FLS Biodiversity Duty Report

2018 to 2020

Introduction

The conservation and enrichment of biodiversity is a key priority for the Scottish Government and this is reflected in the Programme for Government. The *Scottish Biodiversity Strategy* and the *2020 Challenge for Scotland’s Biodiversit*y set out the Scottish Government’s ambitions for biodiversity and reflect a strong commitment to protect and enhance Scotland’s species and habitats. As a Scottish Government agency, Forestry and Land Scotland (FLS) manages Scotland’s national forests and land on behalf of Scottish Ministers. This summary report outlines actions carried out by FLS between 2018 and 2020 as part of its duty to further the conservation of biodiversity.

| Key Facts: Forestry and Land Scotland Action for Biodiversity 2018 - 2020 |
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| **Action** | **Achievements 2018-2020** |
| **Area of land managed to conserve biodiversity** | **640,000 hectares (ha)** |
| **Area managed as High Conservation Value Forest (HCVF)** | **149,076 ha - area maintained** |
| **Pre-operational surveys to identify protected species** | **> 2,500 work sites surveyed** |
| **Designated sites and species**  | **428 sites - 92.5% of features maintained in favourable condition** |
| **Restoration of Ancient Woodland Sites** | **28,000 ha – restoration actions taken in additional 500 ha Area now under active restoration 18,500 ha.** |
| **Protection of Natural Reserves**  | **36,865 ha - increased by 1,222 ha** |
| **Riparian woodland restoration** | **Additional 2,207 ha brought under active restoration** |
| **Peatland restoration**  | **Condition of 1,237 ha habitats improved. Restoration work completed on 2,884 ha** |
| **Coastal Sand Dune restoration**  | **12.6 hectares restored** |
| **Invasive Non-Native Species Removal**  | **> 1,500 ha of Rhododendron removed**  |
| **Creation of new Broadleaved Woodland** | **530 ha planted & 220 ha naturally regenerated** |
| **Flood risk management**  | **Specific measures planned or taken on > 272,208 ha**  |
| **Visits to Scotland’s national forests and land** | **Approx. 2 million rise in visitor numbers 2007-2019** |

**Section 1:** Information about Forestry and Land Scotland

FLS is a relatively new executive agency of the Scottish Government, having been launched in April 2019. The purpose of FLS, in its unique position as both an executive agency and the largest land manager in Scotland, is to act as steward of the public forests and land and to manage them in a balanced way that supports and enables economically sustainable forestry; conserves and enhances biodiversity and the wider environment; and delivers benefits for people and nature.

FLS therefore has a key role to play in delivering the Scottish Government’s ambitions and priorities for biodiversity, forestry and land management – including increasing its contribution to addressing both the current Biodiversity Crisis and Climate Emergency. Our aim is to bring about a transformational change across the 640,000 ha of national forests and land to maximise its contribution to biodiversity conservation, as well as Scotland’s ambitious climate change adaptation and mitigation targets.

**Section 2:** Actions to further the conservation of biodiversity

On an ongoing basis, FLS carries out a huge range of actions to protect and enhance biodiversity. This includes improving existing habitats and creating areas of new habitat. Scotland's national forests and land cover nearly 9% of Scotland’s total land area, but less than two-thirds is actually forest. Therefore, FLS works to improve open habitats as well as woodland, often partnership with other organisations.

Designated sites. FLS cares for a total of 428 statutorily designated sites and species. The designated sites cover 67,500 ha and these range from Caledonian forests and Atlantic oak woods, to blanket and lowland raised bogs. The species that are notified on these sites includes everything from capercaillie and crossbills, to freshwater pearl mussels and chequered skippers. NatureScot coordinates the Site Condition Monitoring across the network of all designated sites in Scotland, and as of December 2020, the vast majority (92.5%) of designated sites managed by FLS were in favourable condition. For designated woodlands, the figure is slightly lower (86%) and FLS is working hard to address the chronic threats; which on many sites result from deer browsing.

Ancient Semi-natural Woodland (ASNW). Scotland’s national forests include over 8,000 hectares of ANSW and these are generally the richest terrestrial habitats. Woodland types vary enormously across different regions of Scotland, depending on the local soils and climate, including Upland Oakwoods, Upland Birchwoods and Wet Woodlands. The best representatives of these have often been designated as Special Areas of Conservation (SAC) and Sites of Special Scientific Interest (SSSI). Work to protect and enhance ASNW sites is ongoing – largely though deer control to reduce browsing damage. Furthermore, during the period 2018 to 2020, a comprehensive survey of ANSW on FLS land has been carried out and is nearing completion. This will be the basis for a comprehensive restoration programme starting in 2021.

Plantation on Ancient Woodland Site(PAWS). These are areas that were formerly ancient, native woodland sites, but which were planted with conifers for timber production. The aim of the FLS PAWS programme is to restore these sites back to native woodland of high ecological value. So far 28,000 hectares of PAWS have been identified in Scotland’s national forests. In 2014, restoration work was underway on approximately 17,000 hectares of PAWS. By August 2020, this had increased to around 18,500 hectares.

High conservation value forest. Across Scotland’s national forest estate, roughly 30% (149,076 out of approximately 470,000 hectares) is classified as ‘high conservation value’ (HCV) forests. This is a Forest Stewardship Council designation and a key part of HCVs is ensuring activity in forests does not have a negative impact on biodiversity. The HCV area includes all the designated sites, PAWS and ASNW areas described above. The designated sites include Sites of Special Scientific Interest, Special Areas of Conservation and Special Protection Areas, and, as stated above, FLS works closely with NatureScot on the management of these sites.

Natural reserves. As part of the requirements of forest certification (see Section 3), FLS is required to create natural reserves (NRs). These are areas managed in perpetuity by minimum intervention and, on the national forest estate, they are predominantly woodland habitats. Conservation of biodiversity is the prime objective for these areas. The function of NRs is to provide a continuity of habitat to allow sedentary species to establish and thrive. NRs provide reservoirs of permanent habitat from which more mobile species can expand into adjacent managed forests. In 2018, FLS had 35,643 hectares of NRs. By the end of 2020, this figure had risen to 36,865 hectares.

Woodland creation. Scotland has approximately 17% woodland cover, which is much lower than most European countries. For example, Finland, Norway, France and Poland have approximately 72%, 37%, 36% and 29% woodland cover respectively. The Scottish Government has set ambitious targets for expanding woodland cover in Scotland and over the last decade FLS has been creating significant areas of new woodland – much of it in areas close to towns and cities to facilitate access and recreation, and a large proportion of it comprised of native broadleaf tree species. An expansion in woodland cover will yield a net increase in Scotland’s biodiversity, whilst important open habitats also need to be protected. More woodland will also increase connectivity for woodland species, allowing them to disperse more easily, and this will enhance the viability of their populations. In the period 2018 to 2020, the following new woodland was created on land managed by FLS:

| **Type of new woodland** | **Area (hectares)** |
| --- | --- |
| New area planted – conifer | 358 |
| New area planted – broadleaf | 530 |
| New area regenerated – conifer | 14 |
| New area regenerated – broadleaf | 220 |
| **Total area of new woodland** | **1122** |

Riparian woodland restoration. For over two decades, and in accordance with the requirements of the UK Forestry Standard and forest certification standards, FLS has had an ongoing programme of riparian woodland restoration. These linear features of natural habitat create a network that links patches of native woodland, increasing connectivity and dispersal, and thereby enhancing the viability of species’ populations. The restoration of broadleaf woodland along watercourses will also benefit aquatic invertebrates and fish, by improving water quality and regulating water temperatures; salmon in Scotland are increasingly threatened by warming temperatures in Scotland’s rivers and burns. Between 2018 and 2020, 2207 hectares of single-species conifer plantations, and former grazing ground, have been transformed into permanent riparian woodlands.

Peatland restoration. The National Peatland Plan (2015) indicates that peatlands cover over 20% of Scotland's land area. However, estimates point to as much as 80% of Scotland's peatland landscape having been damaged. The Scottish Government's Climate Change Plan aims to restore 250,000 hectares by 2030. The primary benefit of peatland restoration is in relation to climate change and storing carbon, though it has many other benefits including providing an internationally important habitat, improving water quality and reducing flood risk.

Since about 1995, FLS (and formerly FES) has been engaged in a significant programme of peatland restoration, both on blanket bogs and on lowland raised bogs. More recently, FLS has been intensifying its restoration efforts on an increasing area of damaged blanket bog, supported by a significant funding commitment from the Scottish Government. The condition of some blanket bogs has been improved by, for example, removing drainage systems and the remedial treatment of peat hags. Other blanket bogs have been completely restored by the removal of plantation crops and tree regeneration, followed by a range of ground re-wetting actions; including the installation of peat dams and the backfilling of drainage ditches.

| **Site treatment completed (ha)** | **2018** | **2019** | **2020** |
| --- | --- | --- | --- |
| Blanket bog condition improvement | 432 | 480 | 325 |
| Blanket bog restoration | 710 | 434 | 503 |
| **Total** | 1142 | 914 | 828 |

Sand dune restoration. FLS has been working to restore sand dune ecosystems on two sites in the north of Scotland: Lossie and Morrich More. Both these sites have been degraded by the encroachment of non-native trees species regeneration and the spread of scrub species, such as broom and gorse. Following basic principles, non-native tree regeneration and scrub species were mulched and the resultant debris removed from site. Next, the humus layers were scraped off the surface and removed from site. These actions are intended to prevent subsequent regeneration and encroachment of undesirable species, and to encourage the target habitat communities to thrive. Since April 2018, 3.6 hectares of dunes have been restored at Morrich More and 9 hectares of dunes have been restored at Lossie.

Species conservation. FLS carries out and supports a very extensive range of conservation work for rare, endangered, and protected species all across Scotland’s national forests and land. This is mainly in partnership with other organisations and individuals who have particular expertise. The work is predominantly focussed on vertebrates, particularly birds and mammals, which reflects the interests of stakeholders. However, FLS is expanding the range of work to include invertebrate species.

Between 2018 and 2020, FLS staff and partners collaborated on action for a large number of species, including capercaillie, golden eagles, white-tailed eagles, goshawks, common scoters, beavers, wildcats, water voles, red squirrels, freshwater pearl mussels and pine hoverfly. Key partners included NatureScot, the Raptor Study Groups, RSPB Scotland, the Royal Zoological Society of Scotland, Saving Scotland’s Red Squirrels, and the Scottish Wildlife Trust.

Forest management and biodiversity. The main driver of overall biodiversity in Scotland’s national forests is silvicultural management. FLS manages over 400,000 hectares of production forest, of which over 360,000 hectares is classed as plantation. Approximately 345,000 hectares is managed on a clear fell rotation, such that trees are grown and clear felled at maturity. A proportion of this area is thinned on a regular cycle. Over 20,000 hectares of the production forest area is managed by thinning and natural regeneration.

 The result of this management is that the forests comprises a mosaic of felled areas, young tree stands, thickets, unthinned mature crop and thinned mature crop, plus areas of natural tree regeneration. In addition, the remaining areas within Land Management Plans (see Section 3) include permanent open space, watercourses with riparian areas, and non-wooded habitats. Furthermore, at a national level, Scotland’s national forest estate is becoming more structurally diverse, as ‘first rotation’ plantations (i.e. those that have not yet been restructured), created in the 1950s and 1960s, are now being restructured and managed according to modern standards, which is creating more diverse forests.

This structural diversity in Scotland’s national forests provides innumerable niches that support a vast array of species – measured in the many thousands (many tens of thousands if you include soil biodiversity). From species that use open areas to those that require interior forest habitats. The structural diversity and the overall biodiversity will continue to increase until all of the first rotation forest have been restructured. Recent research indicates that species richness of various taxa (plants, invertebrates and birds) in managed plantations is surprisingly high and, somewhat surprisingly, approaching that of some semi-natural woodlands. However, the species assemblages of plants and animals in plantations were noticeably different, so plantations are not a direct replacement for native woodlands, which are invaluable for Scotland’s biodiversity. Nevertheless, anybody who uses timber products that are produced in Scotland should rejoice in the fact that plantations support significant biodiversity.

Deer management. Wild red deer and roe deer are an important part of Scotland’s natural heritage. However, in many parts of Scotland they occur at densities that are high enough to cause damage to habitats, particularly native woodlands. Excessive deer browsing prevents tree regeneration and prevents the development of a shrub layer within forests. Both of these impacts have a negative impact on biodiversity; essentially by reducing the structural diversity of habitats and thereby reducing the number of niches available to biodiversity. In addition, deer cause significant damage to tree crops. In order to protect habitats and tree crops, FLS invests significant resources to manage deer populations through culling.

Deadwood. Deadwood provides a habitat and food resources for thousands of species of animals, plants, bryophytes, lichen and fungi (and enormous numbers of microbes).

Scotland is a windy country and this creates deadwood in native woodlands and plantations on an ongoing basis. In native woodlands, deadwood is also created as trees are left to grow old and die. In plantations, huge amounts of certain kinds of deadwood are also created due to the process of timber production. For example, the stumps of felled trees are important deadwood habitats, and the ‘brash’ (branches) left on a felling site creates huge amounts of small diameter deadwood. However, certain types of deadwood, such as large-diameter logs and ‘snags’ (standing deadwood), are lacking in Scotland’s woodlands and plantations, and the overall levels of deadwood in Scotland tend to be lower than in natural forests in other countries). To increase the amount of deadwood – in line with the UK forestry Standard and the requirements of forest certification – and the associated biodiversity, FLS has a comprehensive deadwood policy that ensures the deadwood resource in Scotland’s national forests is enhanced on an ongoing basis.

Invasive non-native control – rhododendron. In 2010, FES set out a vision to remove rhododendron from as much of Scotland's national forests and land as possible. It was estimated that nearly 50,000 hectares of the estate was affected. Since then FES, and more recently FLS, has been undertaking an ambitious programme of rhododendron control across the country. To date action has taken place within 53% of the total area over which rhododendron has been recorded, with over 1,500 ha being removed over the last three years (2018-20).

Invasive non-native control – grey squirrels. Grey squirrels pose the greatest threat to red squirrel populations in Scotland because they can outcompete the red squirrels for habitat, and because they carry and transmit a disease called squirrel pox, which is usually fatal in red squirrels. To keep red squirrels in Scotland’s landscapes it is essential to have sustained, targeted, landscape-scale grey squirrel population control over the long term. To this end, FLS funds Saving Scotland’s Red Squirrels (SSRS) to carry out grey squirrel population control in a number of Scotland’s national forests, and in adjacent areas from which grey squirrels could recolonise. All of this work is part of wider control efforts by SSRS and it is all aligned with the Scottish Strategy for Red Squirrel Conservation (2015).

Further details are available on the SSRS website.

**Section 3:** Mainstreaming biodiversity

Furthering the conservation of biodiversity is a core part of the everyday work of FLS and it is integrated into every stage of the policy, plan and delivery cycle. All management activities in Scotland’s publicly-owned forests and land are carried out in accordance with a range of polices and guidance that ensure the protection, conservation and enhancement of biodiversity is a mainstream activity. Each of the five FLS Regions has a team of environmental specialists that collaborate on a daily basis with the staff involved in felling and planting trees, or building roads, to protect and enhance biodiversity.

Standards, strategies and plans. All FLS’s work is guided by the United Kingdom Forestry Standard (UKFS), the reference Standard for sustainable forest management in the UK. It outlines the context for forestry, sets out the approach taken by UK governments to sustainable forest management, defines standards and requirements, and provides a basis for regulation and monitoring – including national and international reporting.

The UKFS emphasizes that the conservation of biodiversity is an essential part of sustainable forest management in the UK, and outlines the forestry sector’s approach to contributing to the United Nations’ Convention on Biological Diversity, which provides the wider context for the Scottish Government’s approach to forests and biodiversity. The UKFS Guidelines on Forests and Biodiversity provide specific guidance on forest management to conserve and enhance biodiversity, and informs FLS’s work on a day-to-day basis.

Alongside the UKFS, the Scottish Forestry Strategy (SFS) and the FLS Corporate Plan (2019-2022) have also informed and guided FLS’s efforts to further the conservation of biodiversity. To ensure compliance with these requirements, FLS is audited each year by an independent forest certification organisation (currently The Soil Association) as part of our certification under the UK Woodland Assurance Standard (UKWAS). This certification process provides important, independent reassurance that FLS is implementing best practice in terms of its management of biodiversity.

Guidance. In the day-to-day management of Scotland’s publicly-owned forests and land, FLS staff follow a wide range of operational guidance. This guidance covers everything from protecting raptors and squirrels during forest operations, to ensuring watercourses and soils are not degraded during road building or tree felling. All of these guidance notes are available to view in the publication section of the Scottish Forestry website.

In addition to these forestry-sector-wide guidance notes, FLS also has a range of ‘in-house’ guidance notes that aim to reconcile forest management activities with the conservation of biodiversity. Between 2018 and 2020, several pieces of new guidance were developed to enable FLS staff to adopt consistent approaches to emerging issues, and some existing guidance was updated to account for changes in legislation. These included:

* Land management planning. Guidance for the preparation of land management plans on Scotland’s National Forest Estate. (2018)
* Applying an ecosystem approach to land management planning on Scotland’s National Forest Estate. (2018)
* FLS Environment Standard Operating Procedure No.1: Minimising disturbance of birds when using drones. (2020)
* FLS Environment Standard Operating Procedure No.2: Wildlife photography on land managed by FLS. (2020)
* FLS Environment Guidance Note 4: Stopping damage by hares to trees on the national forest estate. (2019 revision)

Land Management Plans. FLS invests significant time in planning land management to further the conservation of biodiversity. It is a complex process of engagement, analysis, design, discussion and agreement with stakeholders. The key output is the Land Management Plan (LMP), which is produced for every large forest or group of small forests managed by FLS. The LMPs are the forest-level plans that translate the strategic plans and policies into land management. Identifying environmental and biodiversity priorities within the LMP is an important part of the process, and each plan is written to further the conservation of these features. Engagement with stakeholders such as NatureScot and RSPB Scotland, as well as with local people and groups, is crucial to identify the most important environmental assets. This engagement is continued throughout the life of the LMP and the partnerships developed in the planning process continue to inform the conservation of biodiversity. In the period 2018 to 2019, FLS planners reviewed and update LMPs covering 125,310 hectares of Scotland’s national forest. All of these plans incorporated actions to further the conservation of biodiversity.

Work Plans. On a daily basis, FLS carries out a wide range of forest and land management activities. To ensure these activities do not have an adverse impact on biodiversity, and to ensure opportunities to enhance biodiversity are taken, FLS uses a ‘work plan’ system for all forest management and most civil engineering work. The Work Plan system is also used to manage a range of other activities. The Work Plan is a fundamental tool in the process of delivery of plans ‘on the ground’ and is fully complementary with forest planning. The Work Plan process provides the means of co-ordinating other plans covering Operations, Environmental and Social remits. The Work Plan is a ‘live’ document that is created for every job, whether it is felling an area of trees or building a new section of forest track. All relevant FLS staff input to the Work Plan and this ensures that relevant issues are highlighted.

 Pre-operational surveys. FLS Environment staff contribute to all Work Plans and this makes sure that operational staff area ware of environmental constraints and opportunities. As part of this core, everyday process, FLS Environment staff carry out pre-operational surveys prior to the commencement of operations. This means they visit each site to identify important habitat features, such as deadwood, and mark the sites of protected species, such as raptor nests and badger setts. They often deploy camera traps to ascertain whether or not setts or dens and other features are being used by protected species. In the three-year period from January 2018 to December 2020, FLS Environment staff carried out pre-operational surveys on over 2,500 work sites.

Once a pre-operational site visit has been carried out, mitigation measures are then written in to the Work Plan. For example, an exclusion zone will be placed around a raptor nest, which means work cannot be carried out within that zone during the breeding season. Exclusion zones and timing restrictions on operational activities are two actions that are used very frequently by FLS to protect biodiversity.

Conservation sites database. FLS Environment staff maintain an extensive database of sites used by protected and priority species and areas of important habitats. Everything that is found during pre-operational surveys is recorded in this GIS-based database. Consequently, it has grown considerably and in 2020 there were over 20,000 breeding sites and resting places recorded on the system. All of this data is used to inform operational planning and to enact mitigation to protect biodiversity. Reconciling wildlife and habitats with operational activities is a daily and ongoing process for FLS staff and the protection of biodiversity is very much a mainstream activity for the organisation.

**Section 4:** Nature-based solutions, climate change and biodiversity

FLS is responding to the climate emergency by proactively creating resilient forests and open land habitats that will continue to make a positive contribution to biodiversity enhancement and climate change mitigation, whilst also being future proofed against wildfire, more frequent storms and flooding, and new or damaging pests and disease. Here are some examples of the use of nature-based solutions being used by FLS to combat climate change and enhance biodiversity:

Land-based Carbon Capture. Over the last two years, FLS has been actively engaging with a range of potential partner businesses and organisations that are interested in investing in land-based carbon capture. Land based carbon capture projects on Scotland’s Forest and Land may involve creating new woodlands or restoring peatlands and can do more than simply lock up carbon. Projects can be tailored to combine climate change mitigation benefits with land reclamation, transforming landscapes, and restoring habitats, as well as linking to the investor’s Corporate Social Responsibility aims.

Woodland creation projects will be validated with and verified against either the Woodland Carbon or Peatland Code to provide independent assurance and registration of the carbon sequestration. As part of this initiative, in 2019 Shell started working with the Forestry and Land Scotland team on a project to establish around a million trees and restore over 800 ha of peatland across the forest estate.

FLS Climate Change Adaptation Programme

* Diversifying the forest. Between 2012 and 2002, FLS has diversified the tree crop in Scotland’s national forest. The proportion of the forest that comprises spruce, pine and larch has decreased by 1%, 3.54% and 1.16% respectively, and the proportion of the crop that comprises birch, oak and other broadleaf species has increased by 1.51%, 0.32% and 1.24% respectively.
* Increasing the proportion of native broadleaf trees. Between 2012 and 2020, the area of broadleaf trees in Scotland’s national forest increased from 32,189 hectares to 42,642 hectares. As a proportion of the crop, this is an increase from 7.5% to 10.56%.
* Flood risk management. This means the phased felling of crops upstream of areas prone to flooding. FLS manages land in 148 of Scotland’s 223 river catchments wherein there are priority areas prone to flooding downstream. These catchments are identified in the Scottish Environment Protection Agency’s (SEPA) Flood Risk Management Strategy (see [here](https://forestergis.com/apps/scot/map/?map=6cbba9fa-75f0-4b6b-a560-9e8aab681b5f)). In total, 272,208 hectares of the 638,786 hectares of land managed by Forestry and Land Scotland (42%) is located upstream of Scotland’s priority river flood points (towns and cities etc.) as defined by the SEPA strategy. Managing water flows sensitively in the header catchments has a significant positive effect on the peak flow at the flood point. Flood risk consideration is a key part of forest planning including woodland creation, phasing felling and replanting, peatland restoration and slowing the flow of water from the land.

Renewable Energy. More than 1GW of electricity generation capacity is installed on FLS land in the form of wind and hydro power. As part of our efforts to support the Scottish Government's ambitious emissions reduction targets and tackle the climate emergency, FLS continues to explore the potential of the renewable energy resource on the land we manage.

**Section 5:** Connecting people with nature, public engagement and workforce development

Connecting people with nature. Everyone can visit and enjoy Scotland’s national forests and land to connect with nature, have fun, and benefit their health and wellbeing. FLS manages some of the best places to visit in Scotland, with over 300 destinations including six Forest Parks, mountains, riversides, lochs, waterfalls, beaches and waymarked trails. FLS also looks after some of the most iconic views in the country, from Queen’s View in Perthshire to Glen Affric in the west Highlands. FLS manages the national forests and land in an inclusive and open way and strives to make the forests and land, and organized activities, more accessible to everyone. People from all backgrounds and communities are actively encouraged to enjoy and benefit from the national forests and land.

FLS Visitor Services teams in each of the five regions work hard to encourage the people of Scotland to visit the land managed by FLS. As evident in the table below, these efforts are successful and the number of visits is increasing. In both 2018 and 2019, there were over 10 million visits to Scotland’s publicly-owned land. At the time of writing, the number of visits in 2020 was not known, and it is difficult to predict, given the coronavirus pandemic. However, it was evident across Scotland that, after the coronavirus-related movement restrictions were lifted, the number of visits was extremely high. This was probably due in part to the fact that people were less able to holiday abroad.

| **Year** | **Number of visits** |
| --- | --- |
| 2007 | 8.7 million |
| 2013 | 9.1 million |
| 2018 | 10.6 million |
| 2019 | 10.6 million |

Most of the land managed by FLS – over 640,000 hectares – has a network of tracks on which people can enjoy recreation. Most people visit to walk, exercise their dogs and to cycle. However, a large proportion visit to see wildlife. Therefore, many FLS destinations are equipped with specially-designed nature hides for getting the best view of the local fauna. In these hides, and on the trails, FLS provides information panels or sometimes even guided tours, with knowledgeable staff on hand to help people make the most of their time in the woods.

Public engagement. FLS employs a large Visitor Services team that engages with the public all across Scotland. This engagement comes in many forms, including events, guided walks and every-day, face-to-face communication with visitors. Communicating the importance of Scotland’s national forests and land for biodiversity is a core message and this chimes well with the huge numbers of people who visit to see wildlife. A large number of other FLS staff give talks to the general public and special interest groups, on an ongoing basis. For example, in the period 2018 to 2020, the FLS Wildlife Ecologist gave 25 talks on biodiversity to a range of audiences.

The FLS public-facing website includes extensive information about biodiversity and in places the public can visit to observe wildlife. FLS also invest considerable effort in supporting television companies to use Scotland’s national forests and land to make documentaries about Scotland’s environment and biodiversity. Between 2018 and 2020, FLS facilitated the filming of wildlife for television programmes such as Countryfile, Landward, and the BBC’s flagship Autumnwatch and Springwatch series. FLS staff also provided expert advice for the producers and presenters of these productions.

Workforce development. FLS is always seeking to improve their staff’s awareness of, and expertise in, biodiversity, conservation and the environment. A range of in-house training is provided and staff are encouraged to undertake training by external providers, such as the Chartered Institute of Ecology and Environmental Management (CIEEM) and the Institute of Chartered Foresters (ICF). Obtaining membership of these organisations is also encouraged and a many staff in the FLS Environment team are members of CIEEM. In 2020, FLS has been developing a new, online training course in environmental awareness. This is being produced in association with LANTRA, which will ensure independent accreditation of the course. This compulsory course will be rolled out in 2021 to all operational staff and eventually to all staff.

**Section 6:** Research and monitoring

FLS funds and otherwise supports a wide range of applied research on biodiversity. Typically, this involves collaboration with conservation organisations and academic partners and numerous students have done their theses based on fieldwork in Scotland’s national forests. Below is a selection of the research that has started since 2018 and is ongoing.

Biodiversity Index. Most biodiversity change on the NFE is brought about by silvicultural and land management choices, which mainly affect lower taxa. For example, a decision to increase the proportion of native broadleaf trees can significantly influence biodiversity across. Structural parameters such as these are therefore ‘proxies’ for biodiversity and have the potential to act as ‘biodiversity indicators’. An appropriate suite of indicators could be combined and used to infer changes in biodiversity, thus providing a ***biodiversity index***. FLS is currently working with Forest Research to develop a biodiversity index for Scotland’s national forests, and changes in this index will give an indication of whether biodiversity is increasing or decreasing in Scotland’s national forests.

Wildcat research.The Wildlife Conservation Research Unit (WildCRU) at Oxford University is carrying out ground-breaking research on the remaining wildcat population in Scotland. This is being done by fitting GPS radio-tracking collars to putative wildcats and studying their behaviour. This work is being led by Dr Kerry Kilshaw of Wildcru and is part-funded and supported by Forestry and Land Scotland and NatureScot. One of the main aims of the project is to obtain new knowledge to improve forest management for wildcats. The project started in 2018 and is part of the Scottish Wildcat Action Conservation Plan. To date (December 2020), a total of 15 individuals have been collared. Although later genetic analysis showed these individuals to be wildcat hybrids, despite their wildcat markings (an issue widespread across the current wild-living cat population), initial analysis of the GPS data has indicated that they are behaving in a way that is similar to mainland European wildcats. It is therefore likely that they are fulfilling the same ecological niche as a wildcat would, and, as such, GPS data can provide important clues as to how they use FLS forests and what effect forest management might have on wildcat populations.

Red squirrel research. Reconciling timber production with wildlife conservation is a major challenge for FLS and much effort is expanded by FLS staff to protect red squirrels from harm during forest operations. However, knowledge of the likely impacts of forest management on squirrels is lacking.  FLS is collaborating with Dr Louise de Raad (Inverness College – UHI) to investigate the impact of forest operations on red squirrels. Specifically, the study is looking at the impact of crop-thinning operations on red squirrel breeding activity, survival, population density, home range size and drey use. This is being done by fitting GPS and radio collars to the squirrels and following them before, during and after forest operations. The results so far, suggest that the impact of these routine thinning operations during the breeding season on red squirrels were minimal.

Cairngorms Connect Predator Project (CCPP). This is a collaboration between the Cairngorms Connect partners (FLS, RSPB Scotland, Wildland Ltd. and NatureScot), Aberdeen University and members of the Highland Raptor Study Group. The CCPP started in 2018 and aims to improve understanding of the predator community and its impacts on priority species such as capercaillie. This collaboration is providing excellent opportunities for post-graduate study and the findings are being used to inform conservation management by FLS.

**Section 7:** Biodiversity highlights and challenges

Here are a few highlights of the biodiversity work carried out by FLS and partners between 2018 and 2020:

Cairngorms Connect. Cairngorms Connect is a partnership of neighbouring land managers committed to a bold and ambitious 200 year vision to enhance habitats, species and ecological processes across 60,000 ha in the heart of the Cairngorms National Park. FLS is working in partnership with RSPB, NatureScot and Wildland Ltd. in this, the largest habitat restoration project in Britain. Between 2018 and 2020, the following management actions were achieved on FLS land: 89 hectares of non-native conifers were removed; 100 hectares of clear fell were scarified to stimulate regeneration of native tree species; and 72 hectares of plantation were restructured for biodiversity. The work is funded by the Endangered Landscapes Programme.

Saving Wildcats project. FLS is a partner in this project, which is led by the Royal Zoological Society of Scotland. Other partners include NatureScot and the Cairngorms National Park Authority. In 2019, the partnership secured an EU LIFE grant of £3.2 million. Over the next six years, the project will aim to bring the wildcat back from the brink of extinction in Scotland by releasing wildcats to reinforcing the dwindling wild populations.

Gow Moss restoration. Gow Moss, which is near Huntly, is an excellent example of bog restoration. Between 2018 and January 2020, all 75 hectares of this intermediate bog were restored by a combination of ground smoothing, peat bank re-profiling, drain blocking and trench back-filling. The consequent raising of the water table has seen a transformation in the vegetation and wildlife. In summer 2020, hare’s tail cotton grass had recolonized and looked spectacular and the returning bird life includes curlews, snipe and common gulls.

Glentrool Oakwood extension. In an area of 160 hectares that is adjacent to the Glentrool Oakwood Site of Special Scientific Interest (SSSI), FLS is creating an oak-dominated woodland corridor along the southern bank of Loch Trool. Securing and safeguarding the local genetic diversity and provenance has been paramount and this has been achieved by collecting acorns from designated woodlands nearby, growing them on, and then planting them back on site. In 2019 and 2020, the area was protected by a deer fence, and over 120,000 acorns were collected, as well as seedlings of juniper, aspen and downy willow. This long-term project is now fully underway and will significantly enhance the viability of the designated woodlands.

Pine marten conservation in Galloway Forest Park. The population of pine martens in Galloway Forest Park (GFP) is an important outlier and FLS has been supporting Dr Johnny Birks and John Martin’s conservation work for this species. Research suggests that pine martens breed more successfully in large cavities in trees, but these are limited in plantations, so artificial boxes may be a way of improving breeding success. In 2018, 50 new den boxes were erected, bringing the total number of boxes in GFP to 142, spread across four zones. In 2019, surveys confirmed that some of the boxes were being used for breeding. This exciting work continues and aims to develop the optimal box design for this charismatic carnivore.

Trossachs Pearl-bordered Fritillary Restoration Project. The aim of this project was to determine whether or not pearl-bordered fritillary was still present in the Great Trossachs Forest National Nature Reserve; which encompasses woodlands at Inversnaid, Loch Katrine and in Glen Finglas. The partners comprise Butterfly Conservation, CLEAR Services Ltd, FLS, RSPB Scotland and Woodland Trust Scotland. Excitingly, surveys in the summer of 2019 located 64 adult pearl-bordered fritillaries in 27 locations. On the back of these remarkable survey results, further surveys and habitat management work are now being planned on FLS land.

Freshwater Pearl Mussel project. In 2018, FLS received a £170,000 grant from the Biodiversity Challenge Fund, which is administered by NatureScot. This money was used to plant over 10,000 riparian trees and to remove three barriers (culverts) to the movement of trout at key sites. Riparian trees cast shade and cool watercourses in summer time, and also improve water quality. Trout are important host for the larvae of the mussels and the project has significantly increased the amount of habitat that is accessible to these fish. These actions, along with other work being carried out by FLS, will improve the quality of the environment for the mussels and will increase the viability of their populations at key sites.

Future Challenges. In Scotland, long-term data show that the abundance and distribution of species has, on average, declined over recent decades and the indicator of average species' abundance of 352 terrestrial and freshwater species has fallen by 24% since 1994 (State of Nature Report for Scotland 2019). The biggest challenge for FLS is to help turn this around over the coming years by ensuring that, alongside our important species-specific conservation work, the wider silvicultural and land management choices that are made, which particularly affect lower taxa, all help to improve the estate’s overall value for biodiversity.