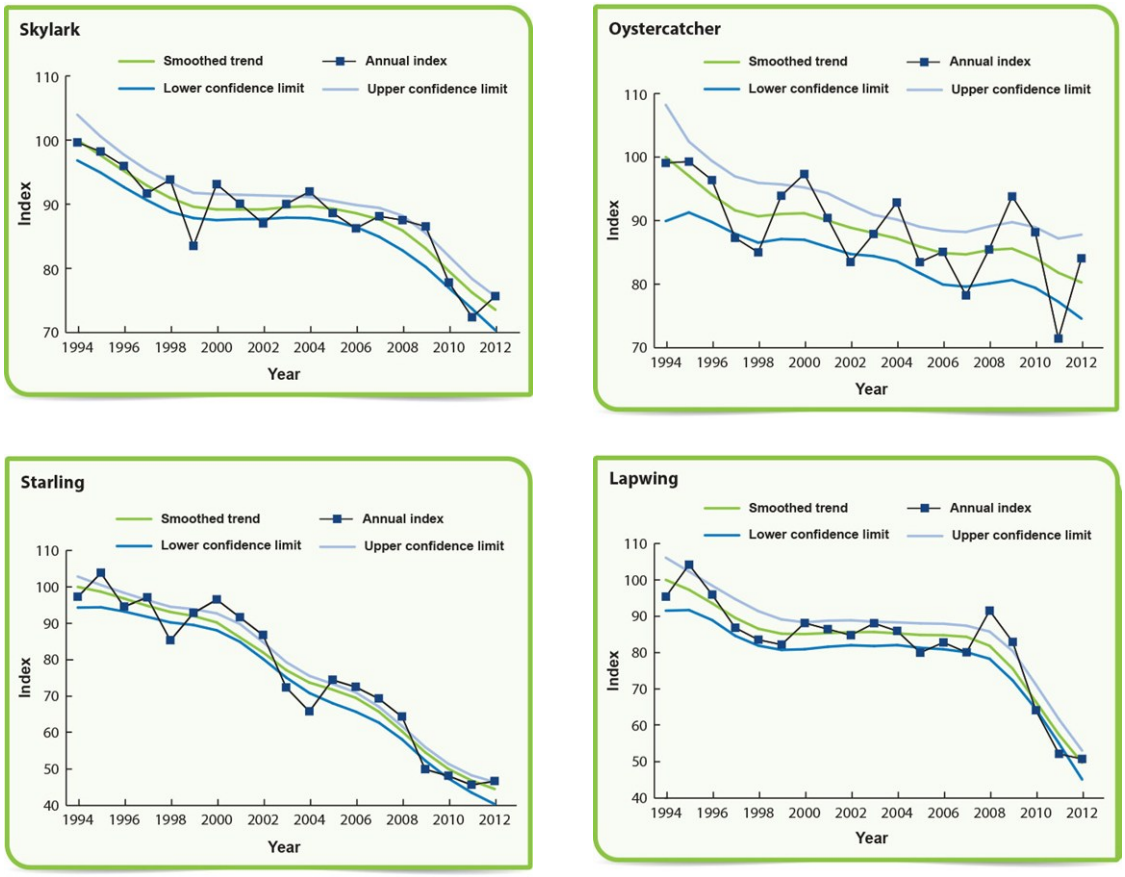


Figure 2: Breeding birds survey population trends for four farmland bird species in Scotland: skylark, oystercatcher, starling and lapwing (source: BTO/JNCC/RSPB Breeding Bird Survey)

Long-term monitoring and research has identified the main reasons why populations of these birds have declined so severely. These are shown in Table 1.

Table 1: Summary of main agricultural causes of population change for some farmland bird species

Source: RSPB Scotland

Species	Main causes of population change on lowland farms
Grey partridge	Decline caused by pesticides, which affect the survival of chicks by reducing insect populations, and changing hedgerow and field margin management, which reduces habitat for nesting.
Corncrake	Long-term decline caused mainly by early and repeated cutting of forage grasses, destroying nests and young. Conservation measures to delay cutting and provide cover throughout the breeding season have led to population recovery in the core range in Scotland.
Lapwing	Declines caused by the reduction of nesting opportunities and nest success as a result of grassland intensification, loss of spring cropping, and the timing and frequency of agricultural operations in remaining spring-sown fields. High densities of generalist predators (crows and foxes) may limit the effectiveness of interventions to preserve habitats.
Skylark	Decline caused by loss of nesting and foraging opportunities in dense, autumn-sown crops, coupled with high rates of nest loss in intensive grass silage systems.
Chough	Causes of long-term population fluctuations are not fully understood, but intensifying or abandoning grazing management of coastal grasslands may have contributed to declines by reducing the availability of soil invertebrates, which, in turn, affects survival, especially of birds in their first year.
Corn bunting	A decline of mainland populations has been caused by herbicide use, efficient harvesting, and loss of spring cropping reducing the availability of weedy, grain-rich over-winter stubbles, as well as the effects of more intensively managed arable and grassland on insects that chicks rely on for food. These effects are compounded by the impacts of earlier cereal harvesting and repeated silage cutting on nests. On the Western Isles, where cereal sowings are exceptionally late and agrochemical inputs very limited, corn buntings nest very successfully in dune grassland. Here declines are being driven by early harvesting and baling cereals as arable silage, which removes the over-winter grain source.

Pressures affecting farmland wildlife

Land management

The future pressures on farmland wildlife are expected to be associated with continuing intensive farming practices.

For arable habitats, the main pressures include:

- use of agro-chemicals (pesticides and inorganic fertilisers), which reduces the abundance and diversity of a wide range of arable plants and insects that birds and other species depend on;
- autumn-sown cereal varieties, which reduce or eliminate the winter and spring fallow period and the availability of stubble seeds for seed-eating birds, as well as nesting opportunities for birds that nest on the ground, like skylarks and lapwings;
- the widespread introduction of ‘new’ arable crops for fodder and fuel.

For grassland habitats, the main pressures include:

- cultivation and conversion to arable production;
- re-seeding with a limited mix of vigorous fodder grass species (which can out-compete more wildlife-friendly species), and increasing use of inorganic fertilisers – such improved grasslands can support far fewer plants and insects;
- higher stocking rates on grazed grasslands, which reduces the ability of plants to seed and increases the destruction of the nests of ground-nesting birds;
- a switch from hay-making to silage conservation, involving earlier and more frequent cutting.

In addition, the loss and neglect of non-farmed features, such as hedgerows, trees, gorse and scrub and ponds in farmland, has gone hand in hand with agricultural improvement and contributed to a decline in biodiversity by reducing the diversity of habitats. While agri-environment funding has helped to stem the loss of hedgerows in recent years – and reverse them in some cases, through replanting – the lack of appropriate management of such habitats more widely is a continuing problem.

For all lowland habitats there are considerable concerns about the state of pollinators, and the possible role of neonicotinoid pesticides.

Globally, according to the Millennium Ecosystem Assessment, land use change is expected to continue to be the main reason for loss of biodiversity. Agriculture is the main reason for changes in land use, and it is the main source of nitrogen, phosphorus and other nutrients that enter the farmland and lowland ecosystem. Agriculture is expanding and intensifying because of the increasing demand for food, which, in turn, is influenced by the increasing population and increasing consumption.

Climate change

The projections for climate change in Scotland suggest that although the growing season may lengthen, this could be accompanied by increases in seasonal rainfall, which limits access to land and increases the possibility of pests and pathogens surviving over winter. Wetter soils in some areas of the west and north may result in low-lying parts of fields being converted permanently to wildlife habitats.

In the east a drier climate may extend the potential for cultivation and put pressure on field-margin habitats, which are currently valuable for wildlife. In addition, there is the possibility of wetland habitats shrinking as the amount of rainfall decreases and for wildfires to become a more common threat to wildlife in the Scottish lowlands.

What is being done

Policy and legislation

The 2020 Challenge for Scotland's Biodiversity, published in 2013, sets out ambitious proposals for restoring nature and broadening the benefits derived from it. This includes the lowlands of Scotland.

Because agriculture is the dominant land use in the lowlands, the legislation associated with the European Commission Common Agricultural Policy is very important for improving the condition of wildlife. This legislation is periodically reviewed to reflect changing policy priorities. The Common Agricultural Policy (CAP) reform has, over many decades, put more emphasis on support payments for farmers who contribute to environmental conservation.

Designations have been used to protect special wildlife in the lowlands. These protected areas are monitored under the site condition monitoring (SCM) programme under the European Commission Habitats Directive. This involves assessing the areas' notified features every 6 to 24 years, depending on how sensitive and vulnerable the features are.

Sustainable land management and practical conservation

With public and private financial support, land managers are doing a huge amount of wildlife conservation work. Most projects are undertaken by farming businesses, but there are also very active not-for-profit and public sector organisations. These are often the land managers who have the resources to undertake the most ambitious habitat-restoration projects.

Land managers in the lowlands can apply for financial assistance when undertaking wildlife conservation projects. The major source of funding comes from Scotland's Rural Development Programme (SRDP). A new SRDP is planned for 2014 and there has been extensive consultation on the content of the programme.

Organic farming

Organic farming is actively encouraged in Scotland. This is a relatively new form of farming (though in the 19th century and earlier a lot of farming was organic, with few inputs of chemicals). It is still too early to judge the relative importance of organic farming for wildlife.

Vast areas of land still do have chemicals applied (and are therefore not organically farmed). Arable crops cover around 530,000 hectares (ha), outdoor vegetable crops 15,000 ha, fodder crops 9,000 ha, and grasslands cover 4.5 million ha, and the majority of these areas (more than 90% of crop areas) are treated with pesticides. Researchers are still determining the impacts of fungicides, herbicides, insecticides and rodenticides on the food chain, and the results need to be compared with organically farmed areas.

5.9 Mountains and uplands

Scotland's uplands contain our wildest places and some of our rarest plants and animals. The condition of many upland habitats is beginning to improve as action is taken to protect and manage them.

Summary

Key Messages

- Mountains, moorlands, blanket bog and rough grasslands define much of Scotland's wild landscapes.
- Scotland contains 90% of the high mountain habitat in the UK.
- Heather and bog mosses characterise much of the landscape and support nature that is synonymous with wild places, such as golden eagles.
- Most of the uplands have been modified through grazing, drainage, tree-planting and deposits of atmospheric pollution, to the extent that near-natural habitats are very rare.
- Since the 1940s, many of the upland habitats and their associated wildlife have declined in extent or worsened in condition. However, there have been some improvements recently.

State and trend

State: Moderate - high agreement, low evidence

Trend: Stable/declining - high agreement, low evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- Assessments are of the current "average condition"; some habitats and species are in a poorer condition, and others are in a better one.
- Making any overall assessment is necessarily a simplification.
- The assessment covers the wildlife of mountains and uplands, excluding forestry. This assessment covers areas such as the Cairngorms, the Ochil Hills and the Pentlands.
- We have taken account of the scale of any damage to the environment in these assessments; impacts can be locally damaging, but may have little effect on a national scale.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.
- The evidence base is low, as there are relatively few monitoring sites covering the extensive upland areas.

Overview

Covering the majority of Scotland, the uplands have some of the most extensive and best examples of near-natural habitats and wildlife associated with northern and remote parts of Europe.

A third of the uplands is bog and the remainder is acidic (rough) grassland, dwarf shrub heath (heather moorland), bracken, fen, marsh and swamp, inland rock and montane habitat. There is a wealth of wildlife, including many species that can only survive in upland and mountain habitats. Some species are regarded with particular affection by the population; the golden eagle was recently voted the nation's favourite bird, and was the subject of a national petition to be Scotland's national bird.

Wild landscapes

Mountains, moorlands, peatlands and rough grasslands form the bulk of the uplands – and these are some of our wildest landscapes. A large proportion of these areas are semi-natural, and most of the flowering plants are native. In the past, forest dominated much of the land, with only the highest reaches free from trees. Today, much of the woodland has been lost to open moorland as a result of tree felling, and later grazing and burning associated with sheep farming and deer-stalking. Above the former, upper treeline the landscapes have changed little. We have some of the most natural habitats found in Britain, especially in the corries and on the summit plateaux of the Highlands.

Forces of nature and people

Scotland's uplands have been shaped by their geology, the climate and land use. The way in which sheep farming, forestry, recreation, hunting (notably red deer and red grouse shooting) and more recently, renewable energy developments have been managed has moulded the distinctive landscape we see today.

Lying at a latitude close to that of Scandinavia, Scotland has similar geology, soils, glacial history and a cool maritime climate, so our plants and animals have much in common with those of the Nordic countries. However, the richness of oceanic mosses and ferns in Scotland's uplands is exceptional, and there is a unique mix of vegetation types associated with the influences of different climates (Atlantic, Arctic, Arctic-alpine, Boreal and even some Mediterranean elements). Many of the plants in the Scottish uplands are on the extreme edge of their world range. Although most of the species are not scarce elsewhere in Europe, the mix of birds, for instance, in Scotland's peatlands, high mountain plateaux and corries is unique; some species, such as ptarmigan and dotterel, nest at higher densities than recorded anywhere else in the world.

You can read detailed descriptions of the Scottish uplands in the UK National Ecosystem Assessment.

Protected areas

Site-based conservation of nationally and internationally important habitats, species and geological features is undertaken through a network of protected areas, including Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Sites of Special Scientific Interest (SSSIs). These protected areas tend to be in much better condition than the wider countryside – they have been chosen for protection because of the special wildlife they support. The features that are of conservation interest are assessed through site condition monitoring, which provides reports on the state of nature every six years. You can find more information about conserving, enjoying and promoting our nature in the Scottish Biodiversity Strategy.

Of Scotland’s uplands, 24% lies within SPAs, 16% in SACs, 22% in SSSIs, 11% in national parks and 3% in National Nature Reserves. That such a large extent of the uplands lies within European designated sites, in particular, is testament to the importance of our upland nature.

State

Upland habitats fall into seven broad types. Table 1 provides an overview of the estimated areas of these habitats across Scotland and how they have changed over time.

Table 1 shows that since 1990 there has been a large increase in the extent of bog and bracken habitats, and a loss of heather moorland and fen, swamp and marshy habitats. The increase in bog reflects the efforts of land managers in the last 20 years to restore bogs that have been drained and planted with trees. By contrast, the increase in bracken has often occurred in places where the land is no longer actively managed or where livestock grazing has been heavy.

Table 1: Area of broad habitats in the uplands of Scotland.

Broad habitat type	1990	1998	2007
Bog	1,922	2,039	2,044
Dwarf shrub heath (heather moorland)	1,007	912	894
Acid (rough) grassland	n/e*	911	983
Fen, marsh and swamp	289	261	238
Bracken	107	121	131
Inland rocky habitats	53	91	84
High mountains	n/e*	38	38

Source: Countryside Survey report for Scotland
**n/e indicates not estimated. Small extents of these habitat types occur outwith the uplands.*

The following sections provide some more detail about some of the habitats. You can find a more comprehensive summary of changes in Scotland's wildlife – an assessment of biodiversity in 2010.

Bog

Bogs (a type of peatland) are essentially compost heaps working in reverse. Bog mosses and other plants break down very slowly in a largely waterlogged and oxygen-starved environment, and gradually form a layer of peat. A variety of plants form peat, notably bog mosses (e.g. *Sphagnum*), but also bog cotton and deer grasses.

Bogs are one of the most extensive semi-natural habitats in Scotland, covering almost a quarter of our land area (just over 2 million hectares). Although relatively common in Scotland blanket bog is a globally rare habitat. Scotland has a significant proportion (60%) of the total blanket bog in the UK.

There is blanket bog throughout the Scottish uplands, but it is most extensive in areas with gentle slopes and poor drainage, dominating the landscape of the gently undulating moorlands, particularly in the North Highlands and Western and northern Isles. Bog plants are adapted to living in soil with low levels of nutrients; for example, the carnivorous sundew supplements its nutrition by trapping insects and digesting them.

Moorland

Heather moorland is probably the most visually distinctive habitat in upland Scotland – especially when its dominant plant is ling (or heather), which flowers beautifully in late summer to give the purple vistas we see on so many postcards. This habitat has a great richness of invertebrates and birds.

Since the 1940s around a quarter of heather cover has been lost, mainly due to heavy grazing by animals. Virtually the entire moorland habitat is grazed by sheep and red deer, and much of it is managed using controlled burning, known as muirburn, to regenerate the heather. This benefits livestock and wildlife by providing nutritious young shoots while retaining areas of older, taller heather for grouse and other birds to nest in. Poorly managed muirburn can result in wildfires that damage wildlife and habitats, especially young native woodland, over hundreds of hectares.

Virtually all of our moorland was once woodland, but land management and climate change over thousands of years has left us with treeless open moors. In the few areas where we still have large areas of natural woodland, especially the Caledonian pine forest, heather is a major part of the shrub layer growing under the tree canopy.

Rough grassland

Rough grassland, which has not been modified by fertilising and re-seeding, usually occurs higher up and beyond the limits of enclosed agricultural land. This habitat is characterised by a diversity of plant species, with many wildflowers and native grasses, These are a haven for invertebrates, such as the rare vertigo snail.

A lot of rough grassland used to be covered by heather, but because of heavy grazing the grasses have overwhelmed and replaced the heather and other dwarf shrubs. The area of rough grassland increased by 8% between 1998 and 2007, possibly because of the need for grazing for sheep.

High mountains

Scotland contains 90% of the high mountain habitat in the UK. The woolly fringe-moss heaths that drape mountain summits are found in few other parts of the world, and the heath on Ben Wyvis forms the largest single expanse of this habitat in the world.

The wildlife of Scotland's mountains includes birds such as ptarmigan, dotterel and snow bunting. These extreme habitats often support species that usually live further north.

Mountain heath and willow scrub are two of the most natural habitats that we have in Scotland – they occur above the tree line, usually above 600 metres, but lower in more exposed locations. Heath dominated by heather and blaeberry supports a diverse population of plants and mosses. Where willows grow, they are stunted. These habitats form mosaics with montane grasslands and moss-dominated heaths.

Changes in the condition of habitats and wildlife

An assessment of Scotland's biodiversity was carried out in 2010 and includes results from monitoring protected areas. Figure 1 compares the condition of features in the uplands in 2005, 2010 and 2014.

Assessments in 2005 and 2010 found that the condition of the majority of features in upland habitats was favourable, although upland grasslands were a particular concern. The most recent results from 2014, show that the condition of the majority of features is continuing to improve gradually as work focuses on remedial action.

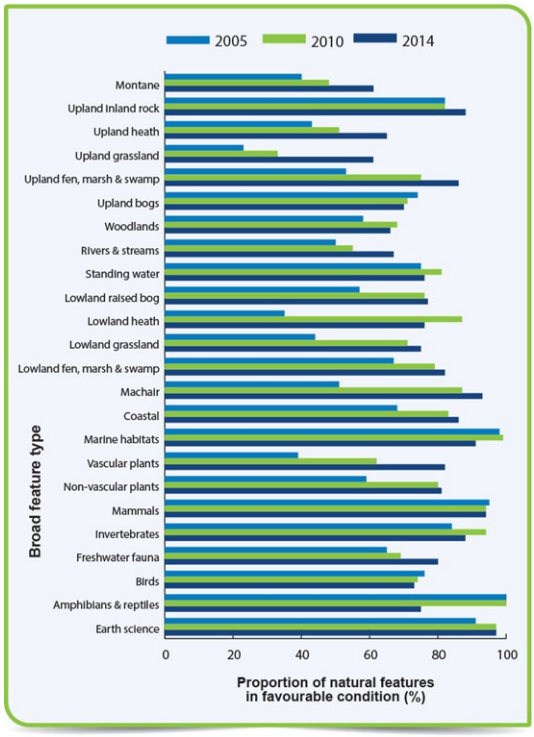


Figure 1: Results of site condition monitoring for a range of features in Scottish uplands.

Source: Scottish Natural Heritage

Pressures affecting upland wildlife

Future pressures on biodiversity across the uplands will result from a complex range of factors. The main ones are as follows:

- land management – the grazing of sheep and deer, poorly managed muirburn, and the drainage of semi-natural areas tend to encourage the growth of grasses at the expense of dwarf shrub heath. The removal of livestock in some areas since the early part of this century has meant that the vegetation has grown more vigorously and densely, leading to a decline in the richness of invertebrates that are an important diet for some nesting birds;
- atmospheric deposition of pollution – although acid deposition is decreasing, there is a still a significant deposition of nutrients and acidic compounds across the uplands. South of the Highlands, the summit heaths have become much grassier as a result, which favours grasses and sedges at the expense of mosses;
- woodland creation will continue in the uplands and, if tree-planting is inappropriately designed or managed, this could harm habitats and species;
- wildlife crime, especially killing raptors such as hen harriers, golden eagles and peregrines, can have a negative impact on biodiversity;
- climate change – the climate is already getting warmer, and spring events, such as bud burst, bird migration movements and egg laying, are happening earlier in the year. Some plants and animals are also shifting northward, although the reasons for this are not straightforward. Shifts up hillsides are also anticipated, with some possibly displacing the plants and animals adapted to alpine or arctic-alpine conditions on the high tops.

What is being done

Policy and legislation

The 2020 Challenge for Scotland's Biodiversity, published in 2013, sets out ambitious policy proposals for restoring nature and getting more benefits from it. At the centre of this policy is a greater recognition of the 'services' that the uplands provide for us.

Policy is frequently reviewed, and this includes evidence-gathering and debate initiated by the Scottish Parliament's Rural Affairs, Climate Change and Environment Committee (RACCE). In 2013 the committee considered deer management in the uplands. It is estimated that around 23% of nature conservation features in protected areas are in unfavourable condition where deer are present. Dealing with this pressure is very important for wildlife and habitats in the future.

Because agriculture is the dominant land use in the uplands, legislation associated with the European Commission Common Agricultural Policy (CAP) is very important for improving the condition of wildlife. This legislation is periodically reviewed and refreshed to reflect changing policy priorities. CAP reform has, over many decades, put more emphasis on support payments for farmers who contribute to environmental conservation, particularly in remote and fragile areas like the Scottish uplands.

Many of the uplands have been protected through designations that recognise their special wildlife value. These protected areas are monitored under the site condition monitoring programme as part of the European Commission Habitats Directive. This involves assessing the important features of the areas every 6 to 24 years, depending on how sensitive and vulnerable the features are.

This monitoring programme applies to SSSIs, SPAs, SACs and Ramsar sites. In total, these sites have 5,372 features for which the sites were designated (44% habitats, 39% species and 17% earth science features) within 1,883 protected areas, covering approximately 17% of Scotland. Annual reports provide detail on the condition of features as 'favourable' or 'unfavourable', with subsets of each ranging from 'favourable maintained' to 'totally destroyed'.

Assessments of features are made on site, with measurements taken of ecological attributes such as the composition and abundance of plant species and the extent of erosion. Formal work on this programme began in 1994, with the first UK report produced for the period 1994–2000.

Sustainable land management and practical conservation

With financial support from public and private sources, land managers are doing a huge amount of wildlife conservation work. Most projects are undertaken by farming businesses, but there are also very active not-for-profit and public sector organisations. These are often the land managers who have the resources to undertake the most ambitious habitat restoration projects.

Large areas of peatland are being restored by blocking ditches and removing trees to improve the prospects for wildlife. The IUCN Commission of Inquiry on Peatlands has highlighted the exemplary nature of peatland restoration work being done in Scotland, and work in the Flow Country peatlands in Caithness and Sutherland has been acclaimed internationally.

Land managers in the uplands can apply for financial assistance for wildlife conservation projects. The major source of funding comes from Scotland's Rural Development Programme (SRDP).

A significant number of volunteers give their time by monitoring wildlife across Scotland with organisations like the British Trust for Ornithology, Scottish Wildlife Trust, Butterfly Conservation and Plantlife. This work contributes a huge amount of detailed knowledge about how upland biodiversity is changing and provides a lot of the information made available through Scotland's network of biological records centres.

It is essential that organisations and land managers work together to improve the condition of habitats and species in the uplands. Scotland's Moorland Forum is a good example of a collaborative group that has commissioned evidence-gathering studies and produced policy and good-practice guidance for land managers.

Some major projects have been established in the uplands to develop and demonstrate good practice in wildlife conservation and management. One example is the Langholm Moor Demonstration Project, which is developing new methods for restoring heather moorland and managing the conflict between grouse-moor management and raptor conservation.

5.10 Woodlands and forests

Scotland's woodlands and forests support a wide range of important plants and animals. For wildlife, our woodlands are in a moderately good condition now and are likely to improve in the future.

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Summary

Key Messages

- Woodlands support a large part of Scotland's terrestrial wildlife.
- Human influence and climate change had reduced forests to only 4.5% of Scotland's land area at the start of the 20th century; no woodlands in Scotland can now be considered truly natural.
- Since then, a huge woodland creation effort has increased our forest area by 1 million hectares.
- In 2013 Scotland's woodland and forest cover was 1.4 million hectares (18% of the land area).
- Rare and threatened species are more often found in and around semi-natural woodlands, but many have also colonised planted forests.
- The condition of our forests and woodlands for wildlife is moderately good, and there are indications that it will continue to improve with sustainable management.

State and trend

State: Moderate - high agreement, high evidence

Trend: Stable/declining - low agreement, medium evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- Woodlands and forests are in a range of different conditions across Scotland; any assessment is a simplification.
- Native woodland and planted forest differ in the potential they have to support wildlife, and they also differ in their state.
    - Native woodland is potentially more valuable for wildlife, but may be further from achieving this potential – moderate/poor state.
    - Planted, mainly non-native forests – good/moderate state.
- Planted forest area and the composition of forests are improving.
- The quality of native woodland is stable/declining (some are improving, some declining), although it is increasing in area.

Overview

In pre-historic times most of what is now Scotland, apart from the high mountain tops, was covered in forest. As the human population increased, forest cover declined. By the start of the 20th century, only 4.5% of Scotland was covered in woodland. Reafforestation efforts since the First World War have created 1 million hectares (ha) of new forest, and by 2013 Scotland's forests and woodlands covered 1.41 million ha – 18% of the total land area. Just over one-fifth of this is currently native woodland; the rest is dominated by introduced species.

People tend to think of forests as being extensive areas dominated by trees, while woodlands are often smaller elements of a landscape where open space is dominant, or at least is equal to tree cover. Plantation is a term used to describe woodland planted to a particular design, with rather narrow management objectives.

Plantations can be established using conifers or broadleaves, and the main tree species can be non-native or native. Typically, plantations have less variety of tree species, tree sizes, dead wood, ground vegetation, and open spaces than mature semi-natural woodlands.

Over the last 30 years there has been a huge change in the approach to designing new woodlands in Scotland, with a strong emphasis on providing multiple benefits. At the same time, an approach to managing existing plantations has been developed that uses the opportunities created by timber harvesting to transform plantations more quickly into forests by diversifying tree species, age structure and the proportion of open spaces. This process, known as **restructuring**, is routinely applied in Scotland to develop forests that are increasingly valuable as wildlife habitats as well as a timber resource.

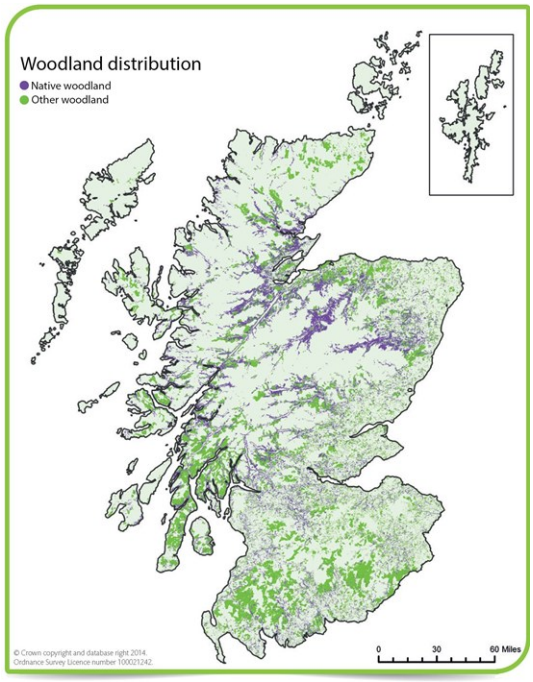

Figure 1: Woodland cover in Scotland

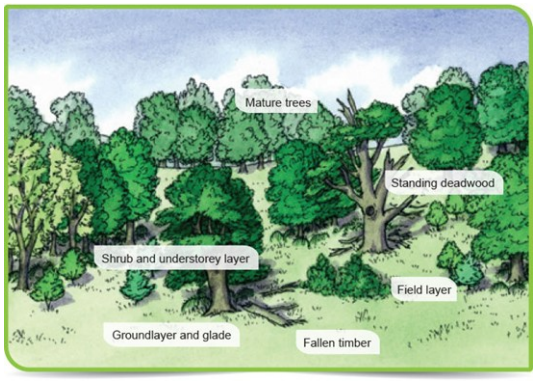

Figure 2: Woodland structure

Much of our wildlife is associated with forests, woodlands and trees. Mature native woodlands support a rich variety of species, and some native woodland, and the plants and animals that live there, are unique to Scotland or are at the limits of their worldwide distribution. However, some conifer forests that started out as plantations provide habitats for rare animals; this can help populations recover and occasionally be used for species reintroduction.

State

Since the 1980s many native woods have been created or put back into positive management after a period of neglect. At the same time significant native woodland loss and fragmentation has occurred in the unenclosed uplands.

The restructuring of planted forests has likely increased their overall biodiversity value although there is limited baseline information to compare with. Woodland birds have benefited significantly, but there has been a decrease in the diversity of woodland plants, probably because many young woodland areas are reaching closed canopy conditions.

Woodland biodiversity indicators

Greater biodiversity (the variety of species, as well as the presence of rare species) tends to be associated with woodlands that have a complex structure (with mature trees, shrubs, deadwood and open ground), and with woods that have more tree species or a larger proportion of native species.

Woodland biodiversity indicators have been developed for the Scottish Biodiversity and Forestry Strategies to reflect these relationships (Table 1). A set of ecosystem health targets and measures are being developed that will build on these indicators.

Table 1: Woodland biodiversity indicators: all woodland types (extract from Scottish Forestry Strategy indicators).

Woodland biodiversity indicators	Last assessed	Baseline value	Most recent reassessment
Scottish Woodland Bird Index	2012	100	156
Woodland structure and composition: mean understorey shrub layer cover (under a canopy of more than 15 m in height)	1995–1999	17%	Next due 2015
Woodland structure and composition: mean number of tree and shrub species within plots (sample plot size of 0.25 ha)	1995–1999	2.2	Next due 2015
Woodland structure: mean deadwood volume (standing and fallen)	1995–1999	4.4 m^3/ha	Next due 2015
Woodland structure and composition: old growth as a proportion of Scotland's woodland cover (‘old’ growth is 95 years or older for conifers, or 135 years for broadleaves)	1995–1999	4.8%	Next due 2015

The Scottish Woodland Birds Index, which is part of a wider index of abundance of terrestrial breeding birds, has shown a gradual increase in woodland bird abundance of 56% since the index started in 1994.

Baseline indicator values for woodland structure and composition across all woodland types come from national inventory data collected between 1995 and 1999 (Table 1). It will be possible to see a trend once the new National Forest Inventory has been completed in 2015/2016; this will be carried out on a five-year cycle thereafter.

- The ‘understorey/shrub layer cover’ indicator reflects the amount of vegetation present under the tree canopy
- The ‘number of tree/shrub species’ indicator measures the presence of a wide range of plants and animals
- Deadwood provides habitat for specialist woodland plants and animals, in particular insects and fungi
- Old-growth woodland is a key indicator of biodiversity – old-growth woodland contains a high proportion of large and old trees, a diverse structure, and deadwood

Other trend information comes from the Countryside Survey, which has also assessed changes in the composition of woodland plant species. Between 1998 and 2007, the richness of plant species declined

slightly in broadleaved and coniferous woods, which may be related to an increase in overall levels of shade as more woods mature.

Priority species and habitats

Priority species and habitats are those identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UKBAP). There are currently 169 of these species in Scotland associated with woodlands and trees including:

- 14 mosses and liverworts;
- 85 fungi and lichens;
- 37 invertebrates;
- 13 vascular plants;
- 20 vertebrates.

UKBAP reporting in 2008 indicated that 75% of woodland-related priority species and habitats were in a stable/favourable or recovering condition.

Although rare and threatened priority species are most concentrated in native woods, many have also been able to thrive in woods dominated by non-native tree species.

Native and ancient woodlands

Native woods can be semi-natural (self-sown) or planted. They are defined as woods in which over 50% of the canopy is made up of species native to the region.

Some have been continuously present in some form for at least 250 years; these are known as ancient woodlands. Native and ancient woods generally have a high value for biodiversity.

The precise area, distribution and condition of native and ancient woodlands has been assessed and reported in the Native Woodland Survey of Scotland (NWSS).

The survey recorded 311,200 ha of native woods, and a further 7,900 ha were estimated to have been established by March 2013, making a total of 319,100 ha. Of this area, 77,900 ha were on ancient woodland sites. Another 42,400 ha on ancient woodland sites are predominantly non-native in species composition, so the total ancient woodland area is 120,300 ha.

Comparing NWSS data with earlier maps of ancient woodlands shows that up to 14% of ancient woodland has been lost over a 40-year period. Almost 90% of this loss has occurred in unenclosed upland areas.

Some of these native woodlands are also listed as European habitats of conservation concern in Annex I of the Habitats Directive.

The NWSS also assessed the condition of native and ancient woods using a specially developed indicator. Just under half (46%) were found to be in satisfactory condition for biodiversity, but most of the rest could achieve this if a single threat was removed. By far, the most widespread threat is excessive browsing and grazing by herbivores, mainly deer. For ancient native woods, 40% were in satisfactory condition.

Table 2: Area covered by the main types of native woodland in Scotland.

Native woodland type[1,2]	Area covered (hectares)	Proportion of native woodland area (%)
Lowland mixed deciduous woodland[3]	23,189	8
Native pinewoods	87,599	28
Upland birchwoods	91,235	29
Upland mixed ashwoods	12,353	4
Upland oakwoods	19,474	6
Wet woodland	44,742	14
Blackthorn scrub	152	<0.1
Hawthorn scrub	2,138	1
Juniper scrub	1,482	1
Montane willow scrub	10	<0.1
'Other' type[4]	28,779	9
Total	311,153	100

1. The first six rows are native woodland types that are priority habitats under the UK Biodiversity Action Plan.
2. 30% of mapped units (polygons) of native woodland surveyed contain a single native woodland habitat type. The remaining 70% consist of two or more woodland types, where no one patch has an area of more than 0.5 ha.
3. This is sometimes referred to as lowland mixed broadleaved woodland.
4. 'Other' native woodland includes areas that could not be attributed to a particular type of native woodland.

Designated woodland features

Many areas of native woodland are legally protected as Sites of Special Scientific Interest (SSSIs) or Special Areas of Conservation (SACs) because they contain one or more features of particular wildlife importance. In March 2013, 67% of these woodland features were in favourable or recovering condition (an increase from 59% in 2005). Around 9% are recovering but still in unfavourable condition.

Pressures affecting woodland and forest wildlife

Although many pressures are being dealt with, and some are declining, others – such as the effects of deer and invasive species – are a threat to woodland wildlife and need more work.

Fragmentation and loss of woodland habitat

Development leads to some loss of woodland area. This is usually on a small scale, with the exception of wind farms, which affect some extensive areas in upland conifer forests. Unauthorised and illegal clearance of woodland is rare. Conversion of woodland for agricultural use is currently a minor issue.

Fragmentation and gradual loss of native and ancient woods remains a serious problem in unenclosed uplands. More work is needed to establish the causes, but they are most likely to be a combination of excessive herbivores and poor regeneration capacity on some sites with old trees. Another factor could be muirburn, which grouse-moor managers and shepherds carry out to rejuvenate mature heather and grass. This can prevent woodland expansion by killing tree seedlings near woodland edges. However, in general, forest fires are not a significant problem for woodland wildlife in Scotland.

There are also pressures to convert some planted woodlands into open habitats where past tree-planting has damaged habitats such as peatlands, which are now recognised as important, and where there is a good prospect of restoring open habitat that supports wildlife.

Economic and management pressures affecting woodland biodiversity

For most woodlands in Scotland, lack of management is likely to have a long-term negative effect on biodiversity. Management can increase structural diversity in a woodland, which provides more opportunity for

a wide range of plants and animals to find a suitable living space. Even semi-natural woods need to be managed; for example, because of deer browsing or invasive species outcompeting rare natives.

If owners do not manage their woodlands, the biodiversity and even the survival of the woodland may be threatened in the long term.

For the conifer forests that were planted in the 20th century, factors can challenge the economic viability of timber harvesting, such as remoteness from processing facilities, fragile rural roads, or the costs of working on steep terrain. In some upland sites, practical issues like site quality and the risk of wind damage limit the speed and extent to which a more diverse forest can be developed, and reduce the incentive to manage them for timber.

Climate change

Climate change is expected to make Scotland a warmer, wetter and windier place, with more extreme weather. The factors determining our climate 50 years from now are not fully understood, but there will be positive and negative effects on trees and woodland wildlife. Some species may need to migrate to new areas as their habitats change; others may be able to colonise a larger area as average temperatures rise. Woodland managers will need to plan for uncertainty and help woodland ecosystems adapt.

Tree pests and diseases

A number of new threats to trees and shrubs have emerged recently, including:

- death of ash trees due to a fungus, *Chalarafraxinea;*
- various *Phythophthera* species of fungi threatening larches, some other trees, juniper and blaeberry (*Vacciniummyrtillus*), which is important for food and shelter for many wildlife species;
- dothistroma needle blight, which affects pines.

There is no common cause for new epidemics, but the trend may be related to climate change and the increasing movement of plants through international trade.

Native deer

Red and roe deer are native to our woodlands and they can help maintain biodiversity. However, in many places there are too many deer and this has a severely negative effect on the ground vegetation and stops trees from regenerating. Excessive browsing or grazing was the main threat to the condition of native woodland identified in the Native Woodland Survey and Scottish Natural Heritage's assessments of the condition of designated woodland features.

Invasive non-native species

Invasive non-native species (INNS) are a pressure in many woods. The common rhododendron (*Rhododendron ponticum*) is the most extensive invasive species in Scottish woodlands, and should be removed where possible to prevent it from spreading. More localised problems also come from other plants, including Himalayan balsam and Japanese knotweed.

Table 3: Extent of recorded invasive non-native shrub and field layer species in native woods.

Invasive species	Area covered (ha)	Proportion of total area of invasive species (%)	Proportion of native woodland area covered by invasive species (%)
Rhododendron *ponticum*	3,691	65	1.2
Other herbaceous invasive exotics	1,468	26	0.5

Himalayan balsam	240	4	0.1
Japanese knotweed	113	2	<0.1
Giant hogweed	96	2	<0.1
Snowberry	46	1	<0.1
Total	5,654	100	1.8

Grey squirrels pose a threat to native red squirrels by spreading squirrel pox virus. Grazing and bark-stripping by non-native sika and fallow deer are also a problem in some areas.

Non-native trees in native woods

Many native and ancient woods have a mixture of native and non-native species due to past management or because they were planted as mixtures. In some places this threatens woodland biodiversity; for example, remnants of ancient broadleaved woodlands can be shaded out by dense conifers. In othercases,non-native species may have little impact if they are not invasive. A site-by-site assessment is desirable. The NWSS showed that non-native trees exceeding 10% of the canopy cover is the second most common threat to native woodland biodiversity.

Nutrient enrichment and deposition of pollutants

Nitrogen deposited from the atmosphere and from agricultural run-off or stock grazing in small woods can alter the balance of plant species. The Countryside Survey showed evidence of significant increases in plant species associated with more acidic conditions between 1990 and 2007.

The acidification of streams and lochs can be made worse when leaves capture air pollutants that are then washed down into the soil by rain. This is a bigger risk in wet upland areas where the underlying rocks and soils are not good at neutralising excessive acidity in rainwater. The effects of acidified water on wildlife in rivers and lochs peaked in the 1980s, but is still a problem in some places. However, most areas are gradually recovering.

Recreation

Woodlands are increasingly popular for recreation, and provide benefits for woodland owners. These uses often complement biodiversity conservation, but can cause damage; for example, by disturbing breeding birds or trampling sensitive plants.

What is being done

Getting multiple benefits from forests and woodlands requires sustainable forest management. Policies and legislation provide a foundation for successful sustainable forest management.

Policies

The Scottish Forestry Strategy sets out the Scottish Government's ambitions for the condition of woodlands and the services that those woodland will provide for society. Land-use decisions need to be balanced at local and national levels.

As recommended by the Woodland Expansion Advisory Group in 2012, the Scottish Government's woodland creation target is to create 100,000 hectares of new woodland over by 2022. This should be carried out to modern standards of good practice and provide multiple benefits.There will be a review, initiated no later than 2020, to set targets for after 2022. Around 40% of the total is expected to be native woodland.

Under the Scottish Government's Control of Woodland Removal Policy, loss of woodland should only be permitted if it results in significant public benefits. Planting in other areas to make up for any loss of woodland is often expected.

Development-planning policies also influence the location and character of woodland expansion through Forest and Woodland Strategies and encourage the development of green networks, notably the Central Scotland Green Network.

Planning policy and management plays an important part in directing development away from woodlands, especially those that are important for biodiversity.

Legislation and regulation

Woodland creation and forest management is regulated by Forestry Commission Scotland (FCS), mainly under the Forestry Act 1967 (revised) and The Environmental Impact Assessment (EIA) (Forestry) (Scotland) Regulations (1999).

Other environmental protection legislation that applies to woodlands includes the Wildlife and Countryside Act (1981, amended 1985), the Nature Conservation (Scotland) Act (2004), Wildlife and Natural Environment Act (2011), the Water Environment and Water Services (Scotland) Act 2003, and the Conservation Regulations (1994, amended in 2004, 2007 and 2011), which incorporate the European Union directives on habitats and species and on wild birds.

Sustainable forest management

FCS provides good-practice standards for managing woodlands and guidance for biodiversity in the UK Forestry Standard (UKFS) and associated guidelines.

Financial support to create and manage woodland is available under the Scotland Rural Development Programme (SRDP) . This includes grants for creating new woodlands that meet the requirements of the UKFS and grants for improving biodiversity, particularly in designated sites and for priority species and habitats.

Planning and managing woodlands is generally best considered over the long term and on a landscape or whole forest scale, within a regional context. Long-term forest plans are in place for all of the national forest estate, and are now required as a condition of grant aid for most management in private woodlands. These plans set out, for a period of at least 20 years, how the diversity of conifer forests will be increased as they mature. At the end of 2013 there were 215,426 ha of privately owned woodland with a long-term forest plan.

Increasing demand for public use of woodlands is being met by encouraging more planting and management of woods in and around towns. These woodlands are often in locations that present a particular opportunity to enhance wildlife habitat networks.

The NWSS provides a comprehensive basis for planning the management of native and ancient woods and developing native woodland habitat networks.

Planting new native woodlands has been a major part of woodland creation over the last 20 years to help meet the UKBAP targets.

Climate change

Measures and advice to help forest managers take action to adapt to climate change are included in the Scottish Government's Climate Change Adaptation Framework, and more detailed advice for the UK as a whole has been published by the Forestry Commission.

Deer

Collaboration between neighbours in the management of deer, which integrates the management of woodlands as well as the deer that live there, is encouraged. A Scottish code of practice for sustainable deer management gives advice on this. Regional deer management groups in the uplands and a new Lowland Deer Network Scotland are developing a more co-ordinated approach to deer management. Deer population levels on the national forest estate are managed so as to minimise negative impacts on biodiversity while sustaining deer as part of woodland ecosystems.

Invasive non-native species (INNS)

Under the Wildlife and Natural Environment (Scotland) Act 2011, SNH, FCS and SEPA have new powers and responsibilities to tackle problems caused by INNS. Grant support under SRDP is available to help land managers.

Nutrient enrichment and deposition of pollutants

As well as removing emissions at source, good river-basin planning and site management can reduce the effects of nitrogen enrichment on woodland biodiversity. Careful management of livestock grazing may also help. The UKFS guidelines on forests and water include measures to minimise the effects of acid rain.

Social use of woodlands: impacts on biodiversity

Most disturbance to wildlife can be minimised by careful planning and communication. FCS has published good practice guidance to help woodland managers manage recreation while minimising any impact on wildlife.

6 Climate

The world's climate is changing at an unprecedented rate.

Scotland has cool summers, mild winters and rainfall spread over the course of the year. There are regional differences in climate as well as differences between seasons.

State

Over the last century, Scotland's climate has become warmer, while changes in rainfall patterns have led to drier summers and wetter winters. We have also seen more frequent heavy rainfall events.

Since the late 1800s the world's atmosphere and oceans have warmed, amounts of snow and ice have diminished, the sea level has risen, and concentrations of greenhouse gases in the atmosphere have increased. Concentrations of carbon dioxide have increased by 40% since pre-industrial times, primarily from burning fossil fuels.

Challenges

The way we live is causing this rapid change in our climate. The industries and processes we rely on are the main source of greenhouse-gas emissions, which are causing an increase in the Earth's temperature, and consequent alterations in weather patterns.

Greenhouse gases already emitted into the atmosphere mean that further climate change is unavoidable, regardless of future emissions. However, we need to reduce our greenhouse-gas emissions to prevent even more climate change.

We also need to prepare for the climate change that we cannot avoid because of our previous emissions, which have set us on course for a changing climate.

Response

The Climate Change (Scotland) Act 2009 makes a commitment to cut greenhouse-gas emissions in Scotland by 80% of 1990 levels by 2050. The Act provides a framework for action in Scotland to mitigate emissions and adapt to a changing climate.

Reducing our emissions and adapting to a changing climate will require adjustments for everyone – our industries as well as ourselves. Some of these will need to be big; for example, changing the way our electricity is generated, whereas others will be small, such as being more careful in using energy in our homes or the decisions we make about transport.

Climate Topic

What is it?

Climate **-** Scotland generally has cool summers, mild winters and rain falls throughout the year. Over the last century it has become warmer, with drier summers, wetter winters and more frequent heavy rainfall.

6.1 Climate

Scotland has cool summers, mild winters and rainfall spread over the course of the year. There are regional differences in climate as well as differences between seasons.


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Summary

Key messages

- Scotland has a variable climate. We have cool summers, mild winters and rainfall spread throughout the year.
- Within the country, there are regional differences in climate as well as differences between seasons.
- Over the last century, our climate has become warmer, while altered precipitation patterns have led to drier summers, wetter winters and more frequent heavy rainfall.
- The world's climate is changing at an unprecedented rate. Since the late 1800s, the atmosphere and ocean have warmed, amounts of snow and ice have diminished, the sea level has risen, and concentrations of greenhouse gases in the atmosphere have increased.
- People are causing this rapid change in climate mainly due to greenhouse gas emissions.
- We need to reduce our greenhouse gas emissions to prevent further climate change.
- We also need to prepare for the climate change that we cannot avoid due to our previous emissions.
- The Climate Change (Scotland) Act 2009 makes a commitment to cut greenhouse gas emissions in Scotland by 80% of 1990 levels by 2050. The Act sets a framework for action in Scotland to reduce emissions as well as adapt to a changing climate.

State and trend

Scotland's climate is currently in a good state for people to live in; however, it is changing rapidly. Over the last 100 years it has become warmer, while altered precipitation patterns have led to drier summers, wetter winters and more frequent heavy rainfall. Changes in our climate over the next few decades are unavoidable because of the greenhouse gases already in the atmosphere. When viewed over long-term averages, we expect the UK to experience more milder wetter winters and more hotter drier summers in the future. These changes in climate and their effect on our weather will have major implications for our way of life.

Overview

Weather is the temperature, precipitation (rain, hail, sleet and snow) and wind we experience. It is short term and changes from hour to hour, and it can be localised in small areas. Climate is the average weather taken over a long period of time – typically 30 years. It is what we expect rather than what we actually get. So, while the weather brings different temperatures across the country every day, the long-term average maximum air temperature for Scotland between 1981 and 2010 was 10.7 °C, while the average minimum air temperature was 4.2 °C.

Scotland's climate

Scotland has a temperate maritime climate (temperate because it has moderate temperatures and maritime because of the influence of the sea). We generally have cool summers, mild winters and rainfall spread throughout the year. However, even within a small country there are regional differences as well as differences

between seasons. These are caused by a range of factors, including latitude, distance from the sea, prevailing winds, ocean currents and altitude.

A changing climate

We have been collecting weather data in Scotland since the 19th century; the first network was set up in 1855. Data show that Scotland's climate has changed rapidly during this time – it has got warmer (Figure 1), while altered precipitation patterns have led to drier summers, wetter winters and more frequent heavy rain.

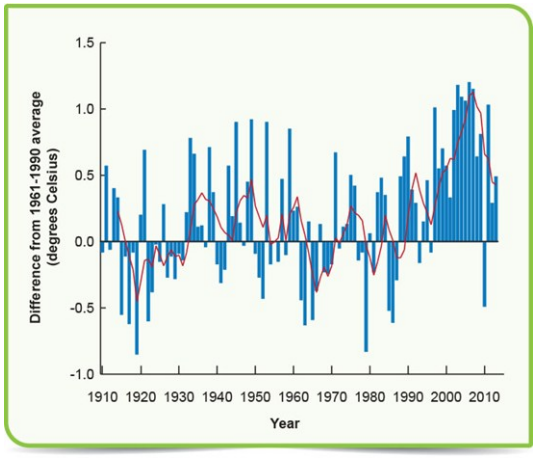

Figure 1: Average annual surface temperature in Scotland compared to the 1961–1990 average

Source: Scottish Government: High level summary of statistics trends - annual mean temperature

Global climate change

On a global scale, it has become more and more apparent that the world's climate is changing faster than ever before. The Intergovernmental Panel on Climate Change (IPCC) report Climate Change 2013: The Physical Science Basis confirms that since the late 19th century the atmosphere and ocean have warmed, amounts of snow and ice have diminished, the sea level has risen, and concentrations of greenhouse gases in the atmosphere have increased.

Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850 (Figure 2). Scientific evidence suggests that in the northern hemisphere, there is a likelihood of between 66 and 100% that 1983-2012 was the warmest 30-year period in the last 1,400 years.

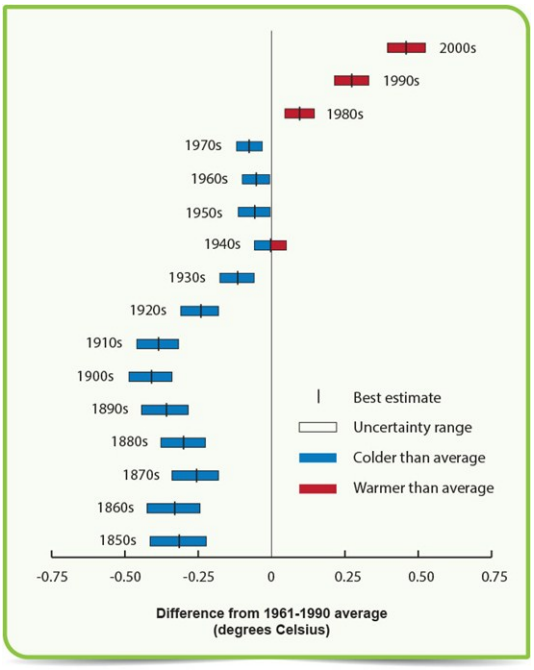

Figure 2: The difference between the average decadal temperature in Scotland and the average 1961-1990 temperature. British Crown Copyright 2014

Source: Met Office

On a global scale, 13 of the 14 warmest years since modern records began in 1850 occurred in the 21st century.

Causes of climate change

The main cause of climate change is increasing greenhouse gas concentrations in the atmosphere.

The Earth receives heat from the sun. About half of this energy is absorbed by the Earth's surface, some is absorbed by the atmosphere and some is reflected back into space. As the surface of the planet heats up, some of the heat is emitted back into the atmosphere and absorbed by greenhouse gases, which trap the heat and keep the Earth warm. This is a natural process and known as the greenhouse effect (Figure 3).

However, if concentrations of greenhouse gases in the atmosphere increase, more heat is trapped and the Earth becomes even warmer. This is known as the enhanced greenhouse effect.

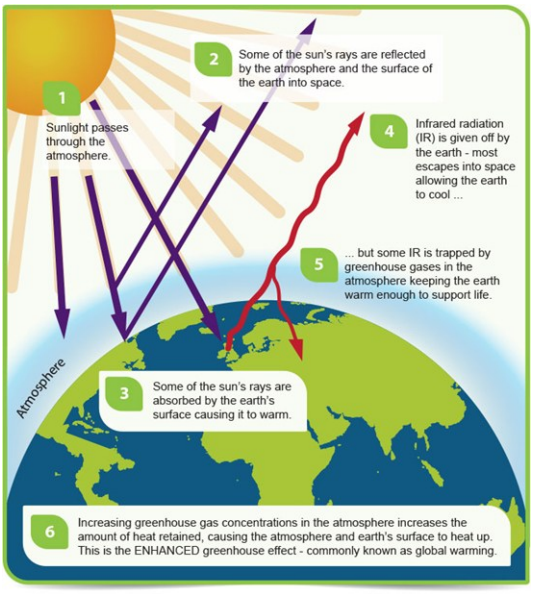

Figure 3: The greenhouse effect

The main greenhouse gases are: water vapour (H_2O); carbon dioxide (CO_2); nitrous oxide (N_2O); methane (CH_4) and ozone (O_3). These are formed as a result of natural and human activities. There are also a number of entirely human-made greenhouse gases in the atmosphere, such as sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

These gases accumulate in the atmosphere. Significant increases in concentrations of CO_2, CH_4 and N_2O occurred in the industrial era (Figure 4). All of these increases have been caused by human activities. The global increases in CO_2 concentration are due primarily to using fossil fuels and changes in land use, while those of CH_4 and N_2O are mainly due to agriculture.

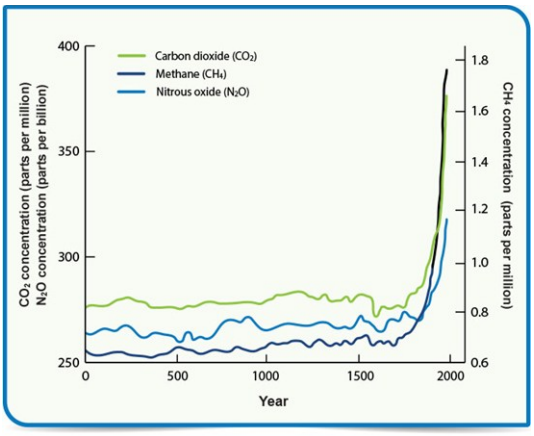

Figure 4: Atmospheric concentrations of important greenhouse gases over the last 2,000 years. Increases since about 1750 are due to human activities in the industrial era

Source: IPCC

The IPCC reports that scientific evidence now shows with at least 95% certainty that human activity is the main cause of global warming since the mid-20th century.

While the recent rapid change in climate can be attributed to human activities, the climate has also changed throughout geological time, well before people were around. This is known as natural climate variability and is due to a number of factors, including:

- changes in solar activity;
- changes in the Earth's orbit;
- volcanic eruptions;
- aerosols;
- El Niño and La Niña.

The difference between weather and climate, what drives our climate and how our climate is changing is summarised on the Met Office website.

Environmental state and trends

State

Scotland generally has cool summers, mild winters and rainfall spread throughout the year. However, there are regional differences as well as differences between seasons.

- The south is generally warmer than the north in summer, mainly due to the influence of latitude.
- The west is generally milder, cloudier and wetter than the east due to the prevailing winds from the south-west and the influence of the North Atlantic Drift. The east is also sheltered by the mountain ranges in the west, which create a rain-shadow effect.
- The west also has a lower range of temperatures than the east because of the moderating influence of the Atlantic Ocean.
- The north and west Highlands usually have lower temperatures throughout the year than the low-lying areas in the south and east because of the influence of altitude.
- The west has more rain in winter, when Atlantic depressions are more frequent.

Scotland can be separated into three climatic zones – north, east and west. Regional climate summaries for northern, eastern and western Scotland are available on the Met Office website. More detail on regional climate statistics can also be found on the Met Office website.

Trends

Scotland's Climate Trends Handbook is published on this website. The handbook describes the changes in weather patterns experienced in Scotland over the last century. The following text summarises the recent climate trends over the period 1961-2011 (unless stated otherwise).

Temperature

Across Scotland the mean annual temperature has increased by 1.3 °C, with the biggest seasonal change found in spring which has warmed by 1.5 °C on average. The mean temperature has also increased for all seasons in all regions by at least 1 °C.

The maximum temperature has increased for all seasons in all regions. The increases have been slightly greater than those observed in mean annual temperatures.

The minimum temperature has also increased for all seasons in all regions. The increases have been slightly less than those observed in mean annual temperature, with the length of cold spells reduced by almost eight days across Scotland (from 1961-2003). However, two exceptionally cold winters (2009/2010 and 2010/2011) have occurred in recent years – the winter of 2010/2011 was the second coldest since that of 1985/1986.

Frost

All regions have seen a decline in the number of days a year on which there is air or ground frost, with a reduction of 21 days of air frost and 29 days of ground frost for Scotland. However, in 2010 the UK experienced the coldest December for over 100 years. Although changes in the total number of air frost days are largest in winter, it is spring and autumn that have seen the largest changes as a percentage and that show a significant downward trend.

Sunshine

Since 1961 there has been a clear increase in sunshine hours for all regions of Scotland in the spring. There has also been an increase in sunshine hours in autumn, but summer and winter have seen little change.

Rainfall

Although there has been an overall increase in rainfall (27%), it varies among seasons and regions. These variations are more marked in winter, with a 24% increase in total rainfall in the east and an increase of 45% and 51% in the west and north respectively. In the west and north, the number of days of heavy rain in a year has increased by 12 and seven days respectively, while an increase of five days is found in the east.

Snow cover

All regions have seen a decline in snow cover from 1971-2011, however autumn is the only season for which there is a clear trend. In recent winters there has been an increase in the number of days of snow cover, following a period of winters with relatively little snow.

Wind

There has been a decreasing trend in average wind speed for all regions of Scotland, with the largest decreases found in the north and west. However, we have low confidence in these results because of uncertainties relating to their measurement.

The future – climate change projections

Our future climate depends on many factors, mainly the concentration of greenhouse gases in the atmosphere. Future greenhouse gas emissions (and, thus, the future climate) will depend on complex interactions between population change, economic development and technological advances as well as the willingness of countries to reduce their greenhouse gas emissions. The IPCC has considered a series of possible future emissions and modelled the potential effects on the global climate. They estimate that global average surface warming is likely to be between 0.3 °C and 4.8 °C by the year 2100. Even if we had stopped emitting greenhouse gases completely in 2000, we would still expect to see an increase in temperature by 2100 because of the amount of CO_2 already in the atmosphere.

The UK Climate Change Projections (UKCP09) provide the latest indications of the likely trends for Scotland's climate throughout the rest of the 21st century (Figure 5). It is based on scientists' best current understanding of how the climate system works and how it may change in the future.

The key climate change trends expected for Scotland are:

- hotter, drier summers;
- milder, wetter autumns and winters.

We can also expect to see:

- an increase in summer heatwaves, extreme temperatures and drought;
- increased frequency and intensity of extreme rainfall;
- reduced frost and snowfall;
- rising sea levels.

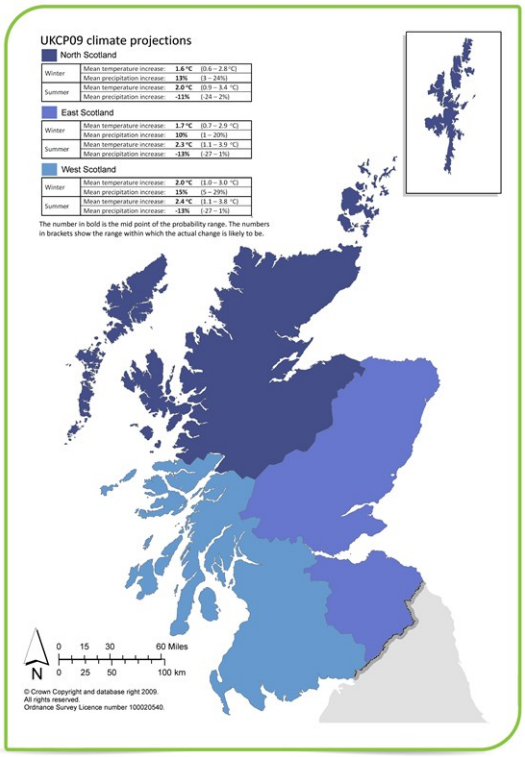

Figure 5: UKCP09 projections for mean temperature and precipitation for winter and summer for different regions of Scotland in the 2050s based on a medium amount of emissions

Source: Adaptation Scotland, Adapting to Climate Change

Pressures

Our climate is affected by a range of global pressures. Some of these pressures are natural, such as the emission of particles and gases from volcanoes or related to the amount of energy coming from the sun or the orbit of the Earth. However, the overriding pressure on our climate is global warming caused by the increase in greenhouse gas concentrations in the atmosphere.

Greenhouse gas emissions

Everyday activities such as our travel choices, heating our homes and how we dispose of our rubbish all lead to greenhouse gases being produced.

In 2012 net emissions of the six main greenhouse gases created by human activities in Scotland were estimated to be 52.9 million tonnes of carbon dioxide equivalent (million tonnes CO_2 eq). The sources and amounts of greenhouse gases emitted in 2012 are shown in Table 1. You can find more information in the Scottish Greenhouse Gas Emissions 2012 report.

Table 1: Scottish greenhouse gas emissions, 2012

Source of greenhouse gas emissions	Greenhouse gas emissions in 2012 (million tonnes CO_2 eq)	Share of 2012 emissions (%)
Energy supply	17.13	32
Domestic transport	10.54	20
International aviation and shipping	2.36	5
Business and industrial process	8.53	16
Residential	7.28	14
Public sector	1.37	3
Waste management	2.77	5
Development	1.68	3
Agriculture and related land use	11.17	21
Forestry	-9.92	-19
Total	**52.9**	**100**

Net Scottish greenhouse gas emissions have fallen by 29.9% since 1990, although there was a 0.8% increase in net emissions between 2011 and 2012. The decline and closure of heavy industries like steel-making in Scotland have led to some of the largest decreases. More efficient energy generation, storing more carbon in soils and trees, and a decline in methane emissions from landfill sites have also contributed to the reduction in emissions.

Scotland's soils contain large amounts of organic matter. Approximately 3,200 million tonnes of carbon is stored within the organic matter in soils. This is equivalent to nearly 230 times our annual greenhouse gas emissions. To put it into perspective, if we lost 0.5% of the carbon contained in Scotland's soil in a year, it would be enough to double our annual greenhouse gas emissions. Therefore, it is vitally important to manage soils carefully to ensure the carbon stays in the soils and does not escape into the atmosphere as greenhouse gases.

Scotland currently produces a small proportion – about one-thousandth – of global greenhouse gas emissions. However, on average, each person in Scotland emits around 10 tonnes CO_2eq each year, which is around one-third more than the average for each person on the planet. So we are responsible for more than our fair share of global emissions. We also import products from abroad, so our influence on greenhouse gas emissions is greater than just those emitted in Scotland. Greenhouse gas concentrations in the atmosphere are a global problem, and the pressures caused by climate change result from activities on a global scale.

Impacts of climate change

Scotland's climate is changing, and the effects are already being felt by people and the environment. Our climate will continue to change in years to come and the effects are likely to become more obvious and widespread. The potential impacts of climate change are outlined in A climate change risk assessment for Scotland.

Impacts on people

The most obvious impacts on people are likely to be caused by more flooding and landslides caused by more frequent extreme weather events and rising sea levels. These will disrupt road and rail links and damage buildings. However, there may be less disruption to transport links due to a reduced occurrence of snow and ice.

Rising sea levels are likely to change the geography of the coast and increase the risk of flooding for low-lying properties. Many sites of historical importance are located on or near the coast, and these will also be in danger of flooding.

There is a significant risk of an increase in mental health problems as a result of more flooding.

Milder, wetter winters may result in houses becoming damper, increasing the growth of algae and fungi, with knock-on effects for health.

There is likely to be less demand for energy in winter for heating and more demand in summer for cooling.

Impacts on the environment

Changing temperature and rainfall patterns are likely to result in changes in river flows and soil moisture as well as an increase in wildfires. These can all result in loss of habitats and the wildlife they support. This may mean the loss of some rare native species, such as capercaillie, as their habitat disappears. However, new habitats may form and new species may become established as the Scottish climate becomes more favourable for them.

Some pests and diseases may become more prevalent as they survive through warmer winters. New pests and diseases may also emerge.

Higher temperatures and more droughts may mean that some of Scotland's blanket bogs may begin to dry out, resulting not only in a loss of internationally rare habitat and species, but also a loss of carbon stored in the peat, which may contribute to further climate change.

Rising sea levels and increased coastal erosion and flooding may damage rare Scottish coastal habitats, such as machair.

Warmer temperatures may lead to a longer growing season for some crops and trees, but higher rainfall may make it more difficult to cultivate the land. Some crops and trees will grow better, whereas others will fail. It may be possible to grow different crops. However, this may be tempered by a reduction in water supply in summer.

You can find more details on the impacts of climate change on the environment in the relevant topics on Scotland's Environment website.

What is being done

Once greenhouse gases enter the atmosphere, their effect will be felt over decades to come. Therefore, we need to reduce (mitigate) our greenhouse gas emissions to prevent additional climate change. We also need to prepare for the climate change that we cannot avoid (adapt) because our emissions have already set us on course for a changing climate.

Climate change is a global issue and greenhouse gas emissions affect the whole planet, regardless of where they come from. Tackling climate change requires co-ordinated action by nations around the world. The United Nations Framework Convention on Climate Change (UNFCCC) came into effect in 1994 with the aim of stabilsing greenhouse gas concentrations in the atmosphere at a level that would prevent "dangerous" human interference with the climate system. Today the Convention has been ratified by 195 countries.

The Kyoto Protocol was adopted in 1997 and came into effect in 2005. It commits industrialised countries to stabilise greenhouse gas emissions based on the principles of the Convention.

As a contribution to global efforts to to stabilise greenhouse gas concentrations in the atmosphere, the Climate Change (Scotland) Act 2009 has made a commitment that greenhouse gas emissions in Scotland will be cut

by 80% of 1990 levels by 2050, with an interim target of a 42% cut by 2020. The Act sets a framework for action in Scotland to mitigate emissions and adapt to a changing climate.

Mitigation

Reducing our emissions by 80% by 2050 will require changes for everyone – our industries as well as ourselves. Some of those changes will need to be big; for example, changing the way our electricity is generated, whereas others will be small, such as being more careful in using energy in our homes or the decisions we make about transport. The Committee on Climate Change published their third report on Scotland's progress towards meeting emission reduction targets in March 2014.

The Scottish Government has published its second report on proposals and policies. This outlines how Scotland can meet its greenhouse gas emission reduction targets for the period 2013–2027. These include:

- expanding our renewable energy production;
- improving energy and resource efficiency in households and industry;
- reducing carbon emissions from transport;
- expanding renewable sources of heat;
- sustainable land use.

Adaptation

Although we can start to reduce emissions, their effects will continue to change Scotland's climate for many decades to come, so we need to adapt the way we live.

We need to plan for the negative consequences to come, as well as the new opportunities change may bring. To do this, Scotland's Climate Change Adaptation Framework was published in 2009, and a series of sector action plans were developed, as many adaptation decisions are taken at a local level by individual organisations.

Adaptation Scotland is an information and advice service, funded by the Scottish Government, to raise awareness of changes in climate. It helps organisations and communities in Scotland prepare for, and increase their resilience to, the impacts of climate change.

The UK Climate Change Risk Assessment (CCRA), published in 2012, was the first assessment of current and predicted impacts of climate change for the UK. The CCRA consists of a number of reports, including a Climate Change Risk Assessment for Scotland. A summary of the assessment for Scotland is also available. These bring together evidence and analysis to help improve our understanding of the threats and opportunities of a changing climate.

A new Scottish Climate Change Adaptation Programme is being developed, which will address the risks identified for Scotland in the CCRA.

7 People and the environment

This section covers the interactions between people and the environment – the impacts we have on the environment, and how the environment affects us.

Our environment provides a wide range of benefits, such as the air we breathe, the food we eat and the water we drink, as well as the many materials needed in our homes, at work and for leisure. A lot of what comes from the environment, and its chemical, physical and biological components, is taken for granted. For example, nature can prevent flooding by storing water, it can keep our environment clean by processing pollutants, and it can provide enjoyment, inspiration and a place to socialise. The environment is often managed to extract or create products that can be sold – sometimes at the expense of other benefits that are equally important.

Our cities and towns, historic surroundings, recreation opportunities and many aspects of our health and well-being are shaped by the environment.

State

Almost 70% of Scotland's people live in urban areas. The majority of these people rate their neighbourhood as a "very good" place to live. However, health inequalities in Scotland are stark, and improving the quality of the environment will help to reduce these inequalities.

Taking part in outdoor recreation is of great benefit to our health and well-being. As well as providing opportunities for outdoor activities and generating income, Scotland's unique environment makes a valuable contribution to our quality of life, cultural identity and education.

Progress is being made to reduce waste and increase recycling in Scotland; the amount of waste produced has reduced by 40% since 2005 (mainly due to reductions in the amount of industrial and commercial waste), recycling of household waste has doubled since 2004.

However, we still send a lot of waste to landfill and we need to further reduce the amount of waste we create if we are to protect the environment and conserve our valuable resources.

Challenges

The overarching challenge is to achieve a sustainable balance between short-term needs and maintaining or enhancing the quality of our environment for future generations.

Response

Managing the environment in ways that provide desired benefits can sometimes reduce its ability to provide others, but by managing the environment well we can greatly improve our quality of life.

People and the environment Topic

Benefits and uses

Benefits from the environment – We all depend on a wide range of essential benefits provided by the environment for our day to day existence, including the air we breathe, the food we eat and the water we drink. By managing the environment well we can greatly improve our quality of life.

Cities towns and greenspace - Most people in Scotland live in its towns, cities and city regions. A good-quality urban environment is a substantial factor in people's health and well-being.

Historic environment - Scotland's historic environment includes thousands of historic buildings and monuments, many of which are unique and irreplaceable. They attract millions of visitors every year and generate income and jobs.

Recreation - Scotland's natural and historic environment provides many opportunities for outdoor activity and attracts millions of visitors a year, generating £2.6 billion of expenditure.

Environmental management

Energy - Energy in Scotland is changing and will continue to do so as we strive towards a low carbon future.

Land use strategy - Scotland's land provides us with a wealth of benefits, such as food, timber, clean water, energy, and a space for recreation. However, we still demand more. The Land Use Strategy addresses how we can sustainably manage our land to ensure we get the most from it.

Waste - Waste is produced by households and businesses. Progress is being made to reduce waste and increase recycling in Scotland, providing environmental and economic benefits.

7.1 Benefits from the environment

We all depend on a wide range of essential benefits provided by the environment for our day to day existence, including the air we breathe, the food we eat and the water we drink. By managing the environment well we can greatly improve our quality of life.

Summary

Key messages

- We all depend on many benefits from the environment and nature, which affect every aspect of our existence.
- Decisions about managing our environment often fail to take account of nature's ability to provide these benefits.
- Managing the environment in ways that provide some benefits can sometimes reduce its ability to provide others.
- By managing the environment well we can provide many more benefits and greatly improve our quality of life.

State and trend

A summarised assessment of the state and trend has not been made for this topic.

Please read the topic for more information; if you have any questions about Scotland's benefits from the environment please feel free to contact us via the contact us facility on the website.

Overview

Our environment provides a wide range of benefits, such as the air we breathe, the food we eat and the water we drink, as well as the many materials needed in our homes, at work and for leisure activities. But a lot of what comes from the environment, and its chemical, physical and biological components, is taken for granted. For example, nature can prevent flooding by storing water, keep our water clean by processing and diluting pollutants, and provide enjoyment, inspiration and a place to socialise. The environment is often managed to extract or create products that can be sold, but this can be at the expense of other benefits that are equally important.

Work is underway across Europe to improve our knowledge about the ways that our environment provides benefits, for if we, and nature, are to keep healthy we need the environment to function well. Pollution, intensive land use and over-exploitation of key minerals, for instance, can all stifle systems that support life and reduce or destroy the benefits.

Economically, we get huge gains from the environment, and recent research has highlighted this in Scotland. You can find links to up-to-date information about this on the Scottish Natural Heritage website, along with information on Scotland's Natural Capital Asset Index.

What do we get from the environment?

The benefits provided by the environment are known as 'ecosystem services'. These are not as drab as they sound! One way to categorise the huge amount that the environment does for us is to think of this in terms of the 'services' it provides, as shown in the diagram below.

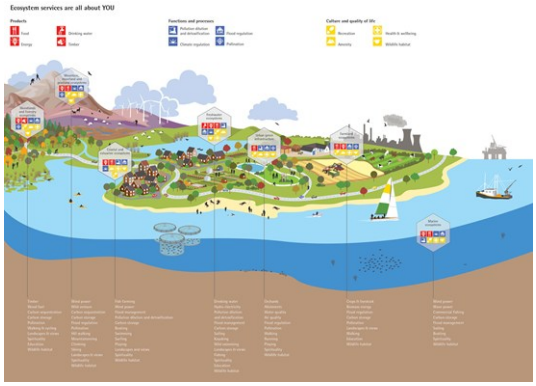

Figure 1: Ecosystem services and human well-being

Supporting – underpinning the benefits

To support life, our environment depends on clean air, land, soil and water. We need to manage our influences over these resources and protect them so the environment can continue to provide the benefits we rely on, now and in the future.

Our environment supports all life forms. Rocks, soils, minerals, air, water, microbes, fungi, plants and animals work together to support life and its ability to provide all the other benefits – provisioning, regulating and cultural. The capacity of the environment to support all of this depends on trillions of physical, chemical and biological interactions. Our understanding of these is just beginning to unravel how sensitive some systems are, and how resilient others can be.

Provisioning – food, drink and fuel

Most of our food, water and fuel comes directly or indirectly from the environment. Fuel for warmth, timber for building, and the fuel in our cars all come from nature. The natural environment provides income from tourism, and resources for development. In the past our environment has often been over exploited to provide products which mean its ability to provide the full range of benefits is jeopardised. Wise and sustainable use of our environment allows us to replace and replenish resources, rather than losing them forever.

Regulating – keeping things in check

The environment is amazingly well able to keep itself in check. Regulating services are vital for healthy ecosystems and are largely taken for granted. Our air, water and food have been through a huge range of physical, chemical and biological interactions that are naturally regulated. The dispersal and dilution of pollutants, steady supply of clean water, protection of our coast, prevention of flooding, regulation of our climate through locking away of carbon, and pollination of crops are all governed by 'regulators' in the environment – often the combined work of chemicals, microbes and insects.

How we make use of these services is often controlled, as excessive use of one service (for example, discharging sewage into rivers to dilution and process it) can reduce the environment's ability to provide others. The way we manage our environment can prevent regulatory services being lost. For example, reducing flooding by restoring wetlands on farmland, which can reduce the speed at which water runs off the land.

Culture and quality of life

We get massive benefits to our health, well-being and quality of life from the environment. These include recreation, inspiration, spirituality and learning. Watching wild birds, mountaineering in a beautiful landscape or visiting a special historic building are all 'cultural' benefits of the environment. The colour and texture of the rocks making up a castle can tell us as much about the origins of the earth and its geology as it does about the

history of the people who built it. We do not even have to visit these places to benefit from them; people value the mere existence of some habitats and wildlife, often in remote mountains, without ever going there. Just the thought of Scottish wildcats, golden eagles or capercaillie living in the wild can be enough to make people feel happy.

An enormous range of places offer us pleasure and enjoyment, including green spaces in towns and cities, rivers, lochs, seashores, farmland, forests and remote wildland. Many important areas are protected by law, but not all areas that are valued for their cultural benefits can be deliberately protected.

7.2 Cities, towns and greenspace

Most people in Scotland live in its towns, cities and city regions. A good-quality urban environment is a substantial factor in people's health and well-being.

Summary

Key messages

- Almost 70% of Scotland's people live in urban areas, and these areas account for just 2% of Scotland's land surface.
- Scotland's urban areas are the focus of economic and social activity.
- Our urban areas are significant: they take up resources, such as land, air and water; are the source of greenhouse gases and other emissions; and supply and consume goods and services, food, energy, heat and waste.
- The majority of people who live in urban areas rate their neighbourhood as a 'very good' place to live.
- Greenspace is a highly valued part of the urban environment.
- Development pressure within urban areas can threaten existing greenspace and the multiple benefits it provides.
- Although air quality in Scotland is generally very good, some parts of our urban areas have poorer air quality, mainly due to transport emissions.
- Contaminated land is mainly a result of industrial activity in the past, and is concentrated in and around urban areas.
- There is a strong legislative framework to deal with pollution of land, air and water.

State and trend

State: Moderate - high agreement, medium evidence

Trend: Stable/improving - high agreement, low evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- The state of our cities, towns and greenspaces has been assessed as being on the good side of moderate. Some urban areas are in a good state while others are in a poor state – the overall assessment is therefore a simplification, being an "average" of all the different parts.
- We have taken account of the scale of any damage to the urban environment in these assessments; impacts of some types of pollution in urban areas can be locally damaging (e.g. air pollution hotspots caused by traffic congestion), but may have little effect on the town or city as a whole.
- Some areas are improving more quickly than others. The overall trend is therefore assessed as stable / improving.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

The urban environment

We experience our environment most immediately in the neighbourhoods we live in. As most people in Scotland live in towns and cities – our urban areas – this topic looks specifically at the urban environment.

Scotland's settlements stem from the pattern of burgh settlement, which began in the 12th century. This was radically modified by industrialisation and the depopulation of rural areas in the 18th and 19th centuries, leading to poor living conditions in overcrowded major industrial centres such as Glasgow and Dundee. After the Second World War, many city slum areas were cleared and residents were moved to new housing estates on the outskirts; for example, Easterhouse and Castlemilk. New towns, like East Kilbride, were also built to deal with the housing shortages and create new centres of economic activity. This urban renewal led to significant improvements in living conditions for many people, providing more space, better sanitation and more access to greenspace.

Today almost 70% of Scotland's people live in urban areas (settlements of more than 10,000 people). These include the four key city regions, three smaller cities and a range of large and medium-sized towns. Most of the population and industry is concentrated in a small, highly urbanised area in the Central Belt and on the East Coast, which covers just 2% of Scotland's land area.

Table 1: Classification of urban and rural areas.

Category	Description	Area of Scotland covered by category (%)	Population living in this category (%)	Examples
Large urban areas	Population greater than 125,000	0.9	39.1	Aberdeen, Dundee, Edinburgh, Glasgow
Other urban areas	Population between 10,000 and 125,000	1.0	30.4	Ayr, Inverness, Perth, Stirling
Accessible small towns	Population between 3,000 and 10,000. Within a 30-minute drive of a settlement with a population of 10,000 or more	0.4	8.7	Cumnock, Lanark, Selkirk, West Calder
Remote small towns	Population between 3,000 and 10,000. Outside of a 30-minute drive from a settlement with a population of 10,000 or more	0.2	3.7	Huntly, Kelso, Lerwick, Oban

Source: Scottish Government 2011–2012 Urban Rural Classification. A map showing the different areas is available here.

Drivers of the economy

Scotland's towns and cities are the centres of economic and social activity. Cities drive Scotland's economy, and the wider city regions and town centres of Scotland support economic growth. These urban areas have

the highest concentrations of population, commerce and industry; therefore, they use the most heat and energy, are the source of most of our waste and are a major source of traffic.

Greenspace

Greenspace, such as private gardens, parks, woodlands and playing fields, are the 'green lungs' of our towns and cities. Greenspace can help mitigate the environmental impacts of greenhouse gases and other emissions within our towns and cities. Oxygen levels can be much lower in cities than in the countryside; vegetation absorbs CO_2, produces oxygen, filters out particles from the air and reduces air pollution.

Urban areas, and particularly the green spaces within them, can be a home to nature and wildlife. They contain a wide range of habitats, some of which are unique, such as 'open mosaic habitat on previously developed land'. This refers to brownfield sites that support a range of habitats, including bare ground, which is important for warmth-loving invertebrates and basking reptiles. Soils on these sites tend to be low in nutrients, supporting plants that thrive in these conditions but would be out-competed in more nutrient-rich soil. At least 194 invertebrate species of conservation importance have been recorded in brownfield sites in the UK, including 50% of rare solitary bees and wasps, and 35% of rare ground beetles.

Greenspace can also reduce the risk of flooding in urban areas because it allows water to filter through the soil and slowly drain away, rather than flowing quickly over hard surfaces. Vegetation can also mitigate the 'urban heat island' effect, where the air temperature in cities reaches higher levels than in the surrounding countryside.

Greenspace is important for health: it provides space for outdoor activities in urban areas, a chance to connect with nature and a place for socialising. Greenspace Scotland's research reports on the links between greenspace and quality of life and the links between greenspace and health found that greenspace has a positive effect on physical and mental health; this includes reducing stress, improving some behavioural or emotional problems in children, and improving the ability to cope with problems.

State

Liveability

The Scottish Household Survey found that in 2011 more than half (55.9%) of adults in Scotland rated their neighbourhood as a 'very good' place to live. This varied with the type of neighbourhood: in large urban areas, 50% of adults said their neighbourhood was 'very good'. When asked about the things they like about their neighbourhood, people said that a sense of community is the most important factor, and a safe and pleasant environment was the second most important. The most prevalent problems are animal nuisance, such as noise or dog fouling, and litter. The 2009 Scottish Social Attitudes Survey found that people in urban areas with populations of more than 10,000 commonly reported the need to improve the quality of places for children to play.

Distribution and use of greenspace

The 2012 State of Scotland's Greenspace report found that the total area of greenspace in urban Scotland is 109,000 hectares. This is equivalent to one tennis court per person. Table 2 shows the different types of greenspace.

Table 2: Types of greenspace.

Type	Description
Public parks and gardens	Areas of land normally enclosed, designed, constructed, managed and maintained as a public park or garden. These may be owned or managed by community groups
Private gardens or grounds	Areas of land normally enclosed, associated with a house or institution and reserved for private use
Amenity greenspace	Landscaped areas designed to improve the appearance of an area or separating different buildings or land uses for environmental, visual or safety reasons. Used for a variety of informal and social activities, such as sunbathing, picnics and kickabouts
Playspace for children and teenagers	Areas providing safe and accessible opportunities for children's play usually linked to housing areas
Sports areas	Large and generally flat areas of grassland or specially designed surfaces, used primarily for designated sports, and generally needing to be booked. Examples include playing fields, golf courses, tennis courts and bowling greens
Green corridors	Routes including canals, river corridors and old railway lines, which link different areas of a town or city as part of a designated and managed network, or link towns and cities to their surrounding countryside or country parks. These may link green spaces together. Used for walking, cycling and horse-riding
Natural/semi-natural greenspaces	Areas of undeveloped or previously developed land which still retain their original (natural) habitats, or which have been planted or colonised by vegetation and wildlife, including woodland and wetland areas
Allotments and community growing spaces	Areas of land for growing fruit, vegetables and other plants, either in individual allotments or as a community activity
Civic spaces	Squares, streets and waterfront promenades, predominantly paved, that provide an area for pedestrian activity and can make connections for people and for wildlife
Burial grounds	Includes churchyards and cemeteries
Other functional greenspace	This depends on local circumstances or priorities

Source: Scottish Government: Planning Advice Note 65; Planning and Open Space

Figure 1 shows the proportion of each of greenspace found in Scotland.

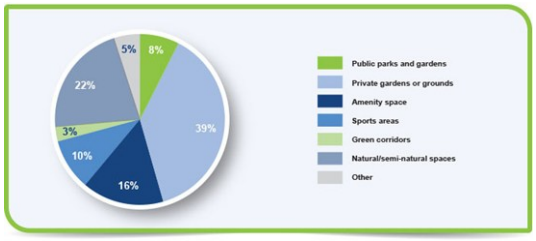

Figure 1: Proportion of different types of greenspace in Scotland

Greenspace Scotland with support from Scottish Government, Scottish Natural Heritage and Forestry Commission Scotland has also produced Scotland's Greenspace Map, which shows the distribution and type of greenspace in Scotland.

About half of the urban population uses public local greenspace. Forty nine per cent of people used local greenspace at least once a week in 2004, 63% in 2009 and 54% in 2011, according to Greenspace Scotland's greenspace use and attitude survey. The survey also shows a reduction in the percentage of people who felt that their local greenspace was a good place for play, physical activity and relaxation.

Over half (56%) of adults in Scotland have access to useable greenspace within a five-minute walk from their home (not including their own garden), according to the Scottish Household Survey. To a large extent, how often people use their nearest greenspace depends on how far away it is. Just under half (44%) of people who live less than a five-minute walk away visit every day or several times a week. When the nearest useable greenspace is more than 10 minutes away, this figure drops to 11%.

Air

Poor air quality can harm people's health and reduce their quality of life as well as damaging the environment. To date, 32 areas across Scotland have been designated as Air Quality Management Areas, due to breaching air-pollution limits. These areas range in size from city centres (such as Glasgow) to individual street junctions. The majority of them relate to transport emissions and are therefore close to or either side of busy roads. Green infrastructure, (the network of green spaces, including trees and green corridors), is particularly important for reducing exposure to poor air pollution by dispersing the pollutant or by removing it from the air.

Water

Water pollution from urban areas can happen when water runs off roads and other sealed surfaces, such as car parks and industrial yards. Run-off from roads can contain many pollutants, such as toxic metals, oils and salt. Chemicals emitted from vehicle exhausts can also be deposited on roads and pavements. All of these substances are washed off into the drainage system and into watercourses, causing water pollution.

Land

Across Scotland, particularly in parts of the Central Belt, the closure of manufacturing industries (such as steel works) has left degraded landscapes, poor-quality environments and significant areas of vacant and derelict land, some of which is polluted by dangerous contaminants.

Vacant land is land that is not being used for the purposes it is held for and is viewed as an appropriate site for development. Derelict land (and buildings) is land that has been so damaged by development that it cannot be redeveloped until it has been improved. The Scottish Vacant and Derelict Land Survey 2013 identified 11,114 hectares of derelict and urban vacant land; 2,355 hectares (21%) were classified as urban vacant and 8,759 (79%) hectares were classified as derelict.

Land is defined as 'contaminated' if concentrations of contaminants could harm human health, ecosystems or water bodies. Approximately 67,000 sites covering an area of 82,000 hectares have previously been used in a way that could result in the land being affected by contaminants. This is approximately twice the area covered by Greater Glasgow and comprises 1% of land in Scotland. However, only a small proportion is likely to be so polluted that it is classed as contaminated.

It is difficult to identify trends relating to contaminated land or the severity of contamination, as methods of recording data have not been consistent across the country. More information can be found in Dealing with land contamination in Scotland.

Pressures

Population and demographic change

Economic activity, inward investment, population change and demographic change all influence the development of our towns and cities. Place-making – how buildings and places are made, the quality of their design and of the built environments they help to shape – has a direct bearing on the environmental quality of our neighbourhoods.

According to the 2011 Census, Scotland's population is estimated to be at its highest ever level – 5,295,400 people. The population is predicted to continue to grow as a result of higher birth rates, longer life expectancy and immigration. The number of households in Scotland increased by 8% between 2001 and 2011. Population projections suggest a net increase of over 200,000 households in Scotland by 2020.

The Scottish government has estimated that each year 20,000 homes will need to be built just to accommodate this growth in households. Meeting the housing needs of a growing population is likely to mean:

- more development of brownfield sites (areas that have been built on in the past, some of which support rich and diverse habitats);
- greater pressure for development on greenfield (previously undeveloped) sites, including agricultural land and urban greenspace, such as playing fields.

Pressure on urban air quality

Increased demand for new housing to meet population and demographic change will place more demands on our existing transport and other parts of the infrastructure, including water and drainage. Emissions and congestion resulting from increasing volumes of traffic in urban areas have a major effect on air quality and human health, and the extra traffic also increases noise pollution. Air pollutants being deposited on land can damage the wider environment.

Climate change

It is becoming more and more important to consider climate change when planning for future development. Extreme weather is becoming increasingly frequent, which brings fresh challenges when designing and developing housing and urban infrastructure.

One result of extreme weather is the likelihood of more flooding. Existing drainage systems may become ineffective because of potential rises in the water table. Increases in sea level and coastal erosion are likely to affect coastal settlements.

The gradual change towards hotter, drier summers and milder, wetter winters is likely to lead to new pests and the spread of insect infestations, which may threaten urban wildlife and urban food production.

What is being done

Plans for Scotland's towns and cities are continuing to meet the needs of a changing society and the economy – offering people choice and meeting local needs, but not at the expense of the environment.

Our planning system is helping to balance the environmental costs and the social and economic benefits of development over the longer term. Rather than allowing development at any cost, planning aims to make sure that the right developments are built in the right places.

Good planning can create places to live that give communities culture, a sense of pride and belonging, and a sense of local and national identity. It can provide urban environments that function well, link well with surrounding towns and villages, and are attractive to socialise and work in.

Development plans and green networks

The Third National Planning Framework (NPF3) aims to make Scotland a successful, sustainable, connected place that businesses want to invest in, where greenhouse gas emissions are low and the environment is resilient. These national priorities will influence development plans for different cities, towns and rural areas, which are prepared by local authorities and National Park Authorities.

The Scottish planning policy (SPP) sets out national planning policies that reflect Scottish Ministers' priorities for developing and using land. The SPP influences the preparation of development plans, design of developments, and decisions about planning applications and appeals. Under the SPP, the planning system should protect and improve green infrastructure (the network of green spaces), provide easy, safe access to it and make sure it is managed well, now and in the future.

The Central Scotland Green Network (CSGN), established by the second National Planning Framework (NPF2), builds on the work of the Glasgow and Clyde Valley Green Network Partnership, the Lothians and Fife Green Network Partnership and other stakeholders across Central Scotland. CSGN aims to provide a high-quality 'green network', linking greenspaces in and around settlements to improve people's lives, promote economic success, allow nature to flourish and help Scotland respond to the challenges of climate change.

Sustainable and healthy places

The Scottish Sustainable Communities Initiative (SSCI), established in 2008, encourages the creation of settlements offering a high quality of life to their residents, including opportunities to live healthier, more active and environmentally responsible lives. It recognises the importance of landscape, cultural identity and high-quality design.

The Scottish Government's policy statement on architecture and place, Creating Places, also recognises the importance of good design in creating good places to live, building vibrant communities and benefiting the economy.

The environment of Scotland's towns and cities affects the physical and mental health of the population. This has been recognised by the Scottish Government in Equally Well, and in Good Places, Better Health. As part of the implementation of Equally Well, Glasgow City Council and its partners involved local people in place-making as a way of reducing health inequalities, and a toolkit was developed to help others apply the same approach.

Another important guiding principle for creating sustainable places is to use the 'ecosystems approach' in planning and development. Scotland's Land Use Strategy sets out how public organisations can use this approach in decision-making in order to provide wider benefits.

Regeneration and sustainable development

Regeneration is the process of reversing the economic, physical and social decline of places where market forces on their own are not enough. The Achieving a Sustainable Future: Regeneration Strategy aims to work towards supporting our most disadvantaged communities and making sure all places are sustainable and promote well-being.

Scottish urban regeneration companies continue to carry out physical, economic and social regeneration in areas like the Clyde Gateway in Glasgow, Irvine Bay in North Ayrshire and Inverclyde.

The Scottish Government published a Town Centre Action Plan in November 2013 following a national review of town centres. This sets out a number of actions to revitalise town centres, including providing a demonstration town centre housing fund to bring empty town centre properties back into use.

Land left vacant due to development projects being put on hold may be temporarily used for greenspace; thus, providing environmental benefits. These 'stalled spaces' projects are bringing sites across Scotland back to life.

Bringing vacant and derelict land back into productive use for housing, for economic purposes and to create attractive environments is another way of dealing with development pressures in a sustainable way. Major land reclamation in former mining areas, and projects such as the Central Scotland Forest and the restoration of the Forth and Clyde and Union canals, have improved the environment and opened up new opportunities for economic development and leisure. To support local authorities to deal with long-term vacant and derelict land the Scottish Government provides funding through the Vacant and Derelict Land Fund.

In Scotland, public agencies must assess, consult upon and monitor the likely impacts of their plans, programmes and strategies on the environment. This process is known as strategic environmental assessment (SEA) and is essential in sustainable development, protecting the environment and extending opportunities for public participation in decision-making.

Adapting to climate change

Scotland's Climate Change Adaptation Framework sets out a national co-ordinated approach to adaptation to ensure that everyone in Scotland understands the risks and opportunities that climate change presents and to provide guidance on adaptation. This includes action plans for the built environment and for spatial planning and land use. The framework will soon be replaced by the Scottish Climate Change Adaptation Programme, which addresses the risks identified for Scotland in the UK Climate Change Risk Assessment. All public agencies in Scotland have to contribute to adapting to climate change. Without measures to avoid and manage flooding and other effects, climate change may cause irreversible damage to buildings, houses and related infrastructure.

Green infrastructure, such as areas of urban green space, can help us adapt to climate change. For example, trees can provide shade and can slow the rate at which rainfall reaches the ground; ponds and wetlands can store water, reducing the risk of flooding elsewhere; and green networks can provide linked habitats, which allow plants and animals to migrate to more suitable areas as the climate changes.

Dealing with urban pollution and flooding

Sustainable Drainage Systems (SUDS) can be built to prevent water contamination and flooding caused by rainfall running off roads, car parks and other hard surfaces into rivers.

Permeable surfaces can also be used to reduce run-off from paved areas. This reduces the amount of pollutants entering watercourses, and allows some pollutants to be broken down. Blocks in permeable pavement systems are not sealed into the ground, but rest on a bed of coarse sand. This allows water falling onto the pavement to trickle down between the blocks and soak away into the ground. Alternatively, the water can be stored in underground tanks and used on site. Porous asphalt has also been developed.

The Dunfermline Eastern Expansion (DEX) site is a major development area in Fife that has become a demonstration site for the implementation of SUDS in Scotland.

Much of the pollution from industrial areas could be reduced by preventing contaminants from getting into the environment. Such measures include keeping oil in sealed containers, making sure that clean and dirty water is kept separate and disposing of chemicals in the correct manner.

7.3 Historic Environment

Scotland's historic environment includes thousands of historic buildings and monuments, many of which are unique and irreplaceable. They attract millions of visitors every year and generate income and jobs.

Summary

Key messages

- Scotland's historic environment includes thousands of historic buildings and monuments, attracts millions of visitors each year and generates income and jobs.
- Although there are good data to describe some of the individual parts of the historic environment, the lack of consistent data means that it is difficult to assess the current and changing state of the historic environment as a whole.
- The main pressures are development, lack of maintenance and investment, inappropriate land use, climate change and visitors.
- Scotland's historic environment makes a valuable contribution to our quality of life, cultural identity, education and economy.
- Our historic environment is irreplaceable and we should protect it for future generations.

State and trend

State: Moderate - medium agreement, medium evidence

Trend: Stable - high agreement, medium evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- Assessments are of the current “average condition”; some aspects of the historic environment are in a worse condition, and others are in a better one. Equally, the condition of some aspects is declining, while others are improving.
- Making any overall assessment is necessarily a simplification.
- We have taken account of the scale of any damage to the historic environment in these assessments; impacts can be locally damaging, but may have little effect on a national scale.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.
- This topic considers marine heritage, archaeology and the wider historic environment. It is difficult to integrate these three disparate strands into an overall assessment.

Overview

Scotland’s historic environment is made up of the physical evidence of past human activity as well as associated concepts that we cannot see or touch, such as stories and traditions. It includes archaeological sites and monuments, buildings, gardens and landscapes, artefacts and archives. The historic environment enriches Scotland's landscapes and townscapes, and is central to the country's distinctive character. It makes a major contribution to Scotland's national identity, culture and economy.

Importance of the historic landscape

Our whole environment – rural and urban, on land and under water – has a history that contributes to its quality and character. It has been shaped by human and natural processes over thousands of years. This is most obvious in our built heritage: ancient monuments; archaeological sites and landscapes; historic buildings; townscapes; parks; gardens and designed landscapes; and in our marine heritage; for example, in the form of historic shipwrecks or underwater landscapes that were once on dry land.

The historic environment is estimated to contribute more than £2.3 billion (2.6%) of Scotland's national gross value added (GVA), which is the contribution to the economy of each individual producer, industry or sector in Scotland. The historic environment also accounts for 2.5% of Scotland's total employment, directly supporting 41,000 full-time-equivalent employees. It is a magnet for tourism and inward investment – attracting around 14 million visitors each year – and it promotes a positive image of Scotland, at home and abroad, creating a sense of place and a unique cultural identity.

Heritage-led development benefits communities and the economy, bringing about regeneration of the built environment and work for the construction industry. The historic environment also provides many opportunities for volunteering across Scotland and contributes to education and training programmes in schools and colleges, as well as developing traditional skills within the construction workforce. Maintaining the historic environment is important for Scotland's construction industry, directly supporting 10,500 full-time-equivalent employees, and contributing some £1 billion to Scotland's GVA.

Parts of the historic landscape

Some parts of Scotland's historic environment are protected through the process of 'designation'. The process aims to identify the most important parts of the built environment to recognise their significance and enhance their protection.

Designated assets currently include:

- 5 world heritage sites;
- 47,672 listed buildings;
- 8,205 scheduled monuments;
- 390 designed gardens and landscapes;
- 645 conservation areas;
- 8 protected wrecks;
- 7 scheduled wrecks;
- 1 historic marine protected area;
- 28 nationally important battlefields.

Scotland has two national parks and 40 National Scenic Areas. These contain many important features of the historic environment, and you can find more information about them in the Landscape topic.

Much of the historic environment is undesignated. The Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS) and local authority Sites and Monuments Records (SMRs) also hold information on historic environment assets that are not necessarily nationally important or legally protected, but nonetheless contribute to Scotland's overall historic environment. There are currently 295,784 RCAHMS records of historic assets or events available on the RCAHMS website. There are 283,238 records held by local authority SMRs.

Description of the historic environment

World Heritage Sites

Scotland has five World Heritage Sites (sites of outstanding universal value) under the terms of the UNESCO World Heritage Convention.

Four are cultural World Heritage Sites:

- Edinburgh Old and New Towns;
- New Lanark;
- The Heart of Neolithic Orkney;
- The Antonine Wall.

St Kilda is a mixed cultural and natural World Heritage Site.

Properties in care

A 'property in care' is an ancient monument or historic building that is cared for by Historic Scotland under the terms of the Ancient Monuments and Archaeological Areas Act 1979. There are 345 properties in the care of Historic Scotland including Edinburgh Castle, Melrose Abbey and Urquhart Castle.

Listed buildings

Historic Scotland lists buildings of special historic or architectural interest and maintains associated descriptions of these listed buildings.

The lists ensure that information is available for the planning process to take the needs of the historic environment into account. Scotland's Historic Environment Audit shows that there were 47,672 listed buildings in Scotland in March 2012: an increase of 507 since 2008. Buildings are assigned to one of three categories according to their relative importance. All listed buildings receive equal legal protection, which applies to the interior and exterior of the building, regardless of its category.

- **Category A**: buildings of national or international importance, either architectural, historic, or fine, little-altered examples of a particular period, style or building type (around 8% of the total).
- **Category B**: buildings of regional (or more than local) importance, or major examples of a particular period, style or building type, which may have been altered (around 50% of the total).
- **Category C**: buildings of local importance, lesser examples of any period, style or building type, as originally constructed or moderately altered, and simple traditional buildings that group well with others in categories A and B (around 42% of the total).

Scheduled monuments

Scheduled monuments are of national importance and are legally protected under the Ancient Monuments and Archaeological Areas Act 1979. Historic Scotland keeps information about monuments.

There were 8,205 scheduled monuments in Scotland in March 2012: an increase of 184 since 2008. The oldest scheduled monuments date from around 8,000 years ago – before farming began in Scotland. The most recent scheduled monuments include Second World War defences. In between, there are many different types of monuments, including prehistoric chambered cairns, Roman forts, early medieval carved stones and industrial mills. They may be visible as earthworks or other upstanding structural remains, but much of a monument may survive beneath the ground, often extending well beyond the visible remains.

Gardens and designed landscapes

There are 390 sites on the inventory of gardens and designed landscapes in Scotland. Sites on the inventory are of national importance and should be taken into account during the planning process.

Conservation areas

Conservation areas are described by local planning authorities as "*areas of special architectural or historic interest, the character of which it is desirable to preserve or enhance*".

There were 645 conservation areas in Scotland in March 2012, compared to 636 in 2008.

Wreck sites

There are 16 nationally protected wreck sites across Scotland. Of these, eight wreck sites are designated by Scottish Ministers (through Historic Scotland) under the Protection of Wrecks Act 1973. Seven other offshore wrecks are scheduled under the Ancient Monuments and Archaeological Areas Act 1979. There is also a single wreck protected as a Historic Marine Protected Area under the Marine (Scotland) Act 2010. Further information on Scotland's marine historic environment is contained in Scotland's Marine Atlas.

Battlefields

There are 28 nationally important battlefields on the Inventory of Scottish Battlefields.

Undesignated assets

Most of Scotland's historic environment is not protected by designation and is privately owned.

The scale of the undesignated built heritage is considerable.

- There are 125,685 archaeological monuments recorded by RCAHMS, of which only 9,967 are linked to scheduled monument designations. This suggests that 92% of known archaeological sites and monuments in Scotland are undesignated.
- RCAHMS holds 138,601 records relating to historic architecture. Of these, 71,232 records (51%) are not linked to listed building records.
- 455,000 Scottish homes were built before 1919, which means that one fifth (19%) of our housing stock is now over 90 years old. These properties comprise the bulk of the vernacular architecture that contributes to Scotland's unique character.
- RCAHMS holds 20,675 records relating to maritime heritage. However, there are only 16 protected wrecks in Scotland, suggesting that 99.9% of recorded maritime heritage is undesignated;
- Of the gardens and related sites (sundials, garden features etc) recorded by RCAHMS, 92% is undesignated.
- RCAHMS holds 297 records relating to battle sites or battlefields, only 28 of which are on the Inventory of nationally important battlefields.

Unprotected assets

There are many different undesignated archaeological sites, monuments, areas of historical interest, historic landscapes, gardens and designed landscapes, woodlands and routes, such as drove roads, that are not protected by law. There are a number of reasons why a historic feature might not be designated, including not meeting the designation criteria, not yet being assessed or not yet being recorded.

State

There is good information about the size and condition of some parts of Scotland's historic environment. However, it is difficult to assess the current and changing state of all of the elements that make up the historic environment because of a lack of nationally consistent trend data.

Scotland's historic environment is under pressure from human activities as well as from the weather. Inappropriate development and lack of maintenance can quickly reduce the value of buildings and other historic features.

Condition of the historic environment

It is difficult to assess the current and changing state of all of the elements that make up the historic environment as a whole. However, the following information sources do provide some useful national data about the condition of various parts of the historic environment.

Condition of listed buildings

The buildings at risk register (BARR) for Scotland was established in 1990 and highlights buildings with architectural or historic significance throughout the country that are considered to be at risk. Buildings at risk are not necessarily in poor condition; they may simply be standing empty with no clear future use.

A survey of category A listed buildings at risk in 2013 found that:

- 8.0% of A-listed buildings (nationally or internationally important) are at risk, compared to 8.2% in 2011 and 8.7% in 2009;
- A-listed buildings in rural areas are more likely to be at risk than those in urban areas;
- nine out of ten A-listed buildings at risk are vacant.

Condition of scheduled monuments

Historic Scotland's Field Officer reports provide systematically generated, detailed data about the condition of scheduled monuments. The data do not represent the overall state of all ancient monuments. However, the range of issues faced by unscheduled monuments is likely to be very similar.

Scotland's Historic Environment Audit reported in 2012 that:

- the percentage of monuments in an 'optimal' or 'satisfactory' condition has increased over the last 13 years, from 82% to around 87%;
- there is a direct relationship between condition and risk, with monuments in an optimal or satisfactory condition likely to be associated with a low risk of deterioration;
- monuments are more frequently being assessed as at high or immediate risk of further deterioration: currently, around 12% of monuments fall into this category;
- condition varies significantly between each category of monument: prehistoric and Roman monuments are generally in a better condition than ecclesiastical, secular and industrial monuments;
- since standard scores were introduced in 1998, around 28% of scheduled monuments have shown an improvement in condition, with 26% showing a decline; while around 26% of monuments have shown a decrease in assessed risk, with a further 26% showing an increase.

Pressures affecting the historic environment

A range of pressures affect the historic environment.

Development pressures

Short-term objectives for the development of places for housing and other needs, such as energy generation and transport infrastructure, can result in inappropriate development and demolition, which can affect the character of a historic area or an individual building or monument.

Maintenance

More focus is needed on long-term sustainability and better repair and maintenance of traditional buildings. As our buildings get older, they require increasing levels of maintenance. Poorly executed repairs can also damage heritage value. The shortage of traditional skills, suitably qualified craftsmen and locally-available materials is an additional pressure on maintaining and repairing the historic environment.

Land use

Changing the way in which land is used and managed can put pressure on the historic environment. For example, light grazing by sheep is often a gentle and beneficial way of keeping monuments in good condition. By contrast, ploughing the site of a monument over successive years can lead to the archaeological remains being worn away, while the spread of tree roots and scrub can disturb and damage buried archaeological deposits and undermine masonry above ground.

Climate change, coastal erosion and pollution

It is projected that climate change will lead to Scotland becoming warmer, with drier summers and wetter autumns and winters. More rainfall will mean that traditional buildings will be wetter for longer periods of time, resulting in increased weathering of stone, rotting timbers and corrosion of metals.

Rising sea levels mean that coastal erosion is an increasing threat to heritage assets. Some of Scotland's most special sites, such as Skara Brae in Orkney, are particularly at risk. Information about the impact of coastal erosion on Scotland's heritage is available from The SCAPE Trust.

In the past, severe pollution in urban areas, particularly black soot and sulphur dioxide, caused significant damage to buildings. Although levels of these pollutants have fallen over recent decades, their effects continue to cause damage, particularly to materials such as sandstone, resulting in these materials being vulnerable to ongoing decay. Furthermore, poorly executed stone cleaning has had a damaging effect on some historic buildings.

Sustainability of traditional buildings

Traditional buildings have embedded energy (the energy required to extract, process, manufacture, transport and install building materials). Although traditional buildings usually have a lower thermal performance than new buildings, continuing to use them can avoid some new carbon by reducing the need for new buildings.

Reducing greenhouse gas emissions associated with the upkeep of old buildings, while maintaining their cultural significance, is a challenge. All measures to improve energy efficiency in traditional buildings need to be considered carefully with thought given to the carbon footprint, lifespan and the sustainability of existing and replacement materials. In improving energy efficiency, it is important to avoid damaging effects on traditional buildings. For example, reducing air leakage in buildings to prevent heat loss may result in condensation and fungus growth, with damaging effects on the fabric of the building and the health of people using it.

Visitors

Tourism, leisure and sport can improve understanding and enjoyment of the historic environment and generate additional revenue for managing it. However, increased visitor numbers can also lead to pressures. For example, visitors can cause damage to heritage sites by wearing down the footpaths across sensitive features, or by lighting fires.

What is being done

A strategy for managing Scotland's historic environment was published in 2014. It complements existing legal measures for protecting and managing buildings and other assets. There is significant investment in care and maintenance, but this often relies on a contribution from public funds or the National Lottery.

Policy and the law

Our Place in Time, the first Historic Environment strategy for Scotland, was published in March 2014. It sets out a vision, definition and desired outcomes for our rich historic environment. It provides an overarching framework within which organisations can work together to achieve these positive outcomes.

The Scottish Historic Environment Policy (SHEP) is the Scottish Ministers' policy for the historic environment in Scotland. Other policies and guidance are also relevant to the historic environment, such as the recently published policy statement on architecture and place-making, Scottish planning policy and the third national planning framework.

Legal measures for protecting the historic environment have been in place for many years and are routinely used by planning authorities to control local development. Recent improvements have been made to the law to make it easier for a wider range of people and organisations to manage the historic environment. For example, the Historic Environment (Amendment) (Scotland) Act 2011 tackles some long-standing practical issues and makes it easier for owners, tenants, businesses, the voluntary sector and the regulatory authorities to manage and care for the historic environment.

Management

Developing a better picture of Scotland's entire historic environment is important for making decisions about how it should be managed. The Historic Land-use Assessment (HLA) is an ongoing project undertaken by RCAHMS and Historic Scotland. It is designed to map past and present land use across Scotland to help us understand how today's landscape has been influenced by human activities in the past. By March 2012 around 80% of Scotland had been mapped using HLA.

The development-planning process helps to manage change in the historic environment. Many developments do not have a significant impact on the historic environment but, when they do, concerns must be considered. A local authority may impose a condition on a development to protect the historic environment and, in rare instances, may refuse a planning application. You can find Scottish Government planning performance statistics on the Scottish Government website.

Specific procedures in place for protecting the historic environment include listed building consent, conservation area consent, and scheduled monument consent. In addition, Historic Scotland publishes guidance on managing change in the historic environment for planning authorities and other interested parties, including owners.

Usually, unlisted buildings in conservation areas also have protection through conservation area consent, because this consent is normally required before unlisted buildings in conservation areas can be demolished.

Climate change could damage Scotland's historic environment, and a lot of effort is being made to raise awareness of the risks so that action can be taken to protect valuable assets. The UK Climate Change Risk Assessment and SEPA's National Flood Risk Assessment are two examples of comprehensive studies that have significantly raised awareness of the potential risks, impacts and adaptations.

Investment

Each year we spend more than a billion pounds on our historic environment. Funding for the historic environment comes from a wide variety of sources in the private, public and voluntary sectors.

- Private investment is the largest source of funding for the historic environment in Scotland: most historic buildings and places are privately owned, so it is critical that private owners are able to invest enough to maintain them. Research undertaken in 2008 and updated in 2013 suggests that the best current estimate of annual spend on repairing and maintaining historic buildings (including historic industrial and commercial buildings and infrastructure) is £1.1 billion.
- In 2012-13, the Scottish Government through Historic Scotland spent £80.6 million on the historic environment, including £33.7 million in income from properties in care.
- The Chartered Institute of Public Finance and Accountancy (CIPFA) figures show that local authorities' net expenditure on heritage was £7.6 million in 2011-12.
- Grant aid is a major incentive for conserving built heritage, regenerating our town centres, creating work in the construction industry and supporting tourism. Between 2003 and 2013, Historic Scotland awarded grants of more than £133 million that assisted with the cost of repairs worth more than £580 million. For every £1 Historic Scotland awards in grant funding, an additional £4.50 is provided from other sources, further benefitting the Scottish economy. An independent assessment of the impact of historic environment grants showed that they have a wide range of social, cultural and economic benefits.
- The Heritage Lottery Fund awarded a total of £29.6 million to 107 different heritage projects in Scotland in 2011-12.
- Some of Scotland’s most important historic places are in the care of charitable trusts, and the voluntary sector plays a vital role in caring for the historic environment in Scotland. For example, in 2011-12 the National Trust for Scotland's total expenditure was £42.1 million.

Investment is also being used to support, develop and promote Scotland's traditional building skills and the use of traditional building materials. Historic Scotland has helped to develop new specialist vocational qualifications and launched the Traditional Building Health Check scheme in partnership with CITB-Construction Skills Scotland. This will introduce independent inspections to identify issues with traditional buildings, which will benefit the repair and maintenance market through using appropriately skilled and qualified contractors.

7.4 Recreation

Scotland's natural and historic environment provides many opportunities for outdoor activity and attracts millions of visitors a year, generating £2.6 billion of expenditure.

Summary

Key messages

- Scotland's natural and historic environment provides a fantastic backdrop for a wide range of outdoor recreation activities, ranging from dog walking and visiting parks to mountain biking, golfing and water sports.
- People who enjoy outdoor recreation contribute to the local economy by spending money on food and fuel, or on hotels and guest houses when they go on longer excursions.
- In 2012 outdoor recreation visits generated around £2.6 billion of expenditure.
- Participation in outdoor recreation, even in activities which aren't particularly energetic, is of great benefit to our health and well-being.
- The state of Scotland's environment is key to the enjoyment of outdoor recreation and can influence whether visitors return to Scotland and recommend it to others.
- Recreation can inadvertently damage the environment, and in very popular destinations visitor management may be needed to protect it.

State and trend

A summarised assessment of the state and trend has not been made for this topic.

Please read the topic for more information; if you have any questions about Scotland's recreation please feel free to contact us via the contact us facility on the website.

Overview

People enjoy and are inspired by the outdoors in different ways – from the simple tonic of breathing fresh air and observing familiar landmarks, to the physical challenge of energetic activities.

Outdoor recreation includes informal outings such as going for picnics, as well as visits to historic buildings and gardens and more specialist pursuits like mountain biking, climbing and kayaking. It can be enjoyed in countryside, urban or marine environments and in many different settings such as parks, woods and beaches.

In many wild or remote areas, people expect very little in the way of visitor facilities. However, in other places – particularly those close to large population centres – paths, ranger services, signs, toilets and play areas can help make the outdoors accessible to everyone and increase participation. These places include city parks and other urban green spaces, regional parks, and historic buildings. Managed places further from large population centres include national parks, National Nature Reserves and forest parks.

The importance of outdoor leisure and recreation

The main benefits of visiting the outdoors are:

improving health and well-being: walking is recognised as the most cost-effective means of improving physical health. Enjoying the outdoors and participating in challenging activities can also contribute to good mental health and well-being;

increasing understanding of the natural world: participation in outdoor recreation and activities like volunteering provides opportunities for people to learn more about the natural world and to care for a resource that is valuable to the whole community;

increasing understanding of our cultural heritage: visits to historic attractions and sites can help provide a sense of place and cultural identity, ensuring we can confidently pass these assets to the next generation;

contributing to the economy: Outdoor recreation is a valuable part of Scotland's economy. It is estimated that all visits to the outdoors made by people living in Scotland generated around £2.6 billion in expenditure in 2012. Mountain biking alone generates around £119 million a year and this is predicted to grow over the next five years, with potential additional revenue estimated at around £36 million a year. Scottish Golf Tourism Market Analysis estimates that golf tourism (not including day visitors, most of whom are Scottish residents) is worth almost £220 million a year.

Social inclusion: well-planned and managed recreation facilities with links to public transport can offer opportunities for everyone.

Settings for outdoor recreation

Urban green space

Most people in Scotland live in urban areas and many live near to urban green spaces, such as parks, gardens, playing fields and natural green spaces. Well-designed and managed green spaces make settlements more pleasant places to live, provide space for wildlife and can encourage healthy, active lifestyles by giving people an opportunity to enjoy the outdoors close to home.

In 2012 the Scottish Household Survey estimated that 71% of Scottish adults have access to a useable green space that they can walk to within six minutes and that 42% use this space every week. There are many green-space partnerships, organisations and groups working in urban areas throughout Scotland to create, improve and manage places for outdoor recreation. Improved access to good-quality urban green space, along with improvements in the provision and promotion of paths (especially paths close to home), is likely to play a key role in increasing recreation in urban areas in the future.

National parks

Scotland's two national parks, the Cairngorms (established in 2003) and Loch Lomond and the Trossachs (established in 2002) were created under the National Parks (Scotland) Act to safeguard areas of outstanding and diverse landscapes, habitats and communities. Together, the national parks offer visitors and local communities a wide variety of opportunities to enjoy our natural and cultural heritage and are estimated to attract more than 6 million visits each year. These include visits for sightseeing, walking, cycling, mountain biking, climbing, kayaking, horse riding and visits to historic and cultural properties and sites.

National forest estate and other public land

The national forest estate in Scotland is the largest single public land resource held by the Scottish Government, comprising over 660,000 hectares and more than 35% of Scotland's woodland. In 2012, the Scottish Recreation Survey estimated that adults in Scotland made 62 million visits to Scottish woodland, including 27 million visits to the national forest estate.

Scotland's 47 National Nature Reserves (NNRs) cover less than 1.5% of Scotland, and contain some of the very best of the country's nature and wildlife, including habitats and species of national and international significance. These sites provide a range of education and recreation opportunities and are estimated to attract more than 400,000 visits each year.

State

Almost 80% of adults in Scotland take part in some outdoor recreational activity; just over 40% do so on a weekly basis. Around half of outdoor visits are taken in the countryside while just over one third are to parks and other open spaces in urban areas.

Around three quarters of visits use paths of some description, most of which are signposted or waymarked.

People visit the outdoors to take part in a wide range of recreational activities. Walking is by far and away the most common activity followed by family outings and cycling.

Enjoying the outdoors brings many positive benefits. Participation in outdoor recreation and contact with nature helps encourage an interest in, and a concern for, the natural and historic environment. However, outdoor recreation also has the potential to put pressure on the environment.

Frequency of visits

In 2012 the Scottish Recreation Survey estimated that 79% of adults in Scotland made at least one visit to the outdoors for recreation. This was lower than in 2010 and 2011, but similar to the levels recorded between 2006 and 2009. Under half (42%) of adults in Scotland visited the outdoors for recreation at least once a week in 2012, a significant decrease since 2011 (46%), although the longer-term trend for weekly visits remains stable.

Outdoor recreation takes place in a variety of settings (Figure 1). The countryside accounted for around half of all outdoor visits for recreation in 2012 (51%), whereas visits made to, or within, towns and cities (including visits to parks and other urban open spaces) accounted for 36% of the total (30% in 2005).

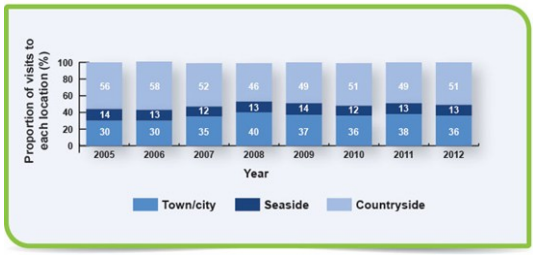

Figure 1: Type of environment for outdoor recreation visits 2005–2012

Source: Scottish Recreation Survey

Places visited

Local parks and open spaces were the most popular places for outdoor visits in 2012 (Figure 2). They were the reason for 36% of all outdoor visits made by adults living in Scotland and the main reason for 64% of outdoor visits made in towns and cities. Visits to woodlands and forests (the main reason for 15% of all visits) and beaches and cliffs (the main reason for 11% of all visits) were the next most popular.

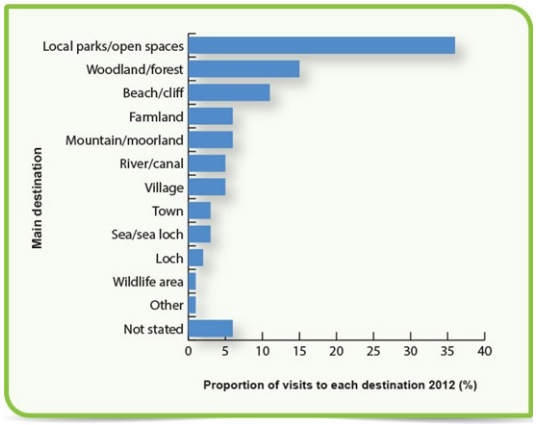

Figure 2: Main destination of outdoor visits 2012

Source: Scottish Recreation Survey

In 2012 the Scottish Recreation Survey estimated that 77% of visits to the outdoors for recreation involved the use of a path or network of paths and 55% involved the use of a path with signposts or waymarks.

In 2003 the Scottish Paths Record estimated that there were around 84,000 km of paths in Scotland, including:

- community paths (such as core path networks, rights of way, local footways and cycleways);
- long-distance routes;
- the national cycle network;
- heritage paths;
- upland paths;
- other types of paths, such as farm, forestry and estate roads, canal tow-paths, coastal and riverside paths.

Over the last decade the path network in Scotland has been improved. Many new paths have been created, additional long-distance routes have been established and many popular mountain paths have been successfully restored. In March 2013, there were 22,218 km of signposted or waymarked paths in Scotland.

Core paths network

The core paths network is provided by Scotland's 32 local authorities and two national park authorities to give the public reasonable access throughout the area. The core paths planning process began in February 2005 and is now nearing completion. In March 2013:

- thirty-one out of the 34 access authorities had adopted a core paths plan, covering 19,612 km of core paths;
- of these, 7,890 km (40%) were signposted or waymarked and the maintenance of 4,776 km (24%) was paid for by a local authority or national park.

Since 2013, another authority has adopted its core path plan.

National cycle network

The national cycle network in Scotland is made up of more than 2,100 miles of traffic-free, quiet-lane and on-road cycling routes around the country, taking in all of Scotland's major cities as well as remote areas of natural beauty.

Long-distance routes

Long-distance routes (LDRs) are routes of 40 km or more that are signposted, maintained and promoted to some extent. There are four officially designated LDRs in Scotland, which make up a total length of 743 km. In

2010 Developing the network of longer distance routes identified a further 29 LDRs that comprise a total length of 2,797 km, as well as an additional eight routes with a total length of 678 km that were at an advanced stage of development or planning. In 2014, 26 of these routes, covering more than 2,700 km of well-managed paths, are being marketed as Scotland's Great Trails. The John Muir Way, a 216 km trail stretching across central Scotland from John Muir's birthplace in Dunbar to the Clyde at Helensburgh, will open in April 2014.

Activities

Walking

Walking is the most popular outdoor activity enjoyed by adults in Scotland – and is the main activity on at least seven out of ten outdoor visits each year. In 2012 the Scottish Recreation Survey estimated that more than half of walking trips included a dog (56%). Walking is also a popular pastime for people taking a holiday or short break in Scotland. In 2012 the Scotland Visitor Survey estimated that 45% of summer visitors in Scotland took a short walk and 33% took a longer walk or hike during their visit. In 2005 holidaymakers rated the Scottish walking experience very favourably, highlighting in particular the natural environment, the diversity and quality of walks, the supporting infrastructure and the opportunities to experience our culture, history and people.

Mountain biking

Scotland is one of the best destinations in the world for mountain biking. Specially-constructed trail facilities, such as the 7stanes network in the south of Scotland and centres such as LagganWolftrax and Learnie Red Rock in the north, attract hundreds of thousands of visitors each year and produce significant economic benefits for local communities. The economic value of mountain biking in Scotland report estimates that there are 1.3 million mountain-biking visits made in Scotland each year.

Water-based activities

With thousands of kilometres of coastline, over 800 islands, numerous sea and inland lochs and white-water rivers, Scotland's renowned water environment appeals to sailors and canoeists. In November 2012, a survey of Royal Yachting Association Scotland affiliated clubs indicated that there were 20,294 sailors in Scotland who are members of clubs. Although much of Scotland's Canadian canoeing and kayaking activity is informal and takes place outside of organised clubs, membership figures provided by the Scottish Canoe Association (SCA) indicate a growing level of interest in the sport. The 95-km Great Glen Canoe Trail, from Fort William to Inverness, was formally opened in March 2012.

Scotland also plays host to a number of water-sports events each year, including the Tiree Wave Classic, a windsurfing national championship event that attracts some of the world's best windsurfers to the island each autumn.

Scotland's beaches and coasts provide great opportunities for family outings and other informal activities, such as walking, paddling, swimming and exploring rock pools.

Equestrian activities

Membership of the British Horse Society Scotland (BHSS) has grown by around 22% in recent years – from 4,095 in 2006 to more than 5,000 in 2012, accounting for 7% of total British membership (71,000).

In 2011 the National Equestrian Survey estimated that 3.5 million people in Britain had ridden a horse during 2010–2011, with 1.6 million riding at least once a month. Using BHSS membership figures as a guide, and the 2011 National Equestrian Survey, it is estimated that there are 245,000 horse-riders in Scotland, almost half of whom ride at least once a month.

Golf

Scotland is known throughout the world as the home of golf and has one of the highest participation rates in the world, with 240,000 golf-club members in 2012, representing 5% of the population. In 2012 the Scottish Household Survey found that 11% of men and 2% of women had played golf at one of the country's 580 courses in the four weeks before the interview.

Fishing and other game sports

Scotland offers extensive opportunities for world-class game and coarse angling on its rivers and lochs, and sea angling from its shoreline or from a boat. In 2012 the Scottish Recreation Survey estimated that around 2% of adults in Scotland go fishing and the Consumer Fishing Market Research, undertaken in 2007, indicated that the majority of this activity (71% of trips) is game angling.

According to the Country Sports Tourism Review undertaken in 2004, more than 70,000 people in Scotland participate in other game sports, such as deer-stalking and hunting.

Culture and history

Scotland's historic monuments, buildings and sites attract millions of visitors each year, providing opportunities for people to enjoy the outdoors and learn more about our history and culture. In 2012 the Scottish Household Survey estimated that 28% of adults had visited a historic or archaeological site in the 12 months prior to interview.

Pressures affecting the recreation environment

Pressures on space for outdoor recreation

Building development can sometimes take away open spaces that were used for recreation. On the other hand, well-situated and well-designed developments can offer additional outdoor recreation and learning opportunities.

Changing weather patterns could limit the availability of some types of outdoor activity in future, particularly those that rely on snow and ice. A changing climate could also have an impact on safe access to the outdoors, especially if storms become more frequent and violent.

Pressures on the quality of outdoor recreation

Even when development makes no significant impact on the available space for recreation, it may have other impacts (for example, visual impacts on the landscape) that reduce the quality of outdoor recreation for some people.

The most popular destinations can suffer from pressures that are directly related to recreational visitors. Outdoor recreation can cause wear and tear on historic buildings, sites and gardens; erode footpaths; and damage other sensitive sites, even when visitors behave responsibly. When visitors don't behave responsibly the environment can suffer additional pressures, such as wildlife disturbance, littering and dog fouling.

Changing weather patterns could have an impact on the quality of recreation for some people. While a wetter climate might make hill-walking or golfing less enjoyable for some, there could be benefits for surfers or kayakers, who enjoy more challenging conditions.

What is being done

Increasing participation in outdoor recreation is good for Scotland's economy and can help to address health and community problems, as well as encourage a lasting interest in the natural environment.

There are a range of policies in place to help and encourage a wide range of people to take part in outdoor activities. These include ensuring access to outdoor spaces is available as well as actively managing areas suitable for recreation.

A key target for the Scottish Government is to 'increase people's use of Scotland's outdoors', and progress has been measured since 2006.

Access rights and responsibilities

The enjoying the outdoors policy sets out a vision in which everyone in Scotland is able to enjoy the outdoors as part of their daily life. An ongoing programme of research will help those involved in providing opportunities for outdoor recreation to better understand the diversity of Scotland's people. This will ensure that effort is targeted effectively to encourage participation from the broadest range of backgrounds, abilities, cultures and needs.

Access to the outdoor environment is provided by the Land Reform (Scotland) Act 2003, which established a right of responsible access to most land and inland water in Scotland, and also set out new responsibilities for visitors to the outdoors and for land managers. These rights and responsibilities came into effect in February 2005 and are explained in the Scottish Outdoor Access Code.

Providing and protecting recreation space

Several initiatives are helping to create opportunities to improve the number, size, and quality of places managed for outdoor recreation.

- Scottish planning policy encourages local authorities to prepare 'open space strategies' to guide future provision within their areas, in particular through the planning system.
- Scottish Government's National Planning Framework 3 (NPF3) includes as one of its Proposed National Developments the National Long Distance Cycling and Walking Network to support recreation, tourism and active travel.
- The Central Scotland Green Network is being developed to enhance landscapes, wildlife and recreational opportunities in central Scotland.
- Local and national park authorities are completing the planning phase of the core paths network.
- Future development of mountain biking in Scotland is being guided by the National Strategic Framework for the Sustainable Development of Mountain Biking in Scotland, which involves key stakeholders at local and national levels.
- The Scottish Historic Environment Policy sets out Scottish ministers' policies on issues including access to historic sites and the important recreational opportunities afforded through volunteering.

Developing good practice and managing recreation sustainably

An ongoing programme of communications and education – Know The Code Before You Go – will continue to help raise awareness and understanding of the Scottish Outdoor Access Code's messages by targeting key audiences, such as young people, campers and dog owners. A series of good-practice guides offers guidance on responsible behaviour for people who take part in individual activities (e.g. canoeing horse riding and cycling) and in specific places (e.g. beaches, riverbanks, woods, and fields containing animals).

Many local and national projects illustrate the ways in which potentially negative impacts can be managed and minimised. These include:

- the Scottish Marine Wildlife Watching Code, which raises awareness of the need for responsible behaviour and offers practical guidance for visitors and commercial operators;
- the Mountains for People Project, which aims to conserve and repair some of the most challenging upland routes in Torridon, Glencoe and on Arran;
- the Cairngorm Outdoor Access Trust, which is working to repair eroded mountain paths so that access can be sustained;

- hillphones and the Heading for the Scottish Hills project, which will help walkers plan routes that are unlikely to disturb deer-stalking.

The provision of paths and trails for all abilities helps to improve access to the countryside for everyone, and being able to source information about the accessibility of paths helps people plan their trips. The Fieldfare Trust works with countryside managers and less-mobile people to improve access to the countryside for everyone. The trust's Phototrails website allows users to look at a series of photos of countryside routes and read descriptions of path features, enabling disabled visitors to decide whether a trail is likely to be accessible to them. Scottish Natural Heritage's 2011 research on path attributes explores how best to provide information describing the physical characteristics of a path so that potential users can decide if it is suitable for them.

New opportunities

Major events and infrastructure projects create opportunities for new outdoor recreation space, sometimes in remote places and sometimes close to towns and cities.

Sites chosen for wind farm development can sometimes be used for outdoor recreation. Good practice during windfarm construction gives advice on providing and managing public access both during and after construction. Providing a ranger service and trails for walking, cycling and horse riding can boost recreational opportunities for local people, as demonstrated at Whitelee wind farm.

Forestry Commission Scotland (FCS) has developed path networks and mountain-bike trail centres throughout the country based on local and national demand. FCS is also restructuring the national forest estate by acquiring land that can be easily accessed close to population centres, creating new opportunities for recreation outdoors.

The 2014 Commonwealth Games have been the catalyst for a large regeneration programme in Glasgow's east end. This will include the creation of more outdoor recreation space through a range of green-space projects, such as the regeneration of the Cuningar Loop woodland, managed by Clyde Gateway in partnership with the Forestry Commission. Other permanent outdoor recreation facilities will be created elsewhere in Glasgow, such as the mountain-bike trails in Cathkin Braes Country Park. Built to international standards and located on the southern edge of the city, the trails will be within easy reach of 1.8 million people.

Paths and climate change

In 2011 an investigation highlighted the possible impacts of predicted climate change trends on path features. The research considered adaptions to planning, designing, constructing and managing paths in Scotland to minimise the negative effects of changing weather patterns and protect investment in the infrastructure of paths.

7.5 Energy

Energy in Scotland is changing and will continue to do so as we strive towards a low carbon future.

Summary

Key messages

- Scotland has some of the most stringent and challenging energy targets in the world to meet our climate-change targets.
- Scotland accounts for around 10% – some 36,600 gigawatt hours (GWh), of the UK's gross electricity consumption.
- Scottish renewable electricity generation made up approximately 32% of total UK renewable generation in 2013.
- An estimated 46.5% of gross electricity consumption in Scotland came from renewable sources in 2013 - up from 40.3% in 2012.
- Renewable energy currently supports nearly 12,000 jobs in Scotland.
- The oil and gas industry directly employs around 225,000 people across Scotland as well as supporting jobs in other sectors of the economy.
- In 2011, Scotland accounted for 60% of European Union oil production, and approximately a third of EU total hydrocarbon production.
- In 2011, 2.6% of Scotland's non-electrical heat demand was met by renewable sources compared to only 1% in 2009.
- Energy in Scotland is changing and will continue to do so as we strive towards a low carbon future.

State and trend

State: Poor - medium agreement, low evidence

Trend: Improving - medium agreement, low evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- These assessments are based on energy supply as a sustainable energy system, taking into account the needs of future generations.
- The assessment includes onshore and offshore energy production.
- These assessments are of the current "average condition"; some aspects are in a worse condition, and others are in a better one. Equally, some aspects are declining, while others are improving.
- Making any overall assessment is necessarily a simplification.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

We need energy to generate electricity, to heat our homes and to run our cars. It comes from a range of non-renewable and renewable sources such as coal, oil, gas, wind and water (Table 1). Over the last 200 years, most of our energy requirements have been met by fossil fuels. However, these are not renewable and will run out eventually. Burning fossil fuels also generates greenhouse gases. Relying on fossil fuels for energy

generation is therefore unsustainable and we need to explore a wider range of energy sources in future – including using more renewable, sustainable ways of generating energy.

Table 1: The main energy sources and their impact on the environment.

Energy Source	Is it renewable?	Impact on the environment
Coal	No	Generates greenhouse gases and other air pollutants
Oil	No	Generates greenhouse gases and other air pollutants
Natural gas	No	Generates greenhouse gases and other air pollutants
Nuclear	No	Waste produced is highly toxic Leakage can damage human health and the environment
Biomass	Yes if the vegetation used is replanted	Generates greenhouse gases and other air pollutants Competes with other land uses
Wood	Yes if trees providing wood are replanted	Generates greenhouse gases and other air pollutants Competes with other land uses
Solar	Yes	Impact on landscape
Wind	Yes	Impact on landscape Competes with other land uses Impact on wildlife and habitats
Tidal	Yes	Impact on landscape Impact on wildlife and habitats
Wave	Yes	Impact on landscape Impact on wildlife and habitats
Hydroelectric power	Yes	Impact on landscape Impact on wildlife and habitats
Ground source heat	Yes	

The European Union have set a target that 20% of energy must come from renewable sources by 2020. The Scottish Government has set more stringent targets and is aiming for at least 30% by 2020. This includes targets for:

- renewable sources to generate the equivalent of 100% of Scotland's gross annual electricity consumption by 2020;
- renewables sources to provide the equivalent of 11% of Scotland's non-electrical heat demand by 2020.

The connection between energy requirements and the environment is important for everyone who lives, or does business in, Scotland.

The main pressures relating to energy are the impacts of climate change, the need to reduce greenhouse gas emissions, the expense of energy, and the need to make sure we have a secure, reliable energy supply.

Scotland accounts for around 10% - some 36,600 gigawatt hours (GWh) - of the UK's total electricity consumption. The vast majority of the UK's oil production, and around half of its natural gas production, is extracted from reserves under the continental shelf around Scotland. In addition a third, around 6 million tonnes, of the UK's coal production comes from Scotland. Scotland has a major economic stake in the production of hydrocarbon fossil fuels, and our coal, oil and gas reserves are valuable assets. The oil and gas industry currently employs approximately 225,000 people across Scotland, either directly in the industry or in supporting jobs in other sectors of the economy.

Scotland also has huge potential for renewable electricity generation. It has been estimated that Scotland could produce 206 GW a year of electricity through offshore wind, wave and tidal generation. This means that Scotland could produce up to 25% of Europe's total offshore wind and tidal energy, as well as 10% of its wave energy.

Currently, electricity generation in Scotland comes from a mixture of fossil fuels, nuclear, and renewables. Around a quarter of the electricity generated is exported to the rest of the UK.

In Scotland, the majority of energy produced is used to provide heat (non-electrical). Transport uses nearly a quarter of energy produced, while electricity uses just over 20% of energy produced.

Excluding transport, approximately 40% of energy (electricity and heat) is used by households while 60% is used by industry and business.

The source of energy and its production can have significant impacts on the environment (Table 1).

State

The demand for energy in Scotland has decreased by about 10% between 2000 and 2012, with a particularly marked reduction between 2008 and 2012. It is unclear whether this reduction in energy consumption is because of the downturn in the economy or because of energy-saving measures.

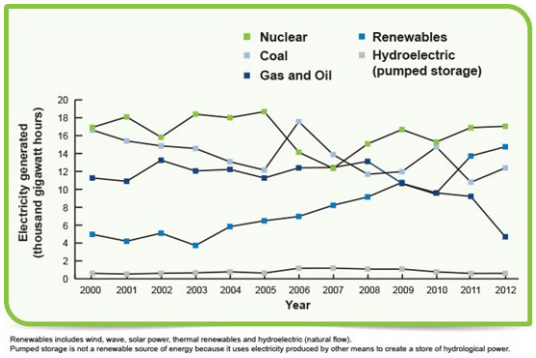

Figure 1: Electricity generation by source 2000 – 2012

Source: Scottish Government

Figure 1 shows there has been a large increase in the amount of electricity generated from renewable sources, and also that the annual contributions from nuclear, coal, gas and oil are relatively volatile. The contribution from pumped storage remains important at around 1.2% of electricity generated in 2012.

Table 2 illustrates the rapid rise in the contribution of renewable energy from the year 2000 and, in particular, the increasingly important contribution from wind power. With the exception of hydropower, all forms of renewable energy are contributing an increasing amount to total energy demand.

Table 2: Contribution of renewables to gross consumption 2000 to 2012

Year	Hydro	Wind (inc.amount of wave/tidal/solar)	Landfill	Sewage	Other biofuels	Total	Gross Consumption (GWh)	Renewables as a percentage of gross consumption
2000	4,665.3	216.7	68.5	*	21.1	4,971.6	40,801	12.2%
2001	3,737.5	245.2	109.3	*	110.4	4,202.4	40,446	10.4%
2002	4,455.4	406.1	157.0	*	80.1	5,098.7	41,619	12.3%
2003	2,902.0	448.9	228.0	*	145.5	3,724.5	41,238	9.0%
2004	4,474.8	848.4	339.2	*	169.8	5,832.2	41,364	14.1%
2005	4,612.2	1,280.9	395.4	*	197.2	6,485.7	41,923	15.5%
2006	4,224.9	2,022.9	424.0	*	291.0	6,962.8	41,309	16.9%
2007	4,692.9	2,644.0	486.5	*	402.7	8,226.1	40,718	20.2%
2008	4,709.2	3,330.0	501.7	*	600.0	9,140.8	41,132	22.2%
2009	4,863.8	4,558.3	533.8	21.1	778.2	10,755.2	39,028	27.6%
2010	3,313.3	4,861.8	534.2	20.6	861.2	9,591.1	39,669	24.2%
2011	5,331.8	6,991.9	506.5	35.3	862.6	13,728.1	37,871	36.2%
2012	4,843.6	8,263.6	548.6	35.4	1,064.8	14,756.1	36,602	40.3%

Source: Scottish Government

Scotland has two operational nuclear power plants, which are an important source of de-carbonised electricity and use fuel imported from abroad. Once fuel has been used in a reactor it can be reprocessed to provide additional energy, but this produces a significant quantity of radioactive waste that has to be safely contained for many years. In Scotland, waste is stored on the surface at the generation site rather than deep underground as is the preference in England and Wales.

Table 3 illustrates the extent of nuclear waste and the lifetime potential volume of waste.

Table 3: Radioactive waste in Scotland

Waste type *	Volume (cubic metres)		
	Stocks at 1 April 2010	Estimated future arisings	Lifetime total once all waste is packaged
Intermediate-level waste	8,080	17,400	41,500
Low-level waste	30,500	245,000	374,000

* Radiocative waste is categorised into four levels; no high-level waste is managed in Scotland.

Scottish energy policy has shifted away from nuclear generation. At the end of their operational life, Scotland's nuclear power plants will not be replaced. Both nuclear power plants currently have a decommissioning date of 2023.

Pressures affecting energy supply and demand

Energy faces pressures in relation to demand (the quantity of energy required) and supply (how energy is produced).

Population and households

Scotland's population is increasing, and how we live is changing (living longer but in smaller sized households). This is leading to increased demand for housing and for energy. Scotland's population was approximately 5.3 million in 2012. The latest projections suggest that this will rise to 5.76 million by 2035.The number of households grew faster than the rate of population increase (by 343,000, or 17%) between 1991 and 2012, indicating that household structures are changing, with fewer occupants per household.

Projections suggest that by 2035 the number of households in Scotland will increase to 2.89 million. This will further increase demand for housing and energy.

Road transport

Figure 2 shows that from 2005 to 2011, total personal transport fuel consumption in Scotland fell by 10%, while over the same period freight consumption increased by 5%.

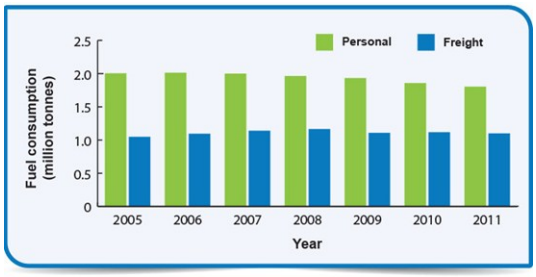

Figure 2: Road-transport energy consumption in Scotland: tonnes of fuel for freight and personal transport per year

Source: Scottish Government, Energy in Scotland Compendium 2014

Figure 3 shows that since 2007, total vehicle kilometres on Scotland's roads had been reducing year on year, although there was a marginal increase in the year to 2012.

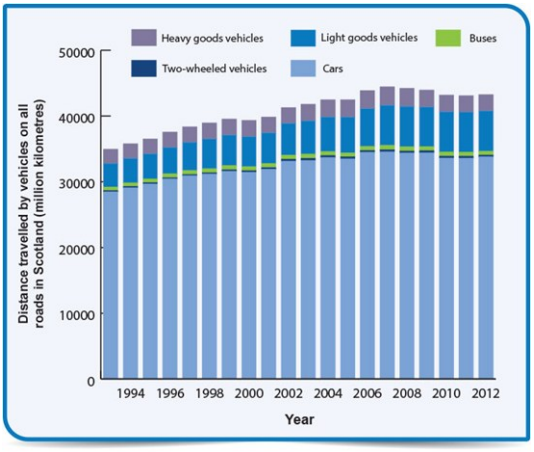

Figure 3: Distance travelled by vehicles on all roads in Scotland, 1993–2012

Source: Scottish Government, Energy in Scotland Compendium 2014

Electric vehicles have great potential for reducing greenhouse gas (GHG) emissions produced by road transport. However, not enough people are buying vehicles that use this technology. Electric vehicles need to become relatively less expensive to buy, easier and cheaper to refuel or recharge, and capable of travelling distances on one charge similar to cars powered by fossil fuels.

Energy reserves

There are significant coal reserves in Scotland, but burning coal (a fossil fuel) produces a lot of greenhouse gases.

However, mine waters in abandoned workings in Scotland's Midland Valley are a potentially important geothermal resource. Deep geothermal energy is an emerging technology that could be an important source of energy in Scotland in future. The Scottish Government has published a study on the potential of geothermal energy in Scotland. It estimates that there could be enough energy available in Scotland's abandoned mine workings to provide one third of Scotland's heat demand – however it notes that the actual contribution is likely to be significantly less because heat cannot be transported efficiently over large distances. Other potential sources of geothermal energy in Scotland were also identified including "hot sedimentary aquifers" and "hot dry rocks".

Scotland also has unconventional sources of oil & gas, including, shale gas and coalbed methane. The British Geological Survey has studied the shales of the Midland Valley and estimated the shale gas and oil resource – that is the total amount of gas and oil present in the rocks. However, further work is required to estimate how much of this resource is recoverable.

In 2011 Scotland produced more than 60% of oil in the European Union (EU) and approximately one-third of EU total hydrocarbon production. It is estimated that 15-24 billion barrels of oil and gas equivalent (boe) could still be recovered from within the UK's territorial waters, worth up to £1.5 trillion and generating between £41 and £57 billion in tax revenue between 2012 and 2018. This is equivalent to more than half the total quantity recovered since the 1970s).

However, continuing to produce and consume oil, natural gas and coal will make it more difficult to achieve Scotland's climate change targets. Also, the development of carbon pricing over the next few years could dramatically reduce the value of fossil-fuel reserves around the world. If international agreement is reached to support the practice of placing limits on greenhouse gas emissions and paying for the excess emissions, this will effectively monetise future carbon emissions and significantly devalue fossil-fuel reserves. Reducing the market value of fossil-fuel reserves could result in them becoming obsolete, and could also significantly reduce

the economic viability of deep marine fossil-fuel reserves and reserves in other locations that are difficult to access, such as places that are highly valued for their habitats or species.

One option to make up for the shortfall in electricity generation when Scotland's nuclear reactors are decommissioned is a large new fossil-fuel-burning plant with integrated carbon capture and storage (CCS). Also, accelerating the upgrade and expansion of the transmission infrastructure could tap into potential wind and wave power.

What is being done

Scotland has some of the most stringent and challenging energy targets in the world, supported by policies, incentives and targeted support. Together, they aim to reduce Scotland's contribution to climate change, support new technologies in Scotland and reduce our reliance on fossil fuel.

Policy and legislation

Targets

To reduce GHG emissions we must decarbonise our energy supplies, and this means moving away from fossil fuels as well as making CCS a reality on an industrial scale.

The Climate Change (Scotland) Act 2009 contains ambitious targets to reduce GHG emissions while maintaining economic growth. Those relating to energy include:

- delivering the equivalent of at least 100% of gross electricity consumption from renewables by 2020, with an interim target of 50% by 2015;
- reduce final energy consumption in Scotland by 12%;
- operating CCS on a commercial scale by 2020;
- fitting CCS in conventional power stations by 2025-30;
- developing better interconnection and upgrading transmission to cope with the projected growth in renewable electricity generation;
- supplying 11% of Scotland's heat needs from renewable sources by 2020.

This is already having a direct impact on the supply and consumption of energy. The Scottish legislation is on top of UK and European Community (EC) legislation and the United Nations' global agreement to reduce emissions.

UK legislation that has a particular impact on energy supply in Scotland includes the Utilities Act 2000, that deals with gas and electricity markets, and the Energy Act 2004, which, among other things, deals with road-transport fuel. The implementation of these two Acts has led to obligations being set for electricity generators and road-fuel suppliers in order to increase the amount of energy from renewable sources supplied to customers.

For private road transport in particular, taxes encourage people to use less fuel – for example, tax on fuel, and higher road tax on cars that are less efficient, and using income tax to eliminate the benefit-in-kind associated with driving a company car.

Policy

The Scottish Government's Electricity Generation Policy Statement 2013 (EGPS) examines the way in which Scotland generates electricity, and considers the changes necessary to meet a range of energy related targets, including the future energy generation mix required. It reflects views from both industry and other stakeholders and also developments in UK and EU electricity policy. It looks at where we get our electricity from, the amount of electricity we use and what we will need to do to meet our energy needs over the coming decade and beyond.

A Scottish Heat Generation Policy Statement is currently being developed and the potential for future generation sources such as geothermal and solar in Scotland are being assessed.

Improving energy efficiency

Individuals, organisations and businesses are being encouraged to reduce the amount of energy they use by installing insulation, energy-efficient lighting, modern heating controls, etc.

Reducing the amount of energy used in households has an important part to play in achieving the energy reduction, climate change and fuel poverty targets. The Scottish Government's Home Energy Scotland advice centres provide advice and support to help save energy, money and to reduce greenhouse gas emissions.

In addition, the advice centres deliver the Home Energy Efficiency Programmes for Scotland (HEEPS) and advice on sustainable transport.

Smart meters are currently limited to providing information about how much gas and electricity is being used, and at what cost. Although this is a useful tool in raising awareness and encouraging energy efficiency. Smart meters are currently being developed to allow energy suppliers to obtain accurate information on energy consumption. The new Energy Efficiency Directive requires estimated bills to be phased out by 2015 and smart meters will help to fulfil this requirement. Starting in 2015, every Scottish household will have the opportunity to take a smart meter. These will include an in-home display unit which will show how much energy is being used. These will show how changing behaviour can change the amount of energy used. Installation of smart meters should be complete by 2020.

The smart meter could even decide when to draw power from an electric vehicle connected to the household supply. Once these meters are in widespread use they could have a huge effect on smoothing out peaks in demand and remove the need for such a high level of spare 'quick response' capacity in the national electricity supply.

New cars and other road vehicles must be sold in the UK with information about their fuel efficiency under standard test conditions. These conditions have been set by various EC directives which first appeared in 1970 and have been frequently revised.

The Resource Efficient Scotland programme has been set up to help the public, businesses and organisations across Scotland save money by providing advice on how they can use their resources (including energy) more efficiently.

Decarbonising energy and heat supply

The Renewables Obligation Scotland (ROS) came into effect in 2002 and places an obligation on electricity suppliers to source an increasing proportion of the electricity they supply from renewable sources. Smaller-scale generation is mainly supported through the Feed-In Tariff scheme (FIT).

The ROS is driving large-scale renewable-energy projects in Scotland. A further 14 GW of planned and approved capacity could become operational in the coming years (Figure 4).

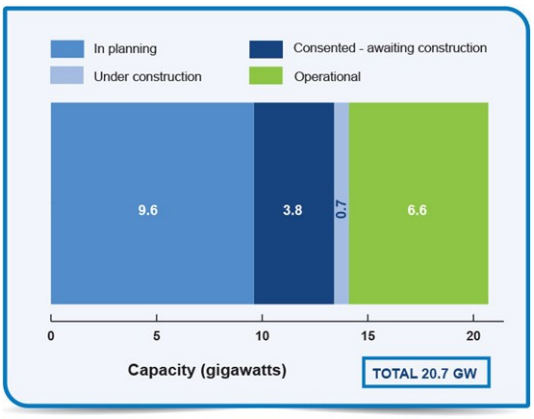

Figure 4: Renewable capacity in Scotland by planning stage, December 2013

Source: Scottish Government, Renewable Energy Statistics for Scotland

The Renewable Transport Fuel Obligation (RTFO) is one of the UK Government's main policies for reducing greenhouse gas emissions from road transport in the UK. The RTFO helps bring the UK into line with European Union Biofuels Directive. Scotland's target is for biofuels to make up 10% of transport fuel consumption by 2020.

The Renewable Heat Incentive (RHI) is a UK Government scheme set up to encourage the use of renewable energy to heat buildings by providing financial incentives. This is now available for households as well as industry, businesses and the public sector.

Supporting new technologies

Although good progress is being made in increasing the supply of de-carbonised electricity, the speed of this development is limited. The high costs of developing new technologies, such as offshore wind and wave, require more assistance than mature technologies, such as landfill gas or biomass co-firing. In order to help overcome these constraints, bandings of Renewable Obligation Certificates have been introduced.

Scotland has the potential to produce 25% of the total potential for tidal energy in Europe, and 10% of its waveenergy. Special support has been given to the development of marine renewables through the establishment of the European Marine Energy Centre (EMEC) in the sea around Caithness and Orkney. More grid-connected marine-energy converters have been deployed at EMEC than at any other site in the world, and the centre is the world's only accredited marine-energy laboratory.

The sea around Orkney hosts the world's first commercial-scale leasing for marine energy. Leases have been awarded for just over 1.6 GW of marine-energy projects in the area. This alone could be enough to power 750,000 households.

Interest in using hydrogen as a fuel is growing in Scotland, and several research, development and demonstration projects have been supported by the public sector. To date, the provision of complete 'renewable energy – fuel cell – hydrogen storage' systems are rare, with operational examples limited to isolated projects such as the Project for Unst Renewable Energy (PURE) Energy Centre, Shetland and within the Hydrogen Office demonstration project in Fife.

In Shetland the project combines wind power with electrolysis to produce hydrogen, which can be stored, used as back-up power and also used for low-carbon transport. From late 2014, Aberdeen will be home to the largest fleet of hydrogen-powered buses in Europe.

Developing the technology for CCS is a priority in Scotland, and this is being taken forward with government support and expertise from the oil and gas sector and academics. However, CCS may not be available on a commercial scale for some years.

The Scottish Hydropower Resource Study found that there could be enough hydropower to supply a quarter of Scotland's homes. However, not all the resource that could be available will be harvested, as the need for drinking water, ecology and recreation (fishing, kayaking) must also be met.

Technology and Project Support

The Scottish Government provides funding to initiate and support renewables projects, to encourage technology development, and to stimulate private sector investment in infrastructure. Examples include:

- £103 million Renewable Energy Investment Fund (REIF), which prioritises marine renewables, renewable district heating and community renewable projects;
- £30 million through Wave and Tidal Energy Support Schemes and investment at the European Marine Energy Centre (EMEC) to support wave and tidal technologies;
- £18 million Marine Renewables Commercialisation Fund (MRCF);
- £35 million Prototyping for Offshore Wind Energy Renewables Scotland (POWERS) fund;
- Community and Renewable Energy Scheme (CARES) to support community investment / ownership of renewable energy;
- the District Heating Loans Fund will provide over £11 million between 2011/15.

7.6 Land use strategy

Scotland's land provides us with a wealth of benefits, such as food, timber, clean water, energy, and a space for recreation. However, we still demand more. The Land Use Strategy addresses how we can sustainably manage our land to ensure we get the most from it.

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Summary

Key messages

- Scotland's landscape is heavily shaped by the way our land is used and managed. From this, we get a wide range of benefits that contribute to the character and attractiveness of being in Scotland.
- Over centuries, land use has significantly influenced the production of food, wood, energy, recreation, a wide range of amenities, and the character of the landscape we have today.
- Scotland's Land Use Strategy provides a strategic vision that will allow us to realise the full potential of our land and use it in ways that result in multiple benefits.

Laid before Parliament in 2011, Scotland's first Land Use Strategy sets out how we can try to get the best from our land. It:

- provides a new Vision for land use;
- sets out three Objectives relating to the economy, environment and communities – the three pillars of sustainability;
- provides 10 Principles for Sustainable Land Use that will guide policy and decision-making;
- includes Proposals to help meet these objectives;
- includes 10 strategic indicators which measure the three objectives;
- builds on the Scottish Government's current activities.

State and trend

The strategy is being monitoring through 10 high-level indicators, they are being monitored annually and the most recent summary can be found at the Land Use Strategy pages.

Overview

The term 'land use' covers all forms of land (and water) management. Farming, forestry, renewable energy, housing developments and recreation are just a few of the major land uses in Scotland. Practically every hectare of Scotland is used in at least one way, though a few of our remote coastal cliffs and mountain tops are free from such uses.

In other areas on the website we give details of the range of land uses, such as agriculture and forestry.

As a key commitment of Section 57 of the Climate Change (Scotland) Act 2009 the Scottish Government committed to developing a land use strategy. The Strategy was laid before Parliament two years later, in March 2011. It emerged from a wide consensus that we are not getting the best from Scotland's land, even though we continue to demand more and more from it. Accordingly, the Strategy looks at the challenges facing land use. By recognising the benefits and implications of decisions we make about land use, and by focusing on common goals, the Strategy will provide a more integrated approach to land use.

The Strategy sets this out its Vision as: 'A Scotland where we fully recognise, understand and value the importance of our land resources, and where our plans and decisions about land use deliver improved and enduring benefits, enhancing the wellbeing of our nation.'

Its three Objectives are to have:

- land-based businesses working with nature to contribute more to Scotland's prosperity;
- responsible stewardship of Scotland's natural resources, providing more benefits to Scotland's people;
- urban and rural communities better connected to the land, with more people enjoying the land and positively influencing land use.

The Strategy has 10 Principles for Sustainable Land Use to help guide decision-making and 13 Proposals for action.

The Land Use Strategy Action Plan provides details explaining how the Strategy will be taken forward by the Scottish Government and its partners. In May 2014 the Scottish Government published an update on progress in developing the Strategy.

Why do we need it?

Scotland's land provides us with a wealth of benefits, such as food, timber clean water, energy, employment, transport links and recreation opportunities.

Yet we demand more and more from the land – in terms of produce, recreational enjoyment, carbon storage, and a home for nature. So, we must try to find the best means of managing the land within its capabilities, while trying to get the most from it in a sustainable way.

Over much of Scotland there are strongly competing interests. In the uplands, for instance, neighbouring interests may favour using the land for sheep farming, grouse shooting, forestry, wind farms or leaving areas wild for nature. In some places all of these uses can be accommodated, but in others some may act against others. Here, the Strategy should guide decisions in an integrated way so that choices are well informed.

Therefore, it helps us think more strategically about the potential of the land and the ways in which it can be better used. Clearly, there are opportunities for major land users to work together to develop the Strategy. Information on some of the key land-use sectors can be found at the following links:

- agriculture;
- planning;
- Forestry Commission Scotland, which maintains three public information registers;
- energy consents;
- Scotland Rural Development Programme, giving details of LEADER and Challenge Funds.

What is being done

The Proposals within the Land Use Strategy are being taken forward by Scottish Government and its partners. Plans and policies in future will follow the Principles for Sustainable Land Use.

The Strategy identifies three significant changes in the way we approach how we use our land to help us meet the Objectives set out in the Land Use Strategy. These changes are:

- delivering multiple benefits from our land;
- working in partnership with nature;
- linking people to the land.

Work is underway to evaluate current land use delivery mechanisms, and to determine their effectiveness in turning the 10 Principles into practical decision-making.

Two ambitious regional land use pilot projects were established in 2013. One is in the north east and is led by Aberdeenshire Council. The other is in the south of Scotland and is led by Scottish Borders Council. These pilots are using an ecosystems approach to develop a framework to guide future decisions about land use.

Although the ecosystems approach has been discussed in ecological and environmental circles for decades, its formal integration into global government thinking came through the Millennium Ecosystem Assessment and, in the UK, through the UK National Ecosystem Assessment published in 2011.

The principles of the ecosystem approach are to:

- take account of how nature functions;
- take account of the services that the land provides;
- involve people in decision making.

A wide range of organisations throughout Scotland are involved in projects and initiatives that demonstrate the ecosystems approach and the benefits it can bring. Examples of these projects are:

- Fountainbridge Canalside Initiative;
- Grandhome Charette;
- Loch Leven Heritage Trail;
- Carse of Stirling Project;
- iDee Project.

The Land Use Strategy will evolve over time to take account of changing circumstances. It will be reviewed every five years and the next strategy is due to be published by March 2016. During 2014 and 2015 the government will provide opportunities for you to give your views on the next Strategy. You can find all the documents associated with the Land Use Strategy on the Scottish Government's Land Use Strategy web page.

7.7 Waste

Waste is produced by households and businesses. Progress is being made to reduce waste and increase recycling in Scotland, providing environmental and economic benefits.

Summary

Key messages

- Scotland generates around 13.2 million tonnes of controlled waste each year. Controlled waste is waste from households, businesses and industry that is legally controlled because of its potential to harm the environment.
- Nearly half of controlled waste comes from the construction and demolition industries.
- The remainder comes from households, businesses and other industries.
- Much of what we discard contains useful materials and energy.
- We need to reduce the amount of waste we create to protect the environment and conserve our valuable resources.
- We can do this by following the waste management hierarchy. This encourages waste prevention, followed by re-use recycling, energy recovery, and, last of all, disposal (for example, in landfill).
- Scotland has improved its recycling rates; household waste recycling has increased from 0.46 million tonnes in 2004 to 1.05 million tonnes in 2011.
- However, we still send a lot of waste to landfill. In 2011, 4.8 million tonnes of waste, including 1.5 million tonnes of household waste, was sent to landfill.
- Reducing consumption and waste generation, and increasing reuse and recycling will reduce greenhouse gas emissions.

State and trend

State: Moderate - high agreement, high evidence

Trend: Improving/stable - high agreement, high evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- These assessments are of the current “average condition”; some aspects are in a worse condition, and others are in a better one. Equally, some aspects of waste are declining, while others are improving.
- Making any overall assessment is necessarily a simplification.
- We have taken account of the scale of any damage to the environment in these assessments; impacts can be locally damaging, but may have little effect on a national scale.
- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

In Scotland we consume large amounts of materials and generate a lot of waste. This uses up finite resources and causes pollution. However, we are reducing the amount of waste we produce and recycling more.

Like most developed countries, Scotland produces waste because our economy is driven by consumption and we throw away many of the things we buy when we no longer want them.

Anything that we intentionally discard is known as waste. Legal controls apply to some waste because of its potential to harm the environment, and this is known as 'controlled waste'. This includes most waste from households, business and industry.

Waste is a problem because it uses up finite resources and causes pollution, which needs to be managed. In the past we sent most of our waste to landfill, but we now recognise the benefits of recovering materials and energy from discarded products.

To help do that, we should follow the waste hierarchy, which is a step-by-step guide to managing waste (Figure 1).

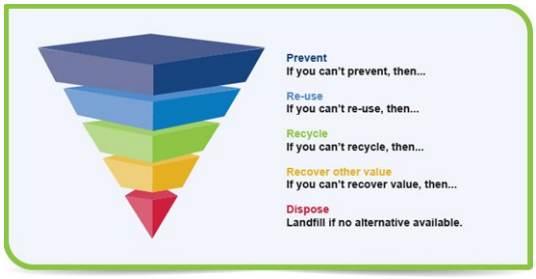

Figure 1: The waste-management hierarchy – a five-step guide to sustainable resource management

This approach means we should first try to prevent waste; for example, by making products that use fewer materials or that are easier to dismantle for re-use. Then, we should re-use, recycle or recover other value from waste. Disposing of waste in landfill is the worst option because all the embedded energy and financial value of the materials is lost. Landfill can also result in water and air pollution and affect the climate; for example, through greenhouse gas emissions.

Following the waste hierarchy will help Scotland achieve its goal of being a zero waste society, where waste is minimised and we get as much value as possible out of materials.

In the longer term, the aim is to eliminate waste through better product and service design. This can be done by using materials that are easier to recycle, making it easier to upgrade and re-use products over a longer lifetime, and by changing how those products are recovered at the end of their useful life.

Benefits of using waste as a resource

Using waste as a resource is the basis of the 'circular economy' concept, where resources circulate continuously and do not become waste. This will benefit Scotland's environment because less waste will be produced and sent to landfill, less energy will be used in managing waste, and more value will be obtained from the materials used in the economy.

We are already making progress. For example, in 2011, Scotland saved nearly 2 million tonnes of greenhouse gases through recycling. That's more than a 10% saving in Scotland's greenhouse gas emissions from waste.

There are also economic benefits. Zero Waste Scotland estimates that 5,000 jobs could be created by keeping materials circulating longer in the Scottish economy, and achieving the zero waste recycling targets is estimated to be worth about £180 million per year.

State

Scotland is producing less waste and recycling more materials. This is reducing the amount of waste we send to landfill. There are targets in place for further improvements.

How much waste do we produce?

In Scotland, we produced around 13.2 million tonnes of controlled waste in 2011.

The largest single amount was from the construction and demolition industry (46%), with waste from business, households and other industry making up the rest (Figure 2). A small proportion of the total (about 4.6%) was classed as hazardous waste.

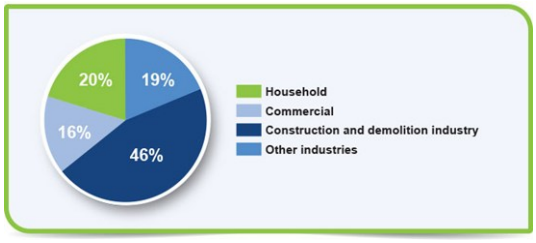

Figure 2: Controlled waste generated in Scotland by source (2011)

Sources: WasteDataFlow, SEPA returns from licensed / permitted sites and exempt activities.

The amount of controlled waste generated in Scotland has fallen over the past seven years from approximately 22 million tonnes in 2005 to 13 million tonnes in 2011 (Figure 3). This was mainly due to reductions in the amount of commercial and industrial waste, rather than the amount of household waste. At present, we do not know if this is a long-term trend or whether it is temporary and linked to the downturn in the economy that began in 2008.

Figure 3: Controlled waste generated in Scotland (2005 to 2011)

Sources: WasteDataFlow, SEPA returns from licensed sites and exempt activities.

How is waste managed?

We are moving away from using landfill to dispose of waste. The amount of Scottish controlled waste sent to landfill has fallen steadily from approximately 11.2 million tonnes in 2000 to 4.8 million tonnes in 2011 (Figure 4).

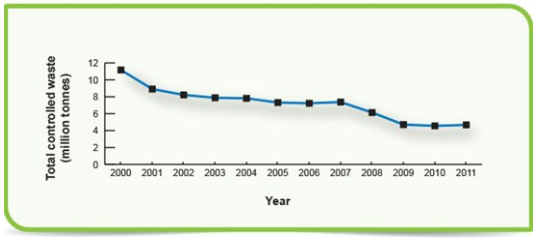

Figure 4: Total Scottish controlled waste sent to landfill (2000 to 2011)

Source: SEPA licensed / permitted site returns.

The reduction in landfill is partly due to increased recycling. Figure 5 shows that in 2011, 1.05 million tonnes of Scottish household waste was recycled, compared to 0.46 million tonnes in 2004.

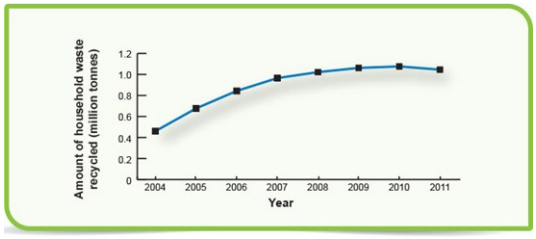

Figure 5: Amount of Scottish household waste recycled (2004 to 2011)

Sources: SEPA Local Authority Waste Arisings Survey (LAWAS) and WasteDataFlow.

Work is underway, through Scotland's Waste Data Strategy, to improve understanding of where our waste ends up and, in particular, how much is re-used or recycled within new products.

The impact of our waste

Our consumer-driven economy means we use up energy and natural resources at every stage of the life cycle of products, from production to consumption, and this creates waste and emissions (Figure 6).

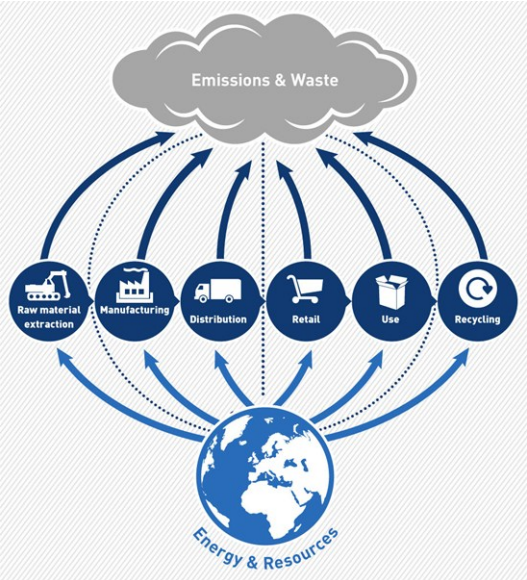

Figure 6: Impacts of energy and resource use across the life-cycle of products

This 'whole system' approach underpins Scotland's Carbon Metric, which measures the environmental impact, in terms of greenhouse gas emissions, of all waste in Scotland.

Greenhouse gas emissions associated with the production and management of Scotland's waste in 2011 were 13.9 million tonnes of carbon dioxide equivalent.

Achieving the Scottish Government's targets for recycling and waste reduction by 2025 should reduce this by 3 million tonnes of carbon dioxide equivalent (22%). The biggest reductions will be achieved through waste prevention.

How waste is managed can harm the environment in other ways, including odours and air and water pollution from landfill sites and other waste-management facilities.

Comparison with Europe

Scotland's record on waste management, particularly for municipal waste, can be compared with the countries of the European Union (EU). For municipal waste, per head of population, and compared with the EU average, Scotland:

- produces more;
- recycles and composts less;
- landfills more;
- incinerates less.

Pressures on using waste as a resource

Globally, a rising population and increased consumerism is placing unprecedented demand on many finite raw materials and causing increased greenhouse gas emissions and waste. Traditional forms of waste management, such as landfill, are physically and environmentally unsustainable and can be highly polluting.

All this has led to a move away from landfill and towards recycling or re-using valuable materials. In Scotland, this shift is supported by policy measures such as the Waste (Scotland) Regulations 2012 and the Landfill Tax (Scotland) Bill.

Although this has helped to increase levels of recycling and reduce waste disposal, there are still a number of barriers that prevent greater use of waste as a resource in Scotland. These include:

- product design (using materials that cannot be recycled, or restricting easy repair or recovery of materials);
- the infrastructure (fragmented collection systems and insufficient facilities to sort and process valuable materials);
- consumer behaviour (the 'throwaway' consumer culture and incorrect use of recycling facilities);
- changes in demand, often driven by new technology, which leads to products becoming obsolete and useless.

What's more, because we live in a globalised economy, Scotland's ability to influence some of these factors is limited. Similarly, because many of the goods we use are sourced and manufactured in other parts of the world, often in locations where production costs are relatively low, much of the waste associated with their production is not visible to us and remains in the country where a product came from.

Therefore, strategies to reduce waste and use materials more sustainably need to work with different sectors of the economy, from design through to waste management, and consider the full impacts of our consumption – not just those which occur within our territorial boundaries.

What is being done

Scotland's aim is to become a zero waste society, managing materials better to benefit from protected resources and a safe and healthy environment, more jobs, and a stronger economy.

Ultimately, the aim is to eliminate waste from the economy by designing better products and business models and making it easier for people to repair, re-use and recycle goods when they have finished with them.

Policy and legislation

Waste management in the EU

Since 1975, the EU has been introducing laws to help minimise the harmful effects of waste and encourage Europeans to conserve natural resources. This has driven waste-management legislation and practices in Scotland, the UK, and every other EU member state.

The European Waste Framework Directive came into force in December 2010. It focuses on waste prevention and on turning EU member states into societies that recycle waste.

Scotland's latest strategy for waste is set out in the Zero Waste Plan, which was published by the Scottish Government in 2010. The Zero Waste Plan aims to reduce the amount of waste we produce and ensure that we recover as many valuable materials from it as possible. It sets long-term targets for recycling and composting 70% of all Scottish waste by 2025, and sending no more than 5% to landfill.

To support these aims, the Waste (Scotland) Regulations were passed by the Scottish Parliament in 2012. These regulations include requirements to separate key recyclable materials, including food waste, that comes from homes and businesses. There will ultimately be a ban on biodegradable waste going to landfill by 2021.

These actions will:

- ensure more materials can be re-used or recycled;
- ensure that energy is recovered from materials that can't be re-used or recycled;
- limit the need to send waste to landfill;
- encourage investment in the infrastructure needed for increased recycling and recovery;
- improve public confidence in recycling and further encourage the culture of recycling across Scotland.

Practical action to reduce waste

The Zero Waste Scotland programme has been created to put in place the actions set out in the Zero Waste Plan.

It has helped to increase recycling collections, including supporting the roll-out of food waste collections by councils to over 1.2 million households, as well as investing in reprocessing facilities for materials like food waste and plastics.

Around 40% of Scotland's household waste is currently recycled and this is continuing to rise, although more slowly as recycling collections become more established.

Reducing the amount of waste generated and encouraging more sustainable consumption are also important areas for action. The Scottish Government has published a separate strategy – Safeguarding Scotland's Resources – that focuses on waste prevention and the circular economy. It includes a target to reduce the amount of waste generated in Scotland by 15% by 2025. Many of the actions within this strategy will be put in place through the new Resource Efficient Scotland programme, which helps businesses and public-sector organisations to use materials, energy and water more sustainably. Individuals are also encouraged to reduce the amount of waste they produce; for example, by the Love Food Hate Waste campaign or by buying re-used goods.

Litter and flytipping will be targeted in Scotland's first national litter strategy and a national litter-prevention campaign. This will be complemented by plans to introduce a charge on single-use carrier bags.

New tools are being developed to collect and report information about waste. This includes a UK-wide Electronic Duty of Care system to record waste transfers (information to allow the tracking of movement of waste) and the Scottish Waste Data Interrogator, an interactive data-analysis tool. These, together with the Carbon Metric, will help to fulfill the aims of the Waste Data Strategy and build a better picture of the impact and management of waste and resources.

The waste-management industry is supporting Scotland's aspirations by providing services to recycle and re-use waste and investing in alternatives to landfill. Many organisations in this industry have signed up to Scotland's Resource Sector Commitment, which sets quality standards for recycling services.

Many businesses are taking action to reduce the impact of waste from their products. This includes action encouraged through a number of voluntary collective initiatives like the Courtauld Commitment, Hospitality and Food Service Agreement and Product Sustainability Forum.

Some businesses are already adopting the circular economy concept; for example, by introducing re-use and repair services, or leasing goods to customers rather than selling them. This will affect the types of things that end up as waste. Many leading companies in this area are supporters of the Ellen MacArthur Foundation, which aims to speed up the transition to a circular economy.

Appendix A

A.1 Scotland's Environment partners

Governing partners involved in Scotland's Environment

	British Geological Survey (BGS) Founded in 1835, the British Geological Survey (BGS) is the world's oldest national geological survey and the United Kingdom's premier centre for earth science information and expertise. As a public sector organisation BGS is responsible for advising the UK government on all aspects of geoscience as well as providing impartial geological advice to industry, academia and the public. The BGS is part of the Natural Environment Research Council (NERC), which is the UK's main agency for funding and managing research, training, and knowledge exchange in the environmental sciences. The NERC reports to the UK government's Department for Business, Innovation and Skills (BIS).
	Education Scotland Education Scotland is an Executive Agency of the Scottish Government, tasked with improving the quality of the country's education system. Education Scotland's vision is that Scottish learners will progress in one of the most effective education systems in the world, renowned for the ability of national and local partners to work flexibly together to achieve high-quality and equitable outcomes for all. Our status as an executive agency means that we operate independently and impartially, whilst remaining directly accountable to Scottish Government ministers for the standards of our work.
	Forestry Commission Scotland Forestry Commission Scotland (FCS) was created on 1 April 2003 as a result of the Forestry Devolution Review. We serve as part of the Scottish Government's Environment and Forestry directorate, and are responsible to Scottish ministers, advising on and implementing forestry policy and managing the national forest estate. **Mission statement** Our mission is to protect and expand Scotland's forests and woodlands and increase their value to society and the environment.
	Health Protection Scotland Health Protection Scotland (HPS) was established by the Scottish Government in 2005 to strengthen and co-ordinate health protection in Scotland. We plan and deliver effective and specialist national services which co-ordinate, strengthen and support activities aimed at protecting all the people of Scotland from infectious and environmental hazards. We do this by providing advice, support and information to health professionals, national and local government, the general public and a number of other bodies that play a part in protecting health.

Historic Scotland

Historic Scotland is an Agency within the Scottish Government and is directly responsible to Scottish Ministers for safeguarding the nation's historic environment, and promoting its understanding and enjoyment.

Historic Scotland has had a number of different names and emphases of function over the past few decades but we became Historic Scotland in 1991.

Keep Scotland Beautiful

Keep Scotland Beautiful (KSB) is the independent charity which takes action, campaigns and educates on a range of local, national and global environmental issues affecting people's quality of life. It is committed to making Scotland clean and green, today and tomorrow.

From our origins as an anti-litter campaign group, KSB is now a multi-faceted organisation operating across the spectrum of environmental issues from littering to climate change.

We operate in three main areas: sustainable development education, local environmental quality and sustainability and climate change.

Marine Scotland

Marine Scotland's purpose is to manage Scotland's seas for prosperity and environmental sustainability.

NHS Scotland

NHS Scotland currently employs approximately 140,000 staff who work across 14 regional NHS Boards, seven Special NHS Boards and one public health body.

Each NHS Board is accountable to Scottish Ministers, supported by the Scottish Government Health and Social Care Directorates.

Regional NHS Boards are responsible for the protection and the improvement of their population's health and for the delivery of frontline healthcare services. Special NHS Boards support the regional NHS Boards by providing a range of important specialist and national services.

All NHS Boards work together for the benefit of the people of Scotland. They also work closely with partners in other parts of the public sector to fulfil the Scottish Government's Purpose and National Outcomes.

Scottish Environment Protection Agency (SEPA)

The Scottish Environment Protection Agency (SEPA) is Scotland's environmental regulator. Our main role is to protect and improve the environment. We do this by being an excellent environmental regulator, helping business and industry to understand their environmental responsibilities, enabling customers to comply with legislation and good practice and to realise the many economic benefits of good environmental practice. We protect communities by regulating activities that can cause harmful pollution and by monitoring the quality of Scotland's air, land and water. The regulations we implement also cover the keeping and use, and the accumulation and disposal, of radioactive substances.

	SEPA is a non-departmental public body, accountable through Scottish Ministers to the Scottish Parliament. SEPA has been advising Scottish ministers, regulated businesses, industry and the public on environmental best practice for over a decade.
	Scottish Natural Heritage **'All of nature for all of Scotland'** Scotland's natural heritage is its wildlife, habitats, landscapes and natural beauty. Scotland is renowned for its attractive scenery and wild places and has a huge diversity of landscapes, habitats and wildlife. These are part of what makes Scotland special and are among the country's greatest assets. Scottish Natural Heritage is funded by the Scottish Government. Our purpose is to: Promote care for and improvement of the natural heritage Help people enjoy it responsibly Enable greater understanding and awareness of it Promote its sustainable use, now and for future generations.
	The Conservation Volunteers (TCV) The Conservation Volunteers have been reclaiming green places since 1959. Right now, when one third of the UK's green places are in danger of being lost or degraded, our work is more important than ever. The everyday green places that people use are especially vulnerable. 10,000 playing fields were sold off between 1979 and 1997. Only 10% of the UK's allotments remain. Places like these do not have special protection. They are all under threat at a time when local councils are cutting budgets. But neglecting green places is a false economy. It doesn't take long for a once-loved open space to become a magnet for anti-social behaviour, and a cost to society.
	The James Hutton Institute The James Hutton Institute is a world-leading scientific organisation encompassing a distinctive range of integrated strengths in land, crop, waters, environmental and socio-economic science. It undertakes research for customers including the Scottish and UK Governments, the EU and other organisations worldwide. The Institute takes its name from the 18th century Scottish Enlightenment scientist, James Hutton, who is widely regarded as the founder of modern geology and who was also an experimental farmer and agronomist.
	The Scottish Government The devolved government for Scotland is responsible for most of the issues of day-to-day concern to the people of Scotland, including health, education, justice, rural affairs, and transport. The Scottish Government was known as the Scottish Executive when it was established in 1999 following the first elections to the Scottish Parliament. The current administration was formed after elections in May 2011.

	The Government's Purpose To focus government and public services on creating a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth.

A.2 Editorial Group

Rebecca Bell

BA (Hons), MSc, AIEMA Chair
Sustainable Scotland Network

Rebecca is the Chair of the Sustainable Scotland Network, the networking organisation for sustainable development officers in the Scottish public sector. The SSN supports the Scottish public sector to work together towards a sustainable Scotland by: coordinating programmes on climate change and sustainable procurement; sharing good practice and supporting collaboration; researching and promoting better solutions; connecting with national and international policy-makers; and providing access to up-to-date news, advice and guidance.Rebecca's main areas of expertise are strategic environmental assessment (SEA) and sustainable development policy, with current work focusing on embedding sustainable ways of working across Clackmannanshire Council, and on monitoring sustainability performance. She is currently preparing a new Sustainability and Climate Change Strategy for Clackmannanshire Council.

Dr Seamus G. Campbell

BSc, PhD, C Geol, C Sci, EurGeol
Chief Geologist Scotland
British Geological Survey

Diarmad is responsible for the British Geological Survey's onshore spatial data capture and 3D modelling programmes in Scotland, and cross-cutting research in the Glasgow area.He provides a range of geoscience information and advice to decision makers in Scotland. This is especially in support of urban development, regeneration and infrastructure projects, and in relation to a wide range of environmental impacts, including hazards related to landslides.He has previously been involved in similar work in Hong Kong, and prior to that in projects on the structural controls of mineralisation, especially gold, in Zimbabwe, and the interpretation of ancient volcanic rocks.

Nathan Critchlow-Watton

BSc, MSc
Chair of SoE Editorial Group
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State of Environment Unit
Scottish Environment Protection Agency (SEPA)

Nathan is responsible for co-ordinating monitoring of the water environment, with a particular focus on freshwaters. He also chairs the cross-partner Freshwater Monitoring group, which is tasked with delivering a co-ordinated monitoring network for Scotland. Nathan produces the annual status assessment for all waters in Scotland, bringing together data from across SEPA and partner bodies and publishing it to inform the public. During the development of this classification system, Nathan worked with partners across the UK and EU to shape the final scheme**.** Prior to this post, Nathan has worked as an ecologist in Scotland, England and Wales.

Dr Karen Dobbie

BSc, PhD, MISoilSci, CSci
Principal Scientist (Soil)
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Karen's role in SEPA focuses on developing soil / land aspects of Scotland's Environment Web and soil monitoring aspects of the CAMERAS Environmental Monitoring Strategy. Over the last six years, Karen has also worked in SEPA's Land Policy Unit and Field Chemistry Unit. She was an author and co-editor of Natural Scotland's state of Scotland's soil report (2011). Before joining SEPA, Karen worked for many years as a postdoctoral research fellow at Edinburgh University mainly on greenhouse gas emissions from soils and published a number of peer reviewed papers on a range of topics.

Dr. Daniel Hinze

Dipl.-Vw., MA, PhD
Head of Environmental Analysis Unit - Rural and Environment Science and Analytic Services (RESAS)
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Daniel is head of the Environmental Analysis Unit which supports Climate Change, Environmental Quality and Natural Resource policy. Daniel joined the Scottish Government in 2003, leaving a post at the Bundesbank in Frankfurt, and has worked in various Government posts, in the Scottish Government's Office of the Chief Economist, the Scottish Government Health Finance Directorate and, on secondment, in Scottish Water's regulation team.

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Historic Scotland

Karen is a Senior Research Manager for Historic Scotland. Her current work includes writing Scotland's Historic Environment Audit(SHEA), managing the Buildings at Risk Register for Scotland and providing evidence to support the implementation of the Historic Environment Strategy. Prior to this post, Karen has worked as Good Practice Manager for the Scottish Housing Regulator and as an analyst for the Scottish House Condition Survey. Karen has a postgraduate diploma in Geographic Information Systems, with a particular interest in geo-demographics.

Dr. Marie Russell

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Marine Scotland Science

Marie is mainly involved in marine environmental issues, particularly in relation to persistent organic pollutants and marine litter. She is the Marine Scotland Science lead on issues relating to marine litter for the Marine Strategy Framework Directive.She is the Marine Scotland Science Responsible Officer on the Clean and Safe Seas Evidence Group(CSSEG) of the UKMMAS(United Kingdom Marine Monitoring and Assessment Strategy). The evidence group co-ordinates and reviews monitoring and evidence requirements relating to hazardous substances, radioactivity, eutrophication, oil and chemical spills, marine litter, underwater noise, microbiological contamination and algal toxins.At Marine Scotland Science Marie works in the Marine Environmental Assessment Group, with responsibility for the analyses of organic contaminants. She is also responsible for ensuring that contaminant data from Marine Scotland Science is submitted to the Marine Environment Monitoring and Assessment National(MERMAN) database annually.

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Professor Des Thompson

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Principal Adviser on Biodiversity
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Des manages SNH policy and advisory work on ecosystems and climate change.With particular interests in the uplands and bird ecology, Des has fifteen books to his name on subjects ranging from raptors, shorebirds, vegetation, mountains and moorlands to the changing nature of Scotland. He manages the SNH-SEPA PhD studentship scheme, is Associate Editor of the Journal of Applied Ecology, and is currently involved in taking forward the Scottish Biodiversity Strategy to meet ambitious 2020 targets.Des collaborates closely with researchers and government advisers across the UK, and has strong ties with Norwegian officials. He is also a Trustee of the Field Studies Council.

Willie Towers

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Willie is a soil scientist whose early career was to map and characterise the soils in the north of mainland Scotland. This gave him the grounding to undertake applied research into diverse topics such as native woodland potential, waste recycling to land and land based renewable energy options for, and in partnership with, a wide range of government teams and agencies. He has produced over 200 publications including 35 refereed papers. More recently he undertook a short secondment to the Scottish Government to assist in compiling the Scottish Soil Framework and has acted as an advisor to the Government in the re-delineation of Less favoured Areas, including at the House of Lords.He is an author and co-editor of Natural Scotland's State of Scotland's Soils report (2011), is a member of Council of the British Society of Soil Science and is chair of the European Soil Bureau Network's Working Group on Soil Education and Awareness.

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The assessments were made in 2013, since then the affiliations of individuals to organisations may have changed.

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