GALLOWAY AND SOUTHERN AYRSHIRE BIOSPHERE

Natural Heritage Management Plan

September 2018

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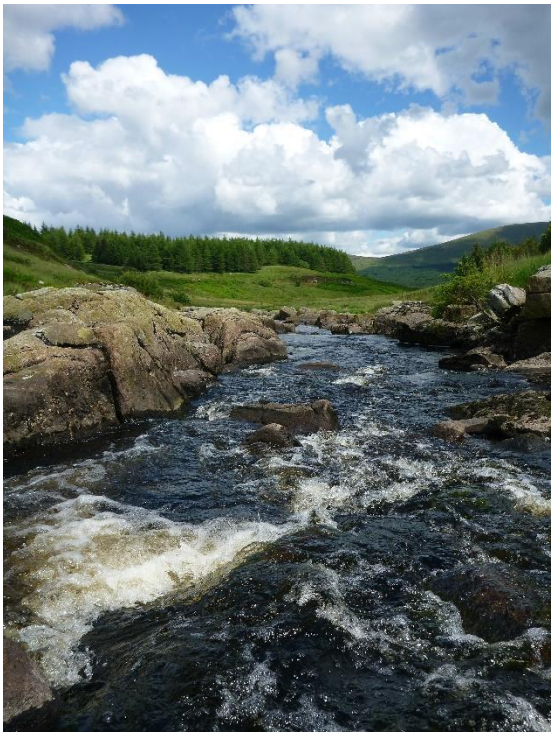

The Galloway and Southern Ayrshire biosphere has a wealth of natural habitats, as recognised by the many designated sites and indeed the Biosphere Reserve status. But, as elsewhere, habitat loss and degradation has led to declines in species across the region. There has also been significant degradation of peatland and loss of woodland, which are now recognised as hugely significant for their role in mitigating climate change. The challenge now is for land owners and managers to help halt the decline in species and habitat condition and improve our resilience to climate change while maintaining productive businesses.

There are many strategies in place to help drive species and habitat recovery, from the Scottish Government's aim of planting 10,000 ha of woodland each year, to the 2020 challenge and the Water Framework Directive. But most importantly, there exists a passion amongst people living and working in the Biosphere wishing to see these changes happen.

The Biosphere status provides a great opportunity for all who care about this special area, whether resident or visitor, land manager or conservationist, farmer or forester to come together and manage the land in a sustainable way that maintains that delicate balance between preservation of the natural environment, sustainable development, farming, human activity and tourism.

This report, prepared by the Biosphere Natural Heritage Officers and representatives from organisations on the Partnership Board, highlights the habitats and species considered to be of particular importance in our Biosphere and sets out their current status, requirements for their conservation, causes of their decline and possible solutions to consider. Land managers across the Biosphere should find this a useful reference when devising management plans, to resolve any issues on their land and help reduce any further decline in habitat quality and species numbers. The inclusion of the wide range of projects that have already been undertaken in recent years provides a source of reference and inspiration for those seeking ideas on how best to manage their land.

I trust that we can look back ten years hence and recognise a Biosphere that has led the way in protection and enhancement of the natural environment, providing inspiration to future generations.

Joan Mitchell, Chair of Biosphere Board

1 Introduction

1.1 The Galloway and Southern Ayrshire Biosphere

Galloway and Southern Ayrshire Biosphere Partnership promotes a balanced relationship between human interaction and the natural environment, through the establishment of effective partnerships, community engagement, innovative projects, research and learning.

A Biosphere Reserve is a United Nations Educational, Scientific and Cultural Organization (UNESCO) designation which recognises areas with special natural qualities, and supports a multi-stakeholder approach to management and involvement of local communities in management. The Galloway and Southern Ayrshire Biosphere (from here in referred to as the Biosphere), which received its UNESCO designation in 2012, covers 5,268 square kilometres, spanning the boundaries of three local authorities: Dumfries and Galloway; South Ayrshire and East Ayrshire. In accordance with UNESCO guidelines the Galloway and Southern Ayrshire Biosphere Reserve is comprised of three "zones"; the Core, the Buffer and the Transition Zone, as described below and illustrated in Figure 1.

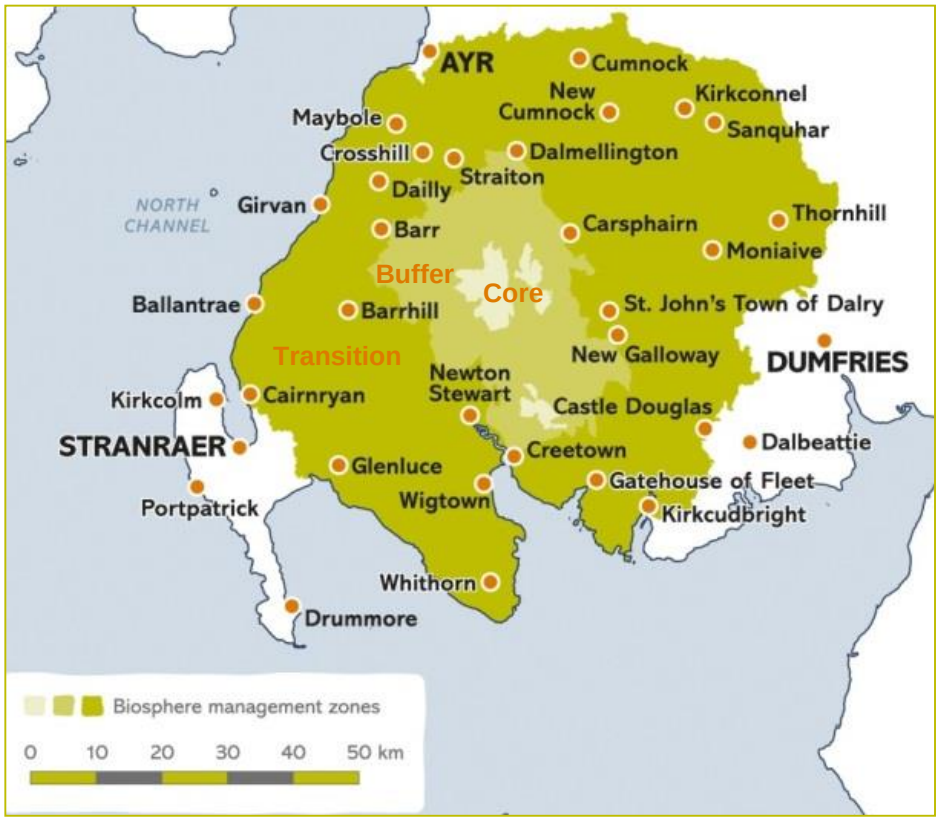

Figure 1 The Galloway and Southern Ayrshire Biosphere. Further information on the Biosphere can be found at www.gsabiosphere.org.uk

The **Core Zone** is formed by sites with statutory nature conservation designations and includes the Merrick Kells Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC), Silver Flowe Ramsar site and the Cairnsmore of Fleet SSSI and NNR.

The **Buffer Zone** corresponds roughly with the boundary of Galloway Forest Park so is largely owned by Forestry Commission Scotland but includes some private land.

Finally, the **Transition Zone**, which is the largest zone, extends into the wider countryside of Dumfries and Galloway, South and East Ayrshire, and is where most of the population of the Biosphere live and work.

1.2 High Focus Habitats and Species of the Biosphere

A prioritisation process involving expert stakeholder engagement was used to select habitats and species deemed to be of high priority within the Biosphere. This process is detailed in the Natural Heritage of the Biosphere Report[1]. Nine High Focus Habitats were identified from priority habitats listed in the Dumfries and Galloway and Ayrshire Local Biodiversity Action Plans (LBAP). These High Focus Habitats were identified for land within the Core and Buffer areas, through a process of consultation with local and national experts.

The nine High Focus Habitats are:

- Blanket bog
- Raised bog
- Upland heathland
- Purple moor grass and rush pasture
- Montane heath and montane scrub (latter is an aspirational habitat)
- Native upland oak woodland
- Native wet woodland
- Acid grassland
- Oligotrophic lochs

In addition to the High Focus habitats there are habitats that are important for the identified High Focus Species. These Additional Habitats are:

[1] Galloway and Southern Ayrshire Biosphere, Natural Heritage of the Biosphere Report. Available at: http://www.gsabiosphere.org.uk/what-we-do/conservation/

- Moorland Fringe for Black Grouse
- Woodlands for Red Squirrel
- Fresh Water Habitats for Water Vole and Brown Trout
- Coastal Habitats for Curlew

A total of nine High Focus Species were identified within the Biosphere and include four bird species, two mammal species, one species of fish and two vascular plants species:

- Black grouse
- Golden eagle
- Curlew
- Golden plover
- Red squirrel
- Water vole
- Brown trout
- Juniper
- Downy willow

1.3 Purpose of the Natural Environment Management Plan

The aim of this Plan is to provide information on the status, conservation and requirements of the High Focus Habitats and Species within the Biosphere and give guidance on their management and enhancement (Table 1). It is envisaged that it will be revised on a five yearly basis or as required, with the example projects updated more regularly and made available on the Galloway and Southern Ayrshire Biosphere website (http://www.gsabiosphere.org.uk/).

The general objectives for Natural Heritage management in the Biosphere are to:

- Restore, enhance and expand habitat extent and networks
- Safeguard and support species viability and extent
- Tailor future management to enhance these habitats and species
- Ensure existing High Focus Habitats are managed to a high standard
- Incorporate follow-up monitoring and management as required
- Ensure habitat restoration and management is based on sound ecological knowledge and research and land management aspirations
- Ensure management is in line with environmental risk assessment review of the threats and opportunities to biodiversity in the Biosphere (GSAB 2014)

The emphasis for management will vary with land ownership across the three different zones of the Biosphere. In the Core and Buffer zones the majority of land is owned by Forestry Commission Scotland and Scottish Natural Heritage, while in the Transition zone the majority of land is in private ownership. Although the High Focus Habitats and Species were selected for the Core and Buffer zones, this management plan aims to help inform and guide land management decision making across the Biosphere.

The report is laid out in three sections: High Focus Habitats; Additional Habitats important for High Focus Species; and High Focus Species. In each section a description of the habitat or species is provided along with its current condition or status and its presence and trend globally and within the Biosphere. The key conservation objectives for each habitat are set out along with potential management and restoration options. To help inform future projects key considerations for any new project or change in management are highlighted in addition to the potential future opportunities for each of the habitats and species.

The estimated extent of the High Focus and Additional Habitats within the Biosphere are mapped using the Biosphere Habitat Map (GSAB 2014) and vegetation and habitat survey data from Scottish Natural Heritage and Forestry Commission Scotland. The Biosphere Habitat Map (GSAB 2014) was produced using information from the Land Cover Map (2007), a Phase 1 Habitat Survey of Ayrshire and the Dumfries and Galloway Environment Audit.

1.4 Transition Zone 2018 Update

The original High Focus Habitats and Species were selected based on their importance within the Core and Buffer Zones of the Biosphere, the Core area being the reason for the original designation of the Biosphere as it contains designated sites of high national importance. However, the Transition Zone is the large area surrounding the Buffer Zone, in which the majority of Biosphere residents live and work and the habitats contained within in it, although not all designated, are consequently of great importance. The majority of the Transition Zone is privately owned, which distinguishes it from the publically owned Core and Buffer.

The 2018 update to the Natural Heritage Management Plan was felt necessary to recognise the habitats of importance within the lower lying Transition Zone of the Biosphere and to provide more specific guidance on their management. In addition, the original section on Freshwater Habitats (originally included specifically in relation to the High Focus Species brown trout) was reviewed and expanded to include important features and habitats within the Transition Zone. The section on Woodlands for Red Squirrels was also updated given the work to minimise threats to red squirrels and their habitats since the original publication of the Natural Heritage Management Plan in 2015.

The 5 additional High Focus Habitats are:

- Coastal Habitats

- Traditional Field Boundaries and Margins
- Calcareous and Neutral Grasslands
- Wetlands
- Woodland Habitats

Table 1 Relationship between the High Focus Species and Habitats of the Biosphere

	High Focus Species								
High Focus Habitats	**Black grouse**	**Golden eagle**	**Golden plover**	**Curlew**	**Red squirrel**	**Water-vole**	**Brown trout**	**Juniper**	**Downy willow**
Blanket and Raised bog	●	●	●	●		●	●		
Upland heathland	●	●	●	●		●			
Purple moor grass and rush pasture	●	●		●		●			
Montane heath and montane scrub	●	●	●					●	●
Native upland oak woodland	●				●				
Native wet woodland	●				●				
Acid grassland	●	●	●	●					
Oligotrophic lochs						●	●		
Coastal Habitats				●					
Traditional Field Boundaries					●				
Calcareous and neutral grassland				●					
Wetlands				●		●			
Woodland Habitats	●					●		●	●
Additional habitats important for High Focus Species									
Woodland Fringe for Black Grouse	●	●						●	●
Woodlands					●				
Fresh Water Habitats						●	●		
Coastal Habitats for Curlew			●	●					

2 High Focus Habitats

2.1 Blanket and Raised Bog

2.1.1 Habitat Description

Blanket and raised bogs are recognised internationally as important habitats and for their role in mitigating climate change. Bogs are formed from the accumulation of peat, produced from the slow decay and compression of organic matter, making peat soils the largest single store of carbon in the UK. The estimated extent of bog habitat in the Biosphere is shown in Map 1.

For centuries peatlands have been managed for farming, forestry and sport, and more recently for windfarm developments. Some of the associated management practices have been detrimental, with draining, over-grazing, burning and planting for forestry significantly altering their hydrology and vegetation, which in some instances has led to erosion, peat loss and increases in greenhouse gas emissions. With advances in our understanding of appropriate management and restoration techniques, damage can now be mitigated and reversed.

Both raised and blanket bogs are characterised by being comprised of peat greater than 50cm in depth. Raised bogs are generally smaller, distinct, areas of very deep peat, with or without the characteristic “dome” appearance. Blanket bogs tend to be over more extensive areas, particularly in the uplands, with peat depths more variable.

Blanket bog is a priority UK BAP habitat and a habitat listed on the Annex 1 of the Habitats Directive. In addition to being in itself an important habitat, it is a preferential habitat of a number of priority species for nature conservation and Biosphere High Focus species (e.g. black grouse, golden plover, hen harrier). This habitat is well represented in the Core (Merrick Kells SAC and SSSI, Silver Flowe NNR and Ramsar site, Cairnsmore of Fleet NNR and SSSI) and also found at sites within the Buffer and Transition zones including Airds Moss, Afton Uplands, High Altercannoch to Loch Duisk, Drumlamford, Stinchar Valley, Knockdaw Hill SSSI/SAC.

Raised bog is a priority UK BAP habitat and a habitat listed on the Annex 1 of the Habitats Directive and is also a preferential habitat of a number of priority species for nature conservation (e.g. azure hawker).

The condition of blanket bogs in the Biosphere is only systematically recorded for blanket bogs found within the designated sites (eg. Merrick Kells SAC and SSSI, Silver Flowe Ramsar site, Cairnsmore of Fleet NNR and SSSI) and ranges from unfavourable declining to unfavourable recovering (more details found in habitat assessment section of GSAB 2014[2]). More recently Forest Enterprise

[2] Galloway and Southern Ayrshire Biosphere, Natural Heritage of the Biosphere Report. Available at: http://www.gsabiosphere.org.uk/what-we-do/conservation/

Scotland has commissioned condition surveys for a number of Forestry Commission Scotland sites and have prepared a Raised Bog Strategy and are currently preparing a Blanket Bog Strategy which will survey and prioritise sites for restoration. However, aerial images show that drainage on both blanket and raised bog is extensive, and that this in some instances has resulted in erosion. Domestic peat cutting and burning can also be locally significant and large expanses of deep peat have been planted with commercial forestry. Only a small area of (lowland) raised bog was recorded within the Core and Buffer zone so the greatest opportunity for this habitat is in the Transition Zone.

2.1.2 Conservation Objectives

The main conservation objectives for both blanket and raised bogs are to:

- Restore and maintain functional, peat forming condition.
- Increase the cover of the key peat forming species, Sphagnum moss.
- Raise and maintain the height of the water table.
- Help improve water quality in sensitive catchments by reducing levels of dissolved and particulate organic carbon.
- Support and maintain a mosaic of pools, Sphagnum dominated bog and appropriate dwarf shrub heath communities.
- Remove trees where possible and manage scrub.
- Stop erosion of the peat.

2.1.3 Management

There are a number of steps that can be taken to improve bog habitat extent and quality as well as return degraded bogs to better condition by reducing erosion and improving peat forming functionality. The suggested actions given in the following sections are intended to indicate the measures that can be adopted. Particular funding schemes may have their own guidance and prescriptions that should be adhered to (eg. agri-environment schemes).

2.1.3.1 Grazing management

Setting the right stocking densities for blanket and raised bog is vital as heavy grazing can reduce the diversity of the vegetation and cause erosion of the peat through trampling and poaching. Grazing, however, can be used as a way of managing scrub and dominant purple moor grass (*Molinia caerulea*). Burning (in isolation), used to improve grazing extent and quality, is usually not considered an appropriate management measure for blanket or raised bog vegetation as it can damage the growth of Sphagnum moss, and may result in less diverse swards and dominance of species such as purple moor grass or cotton-grass (*Eriophorum spp.*) In dry conditions it can lead to burns that consume the peat and cause significant ecological damage.

Suggested Actions:

- The suggested stocking rate on open bog is 0.02LU/ha/yr which equates to 1.3 sheep per 10ha or a maximum of 0.1cow per 50ha. Grazing densities may be higher than this during the summer period (up to 0.75 LU/ha which equates to 4 sheep or 0.75 cattle/ha/yr) if stock are off-wintered.
- It may be necessary to limit winter grazing as the quality of forage in the winter months is low, so supplementary feeding may be required, and the risk of poaching and trampling is greater during wetter months.
- Ensure grazing impacts of deer and wild goats are considered when formulating grazing plans.
- Off-winter stock (heather is most susceptible to grazing damage in autumn, winter and spring).
- Use cattle to graze areas where purple moor grass is dominant.
- Re-profile hagged areas to stop erosion by weather and livestock (rubbing/trampling) and improve access and grazing quality.
- In certain circumstances restoration of bare peat may also require temporary stock exclusion.

2.1.3.2 Management of water levels

Artificial drainage was carried out extensively in the past in an attempt to improve grazing and conditions for commercial forestry. In some circumstances draining has also led to peat erosion, resulting in networks of haggs and gullies. Draining of bog habitats can lead to profound changes in their ecology with a direct effect on their hydrology by reducing the height of the water table, and making conditions less suitable for peat formation. Dry bogs may also support undesirable vegetation communities and allow scrub encroachment.

Suggested Actions:

- No new drainage should be undertaken.
- Hill drains should be blocked using machine dug peat dams.
- Larger drains, often more associated with lowland raised bogs, should be blocked with peat where possible or with plastic piling where size dictates (these areas may also have to be temporarily fenced off from livestock).
- Re-profiling may also be necessary in hagged areas and areas previously afforested.

2.1.3.3 Restoration of bare peat

The greatest carbon savings are gained by preventing further erosion of peat in areas which are actively eroding. Bare peat can be continually eroded by wind and rain, frost heave, and livestock through trampling and rubbing. Without intervention, the peat in these areas will continue to erode so it is important that these bare peat areas are stabilised to allow the vegetation to recolonize.

There are various methods now widely used to restore areas of bare peat and peat haggs, which will not only stop erosion and have ecological and carbon benefits, but may improve grazing and access. Advice should always be sought when considering options for bare peat restoration but the following suggested actions describe the most common methods.

Suggested Actions:

- Actively eroding haggs (indicated by bare peat sides) can be re-profiled using a low ground pressure excavator. This smoothes the profile of the hagg and uses the remaining vegetation on the top of the hagg to cover the bare peat.
- In some instances, where machines cannot gain access to a site, biodegradable geo-textiles can be used to stabilise bare peat surfaces allowing vegetation to recolonize.
- Heather brash with Sphagnum moss cuttings can be applied to bare peat surfaces and can also be used to accelerate re-vegetation and stabilisation.
- In some areas it may also be necessary to reduce erosion by blocking gullies with dams or bunds to reduce water flow.

2.1.3.4 Tree Removal and Scrub management

Encroachment of woodland and scrub species onto blanket bog and raised bogs is likely where there is a seed source nearby and where water levels allow establishment of seedlings or on previously afforested sites.

Suggested Actions:

- Encroaching scrub and trees should be removed where these are considered to affect the conservation interest and peat forming functionality of the habitat.
- Dense scrub and continual regeneration suggests the areas are too dry and additional restoration measures, such as ditch blocking and re-profiling, may be necessary.
- In some instances, retention of some scrub can benefit species of interest (e.g. azure hawker).

Figure 2 Hill drain blocked with peat dams at Cairnsmore of Fleet

Figure 3 An actively eroding hagg and gully system

2.1.4 Example Projects

- Cairnsmore of Fleet SSSI - management changes on SNH-owned area:
  - Reduction of the flock size at SNH-owned part of Cairnsmore of Fleet SSSI by 150 ewes.
  - Off-wintering of ewes from the Mid Hill heft.
  - Cattle grazing on approximately 160ha between the Cardoon Burn and Mid Burn on an area dominated by purple moor grass. Grazing is seasonal (summer) using a herd of 40 Luing cattle.
  - The flock size on part of the site has been reduced to 300 ewes (an additional 90 hoggs stay on the hill for 4 months only).
  - Drain blocking using machine dug peat dams and re-profiling, funded by the Scottish Government Peatland Action project.

- Glenhead and Buchan cattle grazing hill trial by Forestry Commission Scotland (FCS):
  - The site was surveyed using Aerial photography at 5cm resolution to map bracken extent and this survey is to be repeated every 3 years. Baseline monitoring took place prior to the addition of two herds of cattle: One of Highland cattle and one commercial breed (total 120 head). Repeat monitoring is planned, to determine if cattle numbers are sufficient to reduce dominance of bracken. Two cattle have radio collars fitted to track grazing patterns.

- Silver Flowe:
  - Drain blocking with machine dug peat dams in order to raise the water table was carried out by FCS.
  - Assessment of the site was carried out by Crichton Carbon Centre to deduce carbon savings associated with improving peat condition.

- The Coalfield Environment Initiative (CEI) and Scottish Wildlife Trust (SWT) re-wetting of Dalmellington Moss Wildlife Reserve (SSSI), funded by Peatland Action and the Heritage Lottery Fund. Work entailed constructing a trench bund and repair to existing plastic piling dams to slow water loss and scrub removal. The aim was to stop carbon loss to address climate change and help to reduce local flash flooding. The site is monitored using fixed vegetation quadrats and automatic data loggers to record the height of the water table.

- Kilquhockadale Flow
  - A Partnership project between Forest Enterprise Scotland (FES), Galloway Fisheries Trust and Crichton Carbon Centre to survey 1200ha of commercial forestry and open bog to establish peatland condition, peat depth, water quality issues and restoration potential.
  - A report on the findings will help inform the new Land Management Plan and restoration plans being prepared by FES.

2.1.5 Considerations

- Potentially large, up-front, investment in capital works.
- Accessing funding for changes in grazing regime, restoration works and any associated ongoing management.
- Access requirements if machines are used.
- Timing of works (eg. considering ground conditions, ground nesting birds etc.).
- Conflict in management priorities eg. forestry versus open bog.
- Lack of knowledge of current location and condition of habitat, particularly in the Transition zone.
- Risk of wildfire (although re-wetting can help mitigate risk).
- Deforestation and scrub management can mean the removal of important habitat for other species eg. red squirrel.
- Hydrological impacts of restoration on adjacent land (eg. lowland raised bog bounded by improved grassland).

2.1.6 Opportunities

- Scotland's National Peatland Plan launched 2015; continued Government commitment to peatlands.
- The continued development of the Peatland Code as a mechanism to pay for restoration and management through carbon emissions savings.
- SRDP Agri-Environment and Climate Scheme 2014-2020 peatland restoration under Moorland Management and Lowland Bog management options (eg. ditch blocking, scrub removal, grazing).
- Good practice examples: private landowners who already manage their land sympathetically and have undertaken restoration could be used as demonstration sites.
- Rewetting of *Molinia*-dominated bogs helps to prevent wildfires.
- Rewetting of peatland to help prevent scrub/tree encroachment: potentially cost effective in the long term.
- Collaborations between adjacent ownerships to create connected habitat.
- Mapping of areas of plantations and scrub that block open peatland habitat networks.

2.1.7 Further Information

Peatland Action and National Peatland Plan: http://www.snh.gov.uk/climate-change/taking-action/carbon-management/peatland-action/

A Guide to Upland Habitats: Surveying Land Management Impacts - Volume 1 and 2 (SNH): https://www.nature.scot/guide-upland-habitats-surveying-land-management-impacts-volumes-1-and-2

Fen Management Handbook (SNH): https://www.nature.scot/fen-management-handbook

2.2 Upland Heathland

2.2.1 Habitat Description

Upland heathland is a priority UK Biodiversity Action Plan habitat and is represented in the Biosphere by dry dwarf shrub heath and wet dwarf shrub heath, both of which are listed on the Annex 1 of the Habitats Directive. Upland heath is an important habitat that supports a number of priority species including some of the High Focus species identified for the Biosphere such as black grouse, curlew, golden eagle, and golden plover.

Upland heathland is characterised by nutrient poor mineral soils, peaty podsols or shallow peat (less that 0.5m deep) and the presence of dwarf shrubs, notably heather (*Calluna vulgaris*). Species associated with dry dwarf shrub heath, which is found on free draining acid to neutral soils, include blaeberry, crowberry, and bell heather, while those on wet dwarf shrub heath, where heather is less frequent, include cross-leaved heath, deer grass, purple moor grass, sedges, lichens and mosses, notably Sphagnum species.

This is a significant habitat within the Biosphere, with Dumfries and Galloway containing the most extensive area of upland wet heath in the UK south of the Highlands (Map 2). Upland heath is found at Merrick-Kells Hills (SAC/SSSI) and in the Glen App and Galloway Moors (SPA/SSSI). Other areas include Cairnsmore of Fleet (SSSI/NNR), Laughenghie and Airie Hills (SSSI), Artfield Fell, Glenquicken Moor, Auchenroy and Glenmount Upland, Afton Uplands, Black Clauchrie.

The condition of upland heathland in the Biosphere is only known within the Merrick Kells SAC and SSSI, where the mosaic of upland habitat is described as being in favourable maintained condition although heath habitat has been heavily impacted by grazing.

2.2.2 Conservation Objectives

The main conservation objectives for upland heathland are to:

- Establish the condition and extent of areas outwith designated sites
- Restore, extend and enhance upland heaths as part of upland mosaics
- Identify opportunities for restoration in Forest Design Plans and restocking proposals
- Encourage measures that reverse habitat fragmentation
- Use demonstration sites to provide advice on best management and restoration practices for upland heaths

2.2.3 Management

The management prescriptions for upland heath differ according to the type of heathland. Dry heaths are associated with shallow peat or mineral soils, while wet heaths are transitional habitats between dry heaths and blanket bogs. The suggested actions given in the following sections are intended to

indicate the measures that can be adopted. Particular funding schemes may have their own guidance and prescriptions that should be adhered to (eg. agri-environment schemes).

The main management prescriptions for upland heathland are:

- Grazing
- Burning
- Swiping

2.2.3.1 Grazing Management

Historically, sheep grazing on upland heathland suppressed heather by overgrazing, particularly in the winter when the young heather shoots are favoured in the absence of grass. Other species, notably *Molinia caerulea* (purple moor grass) which is less palatable, have then increased and suppressed other vegetation. Cattle are better able to digest purple moor grass than sheep and are proving a beneficial tool in restoring these historically overgrazed sites. Setting the right stocking densities for grazing of heath is crucial in retaining a diverse plant structure. Conversely, undergrazing can lead to an increase in mature stands of ageing, leggy heather, reducing structural diversity and habitat quality and enabling the undesired encroachment of scrub. Wet heath is also vulnerable to trampling and erosion, especially in winter.

Suggested Actions:

- Assess current condition then identify appropriate grazing levels, stock type and timings for the site. Where grazing is having a detrimental impact on vegetation, it would be beneficial to remove stock over winter and/or reduce flock numbers. These management actions may be supported through agri-environment funding (eg. moorland management, stock disposal, away wintering).
- Typically on dry heath in poor condition, grazing at a maximum year round stocking rate of 0.075-0.1 LU/ha or 0.5-0.67 ewes/ha is advisable. Once good condition is achieved the annual grazing density can be increased to 0.075 – 0.22LU/ha; (0.5-1.5 ewes/ha).
- Wet heath, which is usually poorer grazing and more susceptible to trampling, can typically only support 0.037 to 0.075 LU/ha (0.25 to 0.5 ewes per ha).
- Where Molinia is suppressing other vegetation, consider introducing cattle during the spring and summer. This may be supported through agri-environment funding.
- Removing all stock, particularly cattle, from wet heaths in autumn and winter will reduce damage by trampling.

2.2.3.2 Muirburn

Muirburn, which must adhere to the strict restrictions set out in the Scottish Government's Muirburn Code[3], is carried out to regenerate heather, improve grazing and create a mosaic of heather heights.

[3] http://www.scotland.gov.uk/Resource/Doc/355582/0120117.pdf

This increases structural diversity and provides a range of habitats suitable for moorland species such as black or red grouse and hen harrier. Leggy heather is used for nesting and protecting chicks from the elements while shorter heather provides forage. Burning should be avoided on wet heath and in areas where dry heath is already regenerating and there is a good mix of age and structure in the heather.

Suggested Actions:

- For conservation purposes muirburn should be carried out on long rotations, to ensure there are always areas of mature heather, with the time between burns dictated by the habitat. Additional guidance is given in the Supplement to the Muirburn Code: A Guide to Best Practice[4].
- Burning should be done in a patchwork of scattered small areas, i.e. strips approximately 30m wide and not exceeding 0.5-1ha (SRDP Agri Environment and Climate Scheme 2014-2020 stipulates areas no larger than 1ha should be burned).
- The intensity of the burn should be controlled to achieve a burn which does not penetrate the peat and retains the bases of the heather stems from which heather can regenerate.
- Following the burn, grazing densities should be carefully managed to prevent congregation of stock on burnt patches and should not typically exceed 1.5 ewe/ha. This will allow heather to regenerate more successfully.

2.2.3.3 Swiping

Swiping is carried out to achieve the same outcomes as muirburn and is often used when muirburn is unsafe, for example at sites close to forestry or when weather is unsuitable for muirburn. Swiping, however, can be impractical in rocky or more inaccessible areas. Swiping can be used to create a firebreak prior to burning. Swiping should not be used after the 15th April, and throughout the summer months, when ground-nesting birds will be present (further guidance is given in the Muirburn Code).

Suggested Actions:

- Swiped areas should not exceed 1ha in size and 30m in width
- Heather stems should be cut to 10cm height above ground
- Low ground pressure vehicle should be used to carry out swiping to prevent damage to peaty substrate
- Cut heather litter should be removed or finely mashed to assist heather regeneration

2.2.4 Example Projects

- Further information on projects specific to black grouse is given in Section 4.1.

[4] http://www.gov.scot/resource/doc/355571/0120116.pdf

- The Black Grouse Recovery Project, led by RSPB, involves heathland restoration and enhancement for key black grouse leks in Galloway and Nithsdale.

- Black Grouse Conservation in Southern Scotland Project overseen by the Game and Wildlife Conservation Trust which will be developing a regional strategic conservation plan for Black Grouse.

2.2.5 Considerations

- Appropriate grazing levels as well as timing should be established.
- Need for addressing any conflicts in management priorities eg. forestry, wind farms, grassland for farming/short heather for grouse moors, mixed heather heights for biodiversity.
- Lack of knowledge of current condition of habitat.
- Need for skilled personnel and man power in management, particularly when carrying out muirburn.
- Risk of wildfire/loss of control of muirburn (always follow best practice guidance).
- The effect of heather beetle and bracken encroachment on the heather condition/extent.

2.2.6 Opportunities

- Agri-environment funding is usually available for a range of management options eg. away wintering, muirburn, bracken control, summer cattle grazing.
- Working with land owners to host land management good practice events and training to demonstrate techniques and outcomes.
- The possibility of linking existing areas by restoring and extending management over adjacent sites using agri-environment scheme funding.

2.2.7 Further Information

A Guide to Upland Habitats: Surveying Land Management Impacts - Volume 1 and 2 (SNH): https://www.nature.scot/guide-upland-habitats-surveying-land-management-impacts-volumes-1-and-2

Technical Note TN586 Conservation Grazing Of Semi-Natural Habitats (SRUC): http://www.sruc.ac.uk/downloads/download/473/tn586_conservation_grazing_of_semi-natural_habitats

The Muirburn Code (Scottish Government): http://www.gov.scot/Publications/2011/08/09125203/0

Supplement to The Muirburn Code (Scottish Government): http://www.gov.scot/Publications/2011/08/09125113/0

2.3 Purple Moor-Grass and Rush Pasture

2.3.1 Habitat Description

Purple moor grass and rush pasture is a priority UK Biodiversity Action Plan habitat that occurs on poorly drained sites in lowland to mid-altitude areas with high rainfall. Broadly there are two types of purple moor grass and rush pasture; purple moor grass dominated or rush dominated pasture. Both, however are found in similar conditions on moist to wet, acidic to basic soils in the enclosed agricultural lowlands. It is often found within a mosaic of other grassland habitats and is associated with acid grassland, neutral grassland, wetland and heathland habitats.

Purple moor grass dominated examples of this habitat are characterised by being associated with a rich assemblage of grassland and heath species such as tormentil (*Potentilla erecta*) marsh violet (*Viola palustris*), devil's-bit scabious (*Succisa pratensis*), cross-leaved heath (*Erica tetralix*), bog myrtle (*Myrica gale*), velvet bent (*Agrostis canina*). Where soils are more basic, species such as wild angelica (*Angelica sylvestris*), water avens (*Geum rivale*), valerian (*Valeriana officinalis*) and marsh hawk's-beard (*Crepis paludosa*) can be found. It is important that this habitat is not confused species poor rush dominated farmland or extensive areas of species poor purple moor grass dominated peatland, particularly blanket bog, which in these circumstances can be an indicator of poor bog condition.

High Focus Biosphere species black grouse, golden plover and curlew are associated with this habitat along with other species of conservation concern including snipe, redshank, lapwing, barn owl and skylark.

The extent of purple moor grass and rush pasture within the Biosphere could not be accurately determined as little ground has been classified specifically as purple moor grass and rush pasture. However, it is understood that this is a rare and highly localised habitat, found up to 300m above sea level. It is known however to be present at SSSI sites: Skyreburn, Cleugh, Bailliewhirr and Dowalton Loch.

As an indication of habitat extent, records of whorled caraway (*Carum verticillatum*), a species associated with the priority habitat and with a stronghold in Scotland in the Biosphere were used to indicate where purple moor-grass and rush pasture is likely to be present. In addition, the associated habitats occurring below 300m were also mapped to indicate potential distribution (Map 3).

The condition of purple moor grass and rush pasture in the Biosphere is not known for any extent of this habitat, as it is not listed as a designated feature in any of the open ground designated sites. The management prescriptions below will therefore include general management measures appropriate for such a habitat.

2.3.2 Conservations Objectives

The main conservation objectives for purple moor grass and rush pasture are to:

- Better understand its distribution and condition in the Biosphere and ascertain if management is appropriate.
- Maintain the dominance of species rich grassland communities extending over the dry knolls and wet flushes that are typical of this habitat.
- Restrict the extent of scrub encroachment, especially gorse, willows and bracken.
- Ensure areas are not fertilised, which increases nutrient levels, or reseeded with grass mixes.

2.3.3 Management

The main management tool for purple moor grass and rush pastures is grazing. Light to moderate grazing helps to retain large, palatable wetland plants such as meadow sweet, angelica, valerian, ragged robin, and marsh hawk's beard, and prevent vigorous, dominant species, such as purple moor grass and rushes, from outcompeting smaller plants. Without grazing, purple moor grass and rushes could suppress less vigorous plants. The suggested actions are intended to indicate measures that can be adopted. Particular funding schemes may have their own guidance and prescriptions that should be adhered to (eg. agri-environment schemes).

Suggested Actions:

- Managing appropriate grazing levels, preferentially with cattle or a combination of cattle and sheep (suggested stocking rate is 0.5-1LU/ha).
- Introducing/maintaining grazing regimes with the aim of achieving a mosaic of sward heights, with patches of taller vegetation that provide good nesting areas. Some trampling and poaching is beneficial, providing habitat for seeds, but care should be taken to remove stock before any significant poaching occurs. Light summer grazing can help to maintain an open sward, but heavy grazing should be avoided during the flowering and nesting season.
- Typically, grazing by cattle in Spring and Autumn helps to keep the more vigorous *Molinia* and rushes in check as *Molinia* is more palatable to cattle in the Spring. Overgrazing should, however, be avoided in bird nesting areas. Light grazing during the winter, outwith wetter periods, may be possible at some sites if the sward needs to be reduced in height and broken up further, but great care is needed not to damage the habitat by poaching particularly during periods of wet weather and in areas where supplementary feeding is required.
- If a site has not been adequately grazed for a while it may be advantageous to cut some of the denser rushes (and remove cuttings) as the new rush growth will be more palatable to cattle.

2.3.4 Example Projects

- None known, however, management to improve condition of this habitat continues on designated sites.

2.3.5 Considerations

- Lack of knowledge of habitat extent and condition which makes targeting management difficult.
- Where found within a habitat mosaic, management has to reflect the needs of the surrounding habitats as well (eg. blanket bog).
- Some areas may also be degraded due to artificial drainage, so ditch blocking may be required.
- Loss of habitat though afforestation, draining, agricultural improvement.

2.3.6 Opportunities

- Working with land owners to host land management good practice events to demonstrate habitat characteristics and management.
- Working with volunteers to identify and survey the extent of this habitat eg. through DGERC
- Funding opportunities through agri-environment schemes.

2.3.7 Further Information

A Guide to Upland Habitats: Surveying Land Management Impacts - Volume 1 and 2 (SNH):
https://www.nature.scot/guide-upland-habitats-surveying-land-management-impacts-volumes-1-and-2

Technical Note TN586 Conservation Grazing Of Semi-Natural Habitats (SRUC):
http://www.sruc.ac.uk/downloads/download/473/tn586_conservation_grazing_of_semi-natural_habitats

SNH Guidance Note Purple moor grass and rush pasture (UK BAP priority habitat):
http://www.snh.gov.uk/docs/A1509888.pdf

2.4 Montane Heath and Montane Scrub

2.4.1 Habitat Description

Montane heath and scrub includes the UK BAP habitat Mountain Heaths and Willow Scrub, and the Dumfries and Galloway Local Biodiversity Action Plan habitats montane moss-heath and montane scrub. They are very important for their non-flowering plant, fungi and lichen and invertebrate assemblages. These habitats are restricted within UK and are only found in the harshest habitat of the Biosphere, above the tree line (generally above 600m).

Montane heath vegetation is dominated by mosses, club-mosses and lichens, with woolly-fringe moss particularly frequent. Biosphere High Focus species golden plover may nest here and golden eagle will hunt across montane moss-heath. In the Biosphere it is only found in small areas on the highest hills of the Afton Uplands, Carsphairn and the Galloway Hills (Corserine (SAC/SSSI) and Beninner, Moorbroch, Cairnsmore of Carsphairn, Cairnsmore of Fleet (NNR and SSSI) and Merrick Kells (SSSI, SAC).

Montane scrub consists of low-growing, crooked trees and shrubs, predominantly willow, including the High Focus species downy willow and juniper, but may also include stunted oaks and birches. It lies in the transitional zone between woodland and moss-heath, where low temperatures, windy conditions and short growing season restrict the growth of tall woody species. Only a few small remnants of montane scrub survive in Britain, mostly on inaccessible ledges, and occasionally on lightly grazed steep rocky slopes or boulder fields, with some surviving in the Galloway Hills within the Biosphere. This habitat may provide a food source/habitat for the High Focus species black grouse. Within the Biosphere it is present on the Merrick (SAC/SSSI).

The condition of montane heath and scrub in the Biosphere is not known. The only montane habitat type assessed individually is montane acid grassland, present within the Merrick Kells SSSI/SAC, and this is considered to be in poor and deteriorating condition (habitat assessment section of GSAB 2014[5]). The management prescriptions therefore focus on measures to bring montane habitat into good condition. Generally it is thought that the small remaining areas are still adversely affected by grazing pressure with the added recent pressures from hill walking, mountain-biking, quad/trail bikes, potential infrastructure developments and climate change. The extent of montane scrub and heath within the Biosphere and areas above 600m where it could occur are shown in Map 4.

2.4.2 Conservation Objectives

The conservation objectives for montane heath and scrub are:

[5] Galloway and Southern Ayrshire Biosphere, Natural Heritage of the Biosphere Report. Available at: http://www.gsabiosphere.org.uk/what-we-do/conservation/

- To establish the extent and condition of montane heath and scrub throughout the Biosphere.
- To reduce fragmentation and create contiguous stands, particularly montane scrub on cliffs and slopes.
- To enhance the condition of existing areas of montane heath and scrub.

2.4.3 Management

The primary management tools for montane heath and scrub in the Biosphere are:

- Grazing
- Access restriction
- Replanting

2.4.3.1 Grazing management

Grazing management of montane habitats is challenged by their remote and exposed nature. Due to the extreme conditions (altitude, climate, exposure) the rate of growth of montane habitat is slow and therefore the carrying capacity of habitat is low compared to habitats at lower altitudes.

Suggested Actions:

- The extent of existing montane scrub is currently limited to inaccessible crags and steep slopes, which helps restrict access by sheep and wild herbivores. As this habitat is especially sensitive to grazing pressure, any expansion of its extent would require decreasing the grazing pressure or complete grazing exclusion.
- Fencing could be erected in suitable locations to exclude grazing and encourage recovery of montane scrub habitat and species associated with this habitat type.

2.4.3.2 Management of public access and recreation

The montane zones fall within the high elevation walking routes in the Galloway Hills, such as the Merrick summit path, the Rhinns of Kells ridge, or the Range of the Awful Hand ridge, including Benyellary, Merrick, Kirriereoch Hill, Shalloch on Minnoch and Tarfessock. High visitor pressure in the montane areas might lead to damage and erosion of montane habitats and disturbance to animal species.

Suggested Actions:

- Maintenance and repair of footpaths to help limit damage of more sensitive areas
- Provide information on the natural interest of montane habitats and the hill users can reduce and minimise their impact on montane habitats

2.4.3.3 Replanting

Replanting, using local provenance stock, could be carried out in appropriate areas to increase the extent of the habitat. Grazing, by domestic and wild herbivores, may then have to be controlled/excluded.

2.4.4 Example Projects

- FCS willow cuttings and willow and juniper nursery projects, planting of downy willow and juniper in Autumn 2014 on Bennan Hill part of Merrick SAC by Cree Valley Community Woodlands Trust and Forestry Commission Scotland, with fencing erected to exclude grazing. Further information given in Section 4.8.
- Monitoring of woodland fringe by FCS.
- Maintenance of Merrick footpath.
- Although outwith the Biosphere, creation of montane scrub at Carrifran (SAC/SSSI) in the Moffat hills is an example of restoration[6].
- PhD work carried out within the Biosphere entitled 'Assessing the potential for recovery of degraded montane heaths" funded by SNH and supervised by Aberdeen University, SNH, Macaulay Land Use Research Institute and the Centre for Ecology & Hydrology[7].

2.4.5 Considerations

- Emerging tree species pests and diseases when establishing new montane habitats.
- Remoteness of sites when planning and delivering projects.
- Cost of maintenance and labour required.
- Managing public access to vulnerable areas on the hills.

2.4.6 Opportunities

- Raising public awareness of current and proposed projects.
- Expansion of montane scrub habitat in monitored locations where remnant populations survive and prevention of muirburn and herbivore damage to the habitat.
- Collection and propagation of locally rare native species.
- Expansion of woodland fringe habitats is incorporated in the restock proposals of the Forestry Commission Scotland Forest Design Plans.

[6] http://www.carrifran.org.uk/about/what-we-have-achieved/silviculture-2/
[7] Armitage, H. (2006) Assessing the potential for recovery of degraded montane heaths. In: CAPER 2006, 31st Annual Meeting. Book of Abstracts, Edinburgh, Pollock Halls, 10th - 12th April 2006. NERC/Centre for Ecology and Hydrology, 17. (Unpublished)

2.4.7 Further Information

JNCC Habitat Description: http://jncc.defra.gov.uk/page-3556

Montane Scrub SNH Publication: https://www.nature.scot/montane-scrub-natural-heritage-management

Borders Forest Trust: http://www.bordersforesttrust.org/places/wild-heart/

2.5 Upland Oak and Wet Woodland

2.5.1 Habitat Description

Native upland oak and wet woodland are priority UK Biodiversity Action Plan habitats and habitats listed on the Annex 1 of the EU Habitats Directive. In addition to being important habitats in their own right, they tend to have high biodiversity and are preferential habitats of a number of priority species for nature conservation (e.g. wood warbler, willow tit) and the Biosphere High Focus species red squirrel.

Upland Oak woodlands are found on acidic, usually shallow soil, with a predominance of sessile oak, along with birch, holly, rowan and hazel as the predominant understorey species. They occur in the wetter western and northern areas of the UK. Within the Biosphere there are few large upland oak and wet woods, with those that exist generally found on steep slopes or poor soils in valleys such as along the Cree and Fleet. The best examples are the Buchan and Glenhead Woods (SAC/SSSI) in Glentrool and the Penwhapple Burn, the Fleet woodlands at Castramont and Killiegowan and the Martnaham Loch Woods in Ayrshire (Map 5).

Wet woodland is found by watercourses and lochs on floodplains and contains willows (usually then referred to as carr), birches and alder. Scotland has about half of the wet woodland in the UK and whilst most of this is in the Highlands, Dumfries and Galloway is the second most important area in Scotland. Native wet woods are widespread across the region but are fragmented and generally less than 2ha in size. Examples within the Biosphere include Wood of Cree (SSSI), Dowalton Loch (SSSI), Belston Loch, Tranew Flushes and Kerse Loch (Map 5).

The condition of native woodlands in the Biosphere is only known for woodlands found within the Wood of Cree SSSI and Glentrool Oakwoods SSSI (part of Galloway Oakwoods SAC) where it is in good condition.

2.5.2 Conservation Objectives

The main conservation objectives for native upland and wet woodland are:

- Maintain existing areas of native woodland
- Increase the extent of upland oak and wet woodland
- Improve woodland structure and age diversity
- Create links between isolated fragments (without compromising open habitats)
- Re-establish native woodland on sites where they have historically occurred
- Creation and enhancement of woodland along riparian corridors, in areas of dense bracken and on steep slopes. Planting in these areas may also meet wider catchment management objectives eg. flood alleviation

2.5.3 Management

The main management tools for native woodland are:

- Planting
- Semi-natural habitat management (managing grazing/browsing)
- Control of invasive, non-native species such as *Rhododendron ponticum*

2.5.3.1 New native woodland planting

Suggested Actions:

- Establishment of new native woodlands should not be carried out in locations where it would compromise priority open ground habitats.
- Mixtures of appropriate species native to the region should be used as opposed to single species, where possible using stock of local provenance.
- Trees should be planted in groups 10-30m across rather than in lines, to create a more natural effect. The spacing also allows for future natural regeneration and should be highlighted in any woodland scheme grant application.
- Shrub (understorey) species should be planted alongside the trees.
- Approximately 20% of the ground should be left unplanted and linked to the surrounding open habitats.
- Trees should be protected against damage by herbivores by appropriate fencing, tree guards or shelters, or densities of grazing animals should be kept low.
- Depending on circumstances weeding or thinning might be required.

2.5.3.2 Management of established semi-natural/native woodland

Suggested Actions:

- Key biodiversity features should be identified and safeguarded during the management operations.
- Management should focus on reducing any immediate threats to key biodiversity (e.g. reducing excessive shade).
- In even aged stands opportunities should be sought to diversify the woodland structure.
- Planting and/or control of grazing by herbivores will be required in woodlands where natural regeneration is slow or absent.
- When restocking by under planting, local provenance should be used, to retain the local genetic variety and reduce biosecurity risks.
- Stocking rates should reflect site conditions, history of the site and woodland objectives. Recommended planting density to regenerate a native tree canopy is 500 – 1000 trees/ha. SRDP Forestry Grant Scheme 2014-20 provides options ranging from 500 to 1600 tree/ha for native woodland.

- Open space areas should be incorporated in woodland management as the highest biodiversity is at the woodland edge/open habitat interface.
- Invasive and non-native species should be removed as appropriate, preferably in collaboration with other woodland owners at a landscape scale (in some cases it may be preferable to retain non-native species such as sycamore).
- Fencing should be used to protect sensitive areas of planting in the absence of other means of herbivore control.

2.5.4 Example Projects

- Various Forestry Commission Scotland (FCS) objectives including: barn owl and kestrel nest boxes and monitoring, Aspen FCS project collecting, propagating and planting of up to 75,000 Galloway aspen per year and monitoring of woodland fringe by FCS and Cree Valley Community Woodland Trust (see Section 4.8.6).

- Between 2009 and 2012 the Cree Valley Community Woodlands Trust (CVCWT) carried out broadleaved woodland planting (approximately 120ha) on previously afforested ground in riparian corridors in the Upper Cree catchment (Loch Stroan area).

- Expansion of woodland fringe and native woodlands is incorporated in the restock proposals of the FCS Forest Design Plans, D&G Woodland Plan, Ayrshire & Arran Forestry & Woodland Strategy.

- RSPB have planted native woodlands on Barclye to extend their Wood of Cree reserve.

- Nightjar monitoring by RSPB and FCS, red kite monitoring by RSPB.

- CVCWT and RSPB Scotland woodland management and monitoring, nest box monitoring, volunteer survey, monitoring of planted trees and regeneration, monitoring of non-native species.

- Research study undertaken by the British Trust for Ornithology on moorland fringe proposals (see SNH research report number 456 (http://www.snh.gov.uk/publications-data-and-research/publications/search-the-catalogue/publication-detail/?id=2129).

2.5.5 Considerations

- Land-Use conflicts, for example between native woodland expansion and commercial forestry or grazing land.
- Need to take into consideration implication for associated wildlife. For example, significant reduction in conifer plantations where red squirrel exist could reduce red squirrel population in these areas thus compromising population viability.

- Cost of invasive species removal, e.g. Rhododendron
- Emerging tree species pests and diseases when establishing new native woodlands.

2.5.6 Opportunities

- Current Scottish Government target to plant 10,000ha of woodland in Scotland per annum (100,000ha between 2012 and 2022).
- Availability of funding for woodland planting and management through Forestry Grant Schemes
- Establishment of native woodlands, to link existing woodland, along river valley networks, but not to the detriment of priority open habitats such as bogs. For example, along the Cree Valley, at Changue plantation in the north-west part of the Biosphere; along the area of Carsphairn Lane to the north of Carsphairn; and the area adjacent to the Black Water of Dee.
- Collaboration on native woodland network expansion with the Central Scotland Green Networks initiative for which the northern part of the Biosphere is eligible;
- Increased supply of native trees of local provenance and good genetic variety.
- Research and monitoring of native woodland establishment (e.g. reasons for slow establishment of oak in Dumfries and Galloway are unknown).
- Established collaborations between community groups and Forestry Commission Scotland and RSPB

2.5.7 Further Information

The Scottish Forest Strategy: http://scotland.forestry.gov.uk/supporting/strategy-policy-guidance/forestry-strategy

Scottish Forestry Grant Scheme: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/forestry-grant-scheme/

Dumfries and Galloway Forestry and Woodland Strategy: https://www.dumgal.gov.uk/media/17433/Dumfries-and-Galloway-Forestry-and-Woodland-Strategy/pdf/Forestry_and_Woodland_Strategy_April_FINAL1.pdf

Land Information Search service (to help landowners to plant trees and improve their management of the natural environment): http://map.environment.scotland.gov.uk/landinformationsearch/lis_map.html

Ayrshire & Arran Forestry & Woodland Strategy: https://www.east-ayrshire.gov.uk/.../AyrshireandArranForestWoodlandStrategy2014.pdf

Forestry Commission Scotland New native woodland in Galloway Forest Park: http://scotland.forestry.gov.uk/news/1321-new-native-woodland-in-galloway

2.6 Acid Grassland

2.6.1 Habitat Description

Acid grassland is a Local Biodiversity Action Plan habitat and is found across the Biosphere. Acid grassland supports the High Focus Species golden eagle and black grouse along with other species of conservation concern such as adder, slow worm, northern brown argus, hen harrier, red kite and brown and mountain hare.

Acid grassland occurs on soils with low pH (4 to 5.5) overlying acid rocks such as sandstones and igneous rocks. Upland acid grassland is generally found above 300m and is much more common than lowland acid grassland. Plants present may include bent, fescue, mat grass and purple moor grasses and herbs such as tormentil, heath bedstraw, harebell, hawkweeds, devil's bit scabious and eyebright species. Examples of acid grassland within the Biosphere include Merrick Kells Hills (SAC/SSSI) and Cairnsmore of Fleet (SSSI/NNR), Laughenghie and Airie Hills SSSI, Camregan Hill and Penwhapple Burn, Auchenroy and Glenmount Uplands, Dunaskin Glen and Benquhat Hill.

Acid grassland is common across the UK, but its distribution is not well documented and studied. The extent of acid grassland (Broad UK BAP habitat category) within the Core and Buffer zones was calculated to be 16,510ha, with an estimated 748,000ha across Scotland. The estimated extent of acid grassland across the whole of the Biosphere is shown in Map 6.

The condition of acid grassland in the Core area and Buffer zone is not known as it is not listed as a designated feature in any of the open ground designated sites. The management prescriptions below will therefore include general measures considered to be appropriate to bringing the habitat into good condition.

2.6.2 Conservation Objectives

The main conservation objectives for acid grassland in the Biosphere are to:

- Establish more accurately its extent and condition.
- Prevent loss to undesirable scrub or agricultural improvement (using appropriate grazing levels).
- Maintain existing areas of acid grassland, particularly where associated with purple moor-grass and rush pasture (see Section s.5) and wet flushes.
- Increasing the area of species rich acid grassland, with careful consideration for the loss of other important habitat types. In many cases the existing areas of acid grassland were created as a result of overgrazing of heathland sward, so the objective might be to restore the original heathland (where feasible) by reducing/removing grazing.
- Protect existing, and increase the extent of, areas used by golden eagle.

2.6.3 Management

The main management prescription for species rich acid grassland is:

- Grazing

2.6.3.1 Grazing management

Grazing management of acid grasslands is dependent on the dominant grass species in the sward. The management prescriptions differ for grasslands dominated by bent (*Agrostis spp.*) or fescue (*Festuca spp.*) and grasslands dominated by purple moor grass (*Molinia caerulea*), mat grass (*Nardus stricta)* or heath rush (*Juncus squarrosus)*.

Suggested Actions:

- Grassland should be grazed at an appropriate stocking rate and with the appropriate stock and account should be taken of the effect of the grazing stock on the flora. Grazing should also be used to prevent more vigorous plants becoming dominant.
- A typical regime for grassland dominated by *Agrostis*/*Festuca* would be 0.5-0.75LU/ha all year round (3-5 sheep or 0.5-0.75 cattle/ha) or at higher grazing levels if grazing is only suitable during the growing season (for example when acid grassland is in a mosaic with more sensitive habitats such as wet heath which are more sensitive to trampling in the winter).
- Grassland dominated by *Molinia*, mat grass or rushes requires a lower annual stocking rate of around 0.37LU/ha (2.5 sheep or 0.37 cattle/ha or equivalent). Cattle, especially native breeds, are better able to graze these coarser species than sheep. Grazing in the spring is particularly effective early in the growing season when new growth is most palatable.

2.6.4 Example Projects

- No specific projects have been identified, however, acid grassland is often managed under agri-environment schemes, particularly under upland management options.

- Projects which have focused on improving black grouse habitat and populations have improved the condition of acid grassland in some areas through stock reduction.

2.6.5 Considerations

- It is important to assess the most appropriate grazing regime for the site, particularly when acid grassland occurs as part of mosaic with other habitat such as wet heath, heath and bog.
- Adjustment of grazing regime has to be feasible for land owner.
- Agricultural activities such as liming, ploughing or fertilising will have significant impacts on acid grassland. These activities may be limited in areas of high conservation vale under cross compliance Good Agricultural and Environmental Conditions (GAEC) Regulations.

2.6.6 Opportunities

- Funding may be available through agri-environment schemes as part of moorland management for upland acid grassland or species rich grassland for the lowland areas.

2.6.7 Further Information

Detailed information on Cross Compliance: https://www.ruralpayments.org/publicsite/futures/topics/inspections/all-inspections/cross-compliance/detailed-guidance/good-agricultural-and-environmental-conditions/

Technical Note TN586 Conservation Grazing Of Semi-Natural Habitats (SRUC): http://www.sruc.ac.uk/downloads/download/473/tn586_conservation_grazing_of_semi-natural_habitats

Grassland for plants and animals guidance leaflet (SNH): https://www.nature.scot/grassland-plants-and-animals

Grassland Booklet (SNH): https://www.nature.scot/scotlands-living-landscapes-grasslands

Grazing Animals Project: http://www.grazinganimalsproject.org.uk/

2.7 Oligotrophic lochs

2.7.1 Habitat Description

Oligotrophic lochs are a priority UK BAP habitat and included in Annex 1 of the Habitats Directive. They are nutrient poor, usually occurring in upland acidic areas, have clear, well oxygenated water. They support limited plant and invertebrate communities but do support the High Focus species brown trout and in a couple of sites the rare Arctic charr and introduced vendace. Examples in the Biosphere include Lochs Doon, Macaterick, Riecaw, Enoch, Skerrow, Grannoch, Stroan, and Mochrum Lochs (SSSI, near Kirkcowan). Oligotrophic lochs found in the Biosphere are shown in Map 7.

The condition of oligotrophic lochs in the Biosphere is only known for designated lochs found within the Merrick Kells and Mochrum Lochs SAC and SSSI and Wood of Cree SSSI (classified as remaining in good condition) and Mochrum Lochs SAC and SSSI (in poor condition and deteriorating, 2004) (more details found in Habitat assessment section of GSAB 2014). Loch Doon, however, is deemed to have an unsustainably low population of Arctic charr, the notified feature of this SSSI.

2.7.2 Conservation Objectives

The main conservation objective for oligotrophic lochs is to ensure they continue to remain low in nutrients with acid to neutral pH.

2.7.3 Management

Management of oligotrophic lochs may include:

- Exclusion of livestock to prevent trampling of the loch edges by grazing animals to avoid siltation and enrichment.
- Reduction of inputs - prevention of diffuse pollution through silting of lochs and nutrient run-off, through careful control of landuse in the catchments.
- Control of non-native invasive species.

Some prescriptions relevant to different habitat types might deliver benefits to oligotrophic lochs, such as planting of native broadleaved species in a riparian corridor to buffer the acidity associated with coniferous crop species.

Suggested Actions:

- To identify and address any issues, such as stock access, erosion and nutrient input.
- To maintain/improve the water quality and the typical associated species.
- Continue to monitor the recovery from acidification where required.
- Consider the reintroduction or introduction as appropriate of Arctic charr, brown trout etc.

- Continue to improve forestry planting near to the lochs

2.7.4 Example Projects

- Work of Galloway Fisheries Trust and Ayrshire Rivers Trust to assess and reduce acidification and monitor fish populations through genetic sampling, brown trout monitoring, electrofishing surveys.

- Work of the Scottish Environment Protection Agency (SEPA) in monitoring organic and inorganic chemistry, freshwater ecology and morphology of oligotrophic lochs.

- The Department for Environment, Food and Rural Affairs (Defra) Upland Waters Monitoring Network monitors chemical and ecological impact of acid deposition sensitive areas at Round Loch of Glenhead, Loch Grannoch and Dargall Lane (outflow from Loch Dee).

- Loch Glenhead, has an automatic lake monitoring hydro-met station sited on the loch since 2005. As of 2011 this became part of the UK Lake Ecological Observatory Network.

- Loch Grannoch has been selected to form part of SEPA's Water Framework Directive lake surveillance network.

- Bi-weekly bulk rainwater samples are collected from close to Dargall Lane, at Loch Dee, for the UK Eutrophying and Acidifying atmospheric Pollutants (UKEAP) network. Dargall Lane also hosts the SEPA West gauging station number 80005. Data from the SEPA Dargall Lane station are submitted to the National River Flow Archive.

- Forestry Commission Scotland changes to forest structure in line with Forest and Water Guidelines around these waterbodies.

2.7.5 Considerations

- A lack of understanding of the condition of oligotrophic lochs in the Biosphere.

2.7.6 Opportunities

- Heritage Lottery Fund Landscape Partnership bid made in 2015 by D&G Council and partners within Dee catchment which includes aiming to improve water quality e.g. Blackwater of Dee and support the work of the Galloway Fisheries Trust.
- Linking other management objectives, for example peatland restoration, through catchment management to improve water quality

2.7.7 Further Information

JNCC Report No. 317 An estimate of the extent of dystrophic, oligotrophic, mesotrophic and eutrophic standing fresh water in Great Britain: http://jncc.defra.gov.uk/PDF/jncc317.pdf

SNH Guidance Note Oligotrophic and dystrophic lakes (UK BAP Priority Habitat): http://www.jncc.defra.gov.uk/pdf/UKBAP_BAPHabitats-39-OligDysLakes.pdf

UK Forestry Standard Guidelines: http://www.forestry.gov.uk/forestry/INFD-8BVECX

Galloway Fisheries Trust: http://www.gallowayfisheriestrust.org/

Scottish Environment Protection Agency, River Basin Management Plans: http://www.sepa.org.uk/environment/water/river-basin-management-planning/

The standing waters database (this is also based on the GB lakes inventory): https://www.nature.scot/information-library-data-and-research/snhi-data-services/standing-waters-database

3 Additional Habitats for High Focus Species

Additional Habitats (for High Focus Species) have been included as they are habitats important to the High Focus species of the Biosphere (Table 1). Appropriate habitat management is often key to halting the decline and stabilising High Focus Species numbers in the Biosphere.

3.1 Woodland Fringe for Black Grouse

3.1.1 Habitat Description

Woodland fringe is a habitat mosaic found on the interface between both native and coniferous woodland and open hill/moorland. It is a transitional habitat that is sparsely wooded and scrubby and therefore includes pockets of more open ground. A once common feature of the Scottish landscape, it has largely been lost to forestry plantations, grazing and fires. It is an important habitat for a range of species of conservation concern such hen harrier, black grouse, nightjar, tree pipit, pine marten and adder. The Biosphere High Focus Species black grouse will use this habitat for breeding and feeding, and golden eagle feed on prey such as young deer, hare, and grouse chicks. Woodland fringe also softens the harsh edges of conifer plantations, enhancing the landscape value of an area. The mix of trees species will vary according to the topography, soil and altitude, but will typically include juniper and downy willow in the higher areas, rowan, aspen and birch in the mid height areas and willows, hazel, birch, hawthorn, aspen, oak, cherry and rowan in lower lying areas. Alder, a very important food plant for black grouse, can also be found in wetter areas. The potential location of woodland fringe in the Biosphere is shown indicatively in Map 8.

3.1.2 Conservation Objectives

The main conservation objective for woodland fringe woodland is to expand the extent and network of this, once common habitat, throughout the Biosphere by:

- Retaining existing areas of woodland fringe.
- Identifying areas appropriate for new woodland fringe planting, especially in relation to black grouse leks.
- Increasing awareness of the importance of woodland fringe so appropriate management can be adopted for this transitional habitat.
- Monitoring change and developing supply chains of locally rare trees and shrubs to enrich this habitat further.

3.1.3 Management

Without intervention, succession is inevitable and the fringe areas will gradually develop into denser woodland. Shrubs and scattered trees are an important component of the fringe habitat, supporting a wide range of species. The main management tool for existing woodland fringe is grazing management by deer.

Suggested Actions:

- Appropriate grazing of woodland fringe, taking account of wild herbivores when formulating grazing management, is required to retain the balance between open grassland and scattered trees and scrub and allow for regeneration.
- Newly planted areas of woodland fringe may need to be fenced to eliminate browsers such as deer and goats. However, in order to prevent smothering of newly established trees further management may be required, such as a short period of grazing or cutting in the late summer.

3.1.4 Example Projects

- As part of a significant restructuring programme within the Galloway Forest Park 3,000ha of woodland fringe at the interface between conifer plantations and open moorland are being created. This includes a partnership project between Forestry Commission Scotland and Cree Valley Community Woodlands Trust where 260 hectares of woodland fringe have been established on the Bennan Hill, north of Loch Trool, creating a buffer for woodland species, contributing to a forest habitat network form ‘source to sea’. Volunteers have produced and planted over 9000 downy willow trees and carried out surveys.

  In addition the project has a number of research aims which are:

  - to quantify the bird assemblages of restructured Forestry- woodland fringe areas;
  - to assess factors that influence those assemblages;
  - to contribute towards the production of best practice guidance for the creation of the fringe areas;
  - to contribute towards the assessment of the sustainability of such fringe areas.

- Woodland fringe has been created around various black grouse leks in the buffer and transition zones through a project led by RSPB Scotland, in association with various public and private landowners.

3.1.5 Considerations

- Management implications need to be carefully considered for an area: without suitable management shrubs and small trees, particularly taller conifer species such as Sitka spruce and lodgepole pine, will develop into large trees and could create a new ’hard’ boundary. Management decisions need to be taken, such as periodic cutting or grazing, to prevent this.
- Careful selection of species planted can affect how the habitat develops. Slow growing species will need less intervention for example.
- If there is no grazing taking place the sward needs to be monitored and mowing undertaken if necessary and practical to enhance habitat for black grouse.
- Development of new woodland fringe habitats over an extended timescale will provide a better range of habitat age classes and therefore structure types.

3.1.6 Opportunities

- Incorporating woodland fringe as part of forest restructuring in appropriate areas.
- Woodland fringe creation should be targeted towards existing and historical black grouse leks to maximise the conservation benefit for this species.
- Funding opportunities under Forestry Grant Schemes.

3.1.7 Further Information

More information can be found in Section 4.1 Black Grouse

Scottish Natural Heritage Commissioned Report No. 456. Monitoring of woodland fringe biodiversity: the bird communities of the interface between conifer plantations and moorland in the Galloway Forest Park and their relationships with woodland fringe habitats (2014).
https://www.nature.scot/information-library-data-and-research

Information on new native woodland planting projects in Galloway Forest Park available at:
http://scotland.forestry.gov.uk/news/1321-new-native-woodland-in-galloway

3.2 Woodlands for Red Squirrel

In addition to High Focus Wet and Upland Oak Woodlands, other woodlands in the Biosphere are significant habitats for the High Focus Species red squirrel and black grouse. These include various broadleaved and coniferous woodland. Of the wide range of woodland utilised by red squirrels upland mixed ash wood and lowland mixed deciduous woodland are UK Biodiversity Action Plan habitats.

Further information on the ecology and status of red squirrel in the Biosphere is given in Section 5.5.

3.2.1 Habitat Description

Any woodland type can be suitable for red squirrels, but in areas with grey squirrels, the mix of tree species can influence the balance of competition between the species. Broadleaved woodland containing trees that produce small seed species such as birch, rowan, willow, alder and ash are more likely to support red squirrels because grey squirrels prefer larger seeds from broadleaf trees such as sycamore oak, beech, chestnut and hazel. Red squirrel populations depend on having a sufficient area of wooded habitat, which continuously provide seeds and nuts to support populations in the long-term. Conifer woodlands within the Biosphere provide a large area of suitable habitat for red squirrels where they have the competitive advantage over greys. Priority woodlands for red squirrels and grey squirrel control are shown in Map 9.

3.2.2 Conservation Objectives

The main conservation objectives for woodland for red squirrels are to:

- Maintain and enhance areas of woodland that can support red squirrel through good forest management.
- To defend priority populations from the threats of replacement by grey squirrels from disease and competition.

3.2.3 Management

Sympathetic woodland creation and woodland management is important to ensure red squirrels are preferentially encouraged over grey squirrels with management specific to woodland type. Where considering changes to existing forestry or creating new forestry, it is recommended that advice is sought from Savings Scotland's Red Squirrel Project[8] and Forestry Commission Scotland as felling licences may be required.

3.2.3.1 Woodland Creation to Encourage Red Squirrels

- New planting should strive to link existing woodland suitable for red squirrel.

[8] http://scottishsquirrels.org.uk/

- Species preferred by grey squirrels, such as oak, beech, chestnuts and hazel, should not be planted in areas where these species are scarce as this could encourage greys into new areas.
- Planting trees favoured by red squirrels such as: blackthorn, hawthorn, wild cherry, yew, larches, douglas fir, Norway spruce and Scots pine[9].
- Seed production can be encouraged by selecting south-facing aspects and long south-facing edges to east/west rides.
- Planting irregular shapes is important to increase woodland periphery.

3.2.3.2 Coniferous Plantation Planting and Management

- Where possible include heavy coning and fruiting species: Scots pine, Norway spruce, Lodgepole pine, firs, either within the coup or along the edges and by rides. Larch can no longer be included in the current Forestry Grant Scheme due to disease risk (see Section 3.2.4).
- Where possible include the following to discourage greys: Birch, Rowan, Willow, Aspen and Alder. Ash can no longer be included in the current Forestry Grant Scheme due to the Ash dieback disease (see Section 3.2.4).
- Tailor thinning to increase seed production and create a more continuous supply; middle aged trees produce more seed.
- When harvesting leave blocks linking to other coups as habitat networks are important
- Use suitable species to link habitats such as riparian areas and rides with the forest
- Consider alternative silvicultural systems to clearfelling.

3.2.3.3 Broadleaf Woodland Management

- Oak, beech, chestnuts and hazel should not be planted in areas where red squirrels are being encouraged and if they are present and a deterrent to greys is required, consider removal. Trees over 30 years should be removed first as these are the heaviest producers. This must be carefully considered as loss of these species can be detrimental to native woodland.
- For all woodland types establish a monitoring system and a review process.
- Management should aim to create uneven-aged woodland to ensure a constant supply of seed-producing trees.

3.2.4 Current Status

Southern Scotland contains a significant proportion of Ash trees within Scotland (mostly within private woodland) and native ash woods are a LBAP habitat within Dumfries and Galloway Ash dieback (a disease caused by the fungus *Hymenoscyphus fraxineus*, previously called *Chalara*

[9] For a comprehensive list of trees and shrubs which are good for red squirrels visit the Red Squirrels in South Scotland website at http://www.red-squirrels.org.uk/shrub.asp

fraxinea hence the term 'Chalara dieback of ash') was first confirmed as present within the Biosphere in 2015 and, although at a relatively low level compared to other parts of the UK, is now present in a number of sites within the Biosphere (check the Interactive map http://www.chalaramap.fera.defra.gov.uk for current status). As a consequence of this disease no Ash is currently being planted within woodlands and it is thought that only a very few resistant trees will remain in the long term. Its loss is expected to have a significant detrimental effect on woodland biodiversity[10] and it has been suggested that seed banking should be taking place to preserve the genetic range, in addition to research to combat the disease.

An action plan can be viewed at: Chalara action plan for Scotland https://scotland.forestry.gov.uk/images/corporate/pdf/chalara-action-plan-scotland-2017.pdf.

The latest information is available at: Chalara ash dieback in Scotland (Forestry Commission Scotland) can be found here: https://scotland.forestry.gov.uk/supporting/forest-industries/tree-health/chalara-ash-dieback

Larch trees are also being lost from the Biosphere at an alarming rate due to *Phytophthora ramorum*. First found within the Biosphere in 2011, south west Scotland became designated as a 'Management Zone' in 2012 as the disease had spreading rapidly across the area. Larch is now being removed from the National Forest Estate across the Biosphere by Forest Enterprise Scotland and areas out-with the management zone are being removed in an attempt to halt the spread of the disease. It has been suggested that seed banking should be taking place to preserve the genetic range, in addition to research into how to combat the disease.

The latest information can be viewed at: *Phytophthora ramorum* in Scotland: https://scotland.forestry.gov.uk/supporting/forest-industries/tree-health/phytophthora-ramorum?highlight=WyJsYXJjaCIsImxhcmNoJyIsImxhcmNoJ3MiLCJkaXNlYXNlIiwiZGlzZWFzZSdzIiwibGFyY2ggZGlzZWFzZSJd

The Ramorum (on larch) action plan for Scotland can be viewed here: https://scotland.forestry.gov.uk/images/corporate/pdf/phytophthora-ramorum-action-plan-2017.pdf

3.2.5 Example Projects

- For red squirrel project details see Section 5.5.6

[10] Assessment of potential impacts in Scotland https://scotland.forestry.gov.uk/images/corporate/pdf/chalara-impact-report-scotland.pdf

3.2.6 Considerations

- Potential conflict with native broadleaved woodland management and establishment needs to be resolved on a site by site basis.
- Woodland creation must not facilitate grey dispersal from Ayrshire and Cumbria into the Biosphere.
- For new woodland identify the most appropriate type of planting for the site through consultation with Forestry Commission Scotland, identifying other nearby woodland types, species present in the area and in nearby/linked woodlands.

3.2.7 Opportunities

- Funding available under Forestry grant schemes for forest management, woodland creation, restructuring etc.

3.2.8 Further Information

Action for red squirrels by Forestry Commission Scotland (2008): http://scotland.forestry.gov.uk/supporting/strategy-policy-guidance/biodiversity/species-action-notes

Saving Scotland's Red Squirrels Project Resources: https://scottishsquirrels.org.uk/

A range of informative leaflets and policy guidelines are available from Forestry Commission Scotland at: http://www.forestry.gov.uk/fr/infd-8c8bs6

3.3 Fresh Water Habitats

3.3.1 Habitat Description

Many fresh water habitats are included in the UK Biodiversity Action Plan as they have been identified as being threatened and require conservation action. These water bodies include rivers and streams, lochs (oligotrophic, dystrophic, mesotrophic and eutrophic), ponds, and aquifer fed naturally fluctuating water.

Over time many water bodies have been detrimentally affected by pollution, abstraction and impoundment and alternations to their bed, banks and shores. This has led to legislation being put in place, arising from the European Community (EC)'s Water Framework Directive (WFD) and implemented by the Scottish Environment Protection Agency (SEPA), to regulate certain activities and covers rivers, lochs, transitional waters (estuaries), coastal waters groundwater, and groundwater dependant wetlands. Locally, issues such as acidification and diffuse pollution are particularly significant in the Biosphere.

Watercourses and waterbodies form a significant part of the Biosphere ecosystem, with river systems radiating out from the Core zone, feeding across the Biosphere (see Map 7). Only oligotrophic lochs have been selected as High Focus Habitats but many fresh water habitats found throughout the Biosphere provide vital support to a wide range of wildlife. Of particular importance within the Biosphere are the fresh water habitats supporting the High Focus Species brown trout and water vole. These include: the Water of Girvan, rivers Doon, Stinchar, Nith, Dee, Fleet, Bladnoch, Cree and Urr. These range from high energy upland burns to the slower flowing, larger bodied, meandering sections nearing the coast. They can also support a wide range of other species including otter, bat, Atlantic salmon and many birds such as kingfisher, moorhen, sand martin and wintering wildfowl.

Smaller water bodies within the Transition Zone are also important for biodiversity. Great crested newt, for example, can range across large areas of land, so a series of farm ponds linked by suitable habitat such as rough grassland, hedgerows, woodland etc. can contribute significantly to their survival. Likewise, well vegetated margins alongside watercourses provide important habitat for a range of wildlife such as Water vole (See Section 5.6), offer shade for fish and help in stabilising banksides.

3.3.2 Conservation Objectives

The main conservation objectives for freshwater habitats are to:

- Maintain or improve water quality.
- Maintain or restore suitable bankside vegetation. This can vary depending on species present in and around the water environment.
- Integrate management of fresh water habitats with wider catchment management.

- Enhance connectivity between water bodies by creating good wildlife habitat and cover in adjacent areas
- Land management to improve water quality, for example improving forestry practices and peatland condition in acidified catchments
- Further / continued awareness of and reduction in diffuse pollution

3.3.3 Management

Management required to maintain/improve the condition of fresh water will vary by habitat and in the Biosphere there is particular emphasis on improving freshwater habitat for the High Focus Species brown trout and water vole (see Sections 4.6 and 4.7). It is also important, however, to ensure all activities are in line with the Water Framework Directive[11], a European Union directive which commits European Union member states to achieve good qualitative and quantitative status of all water bodies. To achieve this SEPA produces and implements River Basin Management Plans which use a set of environmental standards on which to assess condition. The second cycle of River Basin Management Plans[12] (updated in 2015) set out the state of the water environment, the pressures affecting the water environment where it is in less than good condition, the objectives for protecting and improving the water environment and the actions or measures for improvement or protection. These plans should be used to inform any freshwater habitat management in the Biosphere. In addition, SEPA should always be consulted when formulating new projects to ensure they meet regulations and will not have adverse impacts on other species/habitats such as fresh water pearl mussels.

SEPA has actively encouraged fencing off of water courses to reduce diffuse pollution through dunging by cattle. A grass margin also helps reduce diffusion pollution from fertiliser runoff (along with targeted application). This may be funded though agri-environment schemes, along with provision of watering facilities for stock. Bank side vegetation can be kept at optimal levels by grazing or cutting if required. This should take place in late summer to avoid disturbance during nesting times. Lack of management can lead to development of rank vegetation and consequent loss of diversity and possible choking of the watercourse.

3.3.4 Example Projects

- Refer to sections 4.6 (water vole) and 4.7 (brown trout)

[11] More information of the Water Framework Directive can be found at: http://www.gov.scot/Topics/Environment/Water/15561/WFD

[12] Further information available at: http://www.sepa.org.uk/environment/water/river-basin-management-planning/

- Galloway Fisheries Trust CIRB - Invasive Non-Native Plant Species Project http://www.gallowayfisheriestrust.org/CIRB-invasive-non-native-plant-species.php

3.3.5 Considerations

- The need to understand and identifying reasons for poor condition, for example; acidification being caused by underlying geology or land use such as forestry, diffuse pollution from agriculture activities, 'canalisation' or watercourses which can lead to faster run-off which can increase the frequency and magnitude of flooding events.
- The appropriate level and composition of riparian vegetation will depend on species present. For example water vole require plentiful bank side vegetation rich in tall herbaceous plants.
- Mandatory requirements such as Cross Compliance (Good Agriculture and Environmental Condition and Statutory Management Requirements) and the UK Forestry Standard.
- The downstream impacts of any restoration or change in management should always be considered as river behaviour can be complex and any intervention may disrupt natural processes which may have unexpected outcomes.
- Restoration and management may have to be carried out at the catchment scale to be effective and sustainable.

3.3.6 Opportunities

- The Galloway Glens Landscape Partnership (A Heritage Lottery Funded project in the Ken-Dee catchment www.gallowayglens.org). .
- Agri-environment funding to manage water quality and flood risk.
- Complimentary habitat management, such a peatland restoration, and the increasing emphasis on catchment scale management.
- Requirement under new SRDP agri-environment scheme for all farms to produce Farm Environment Assessment and where necessary a Diffuse Pollution Risk Assessment.

3.3.7 Further Information

Scottish Government Water Policy: https://beta.gov.scot/policies/water/

SEPA website http://www.sepa.org.uk/

- Invasive non-native species: https://www.sepa.org.uk/environment/biodiversity/invasive-non-native-species/
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011. A Practical Guide Version 7.1, March 2014: https://www.sepa.org.uk/regulations/water/

- Managing River Habitats for Fisheries: A Guide to Best Practice (SEPA). Available at: https://www.sepa.org.uk/media/151323/managing_river_habitats_fisheries.pdf

Good Agricultural and Environmental Conditions (GAECs): https://www.ruralpayments.org/publicsite/futures/topics/inspections/all-inspections/cross-compliance/detailed-guidance/good-agricultural-and-environmental-conditions/

- Buffer strips along watercourses (GAEC 1) https://www.ruralpayments.org/publicsite/futures/topics/inspections/all-inspections/cross-compliance/detailed-guidance/good-agricultural-and-environmental-conditions/buffer-strips-along-water-courses--gaec-1-/
- Abstraction of water for irrigation (Protecting water resources) (GAEC 2) https://www.ruralpayments.org/publicsite/futures/topics/inspections/all-inspections/cross-compliance/detailed-guidance/good-agricultural-and-environmental-conditions/abstraction-of-water-for-irrigation--gaec-2-/
- Protection of groundwater against pollution (GAEC 3) https://www.ruralpayments.org/publicsite/futures/topics/inspections/all-inspections/cross-compliance/detailed-guidance/good-agricultural-and-environmental-conditions/protection-of-groundwater-against-pollution--gaec-3-/

Scottish Rural Development Programme 2014 -2020 Agri-Environment Climate Scheme (AECS):https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/

Supporting guidance for Restoring (Protecting) River Banks under SRDP Agri-Environment and Climate Scheme (2014 – 2020) https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/restoring-river-banks/guidance-for-restoring--protecting--river-banks/

SNH Information on Managing Freshwater http://www.snh.gov.uk/land-and-sea/managing-freshwater/

River Bladnoch SAC Atlantic Salmon Catchment Plan. Available at: http://www.snh.gov.uk/publications-data-and-research/publications/search-the-catalogue/publication-detail/?id=1026

Pond management: Ponds, Pools, Lochans - SEPA https://www.sepa.org.uk/media/151336/ponds_pools_lochans.pdf

Ayrshire Fisheries Trust: www.ayrshireriverstrust.org

Galloway Fisheries Trust: www.gallowayfisheriestrust.org

3.4 Coastal Habitats for Curlew

Curlew nest in tussocky vegetation and need plentiful supplies of invertebrates for their chicks (see Section 4.3) so during the breeding season they utilise rough farmland and open moorland and many of the High Focus Habitats of the Biosphere (see Table 1). However, curlew overwinter along the coast making it important to also consider coastal habitats when looking to support the curlew population within the Biosphere.

Coastal saltmarsh, mudflats, coastal and floodplain grazing marsh, are UK priority habitats. Although limited within, and on the edges of, the Biosphere (Map 10), these are important wintering grounds for a range of wildlife including High Focus species curlew and golden plover. Coastal saltmarsh and intertidal mudflats are priority UK BAP habitats and examples include Fleet Bay, Wigtown Bay Local Nature Reserve, Luce Bay, Loch Ryan. Other adjacent habitats, particularly wet coastal grasslands, can also be very important for curlew in the winter, where they will feed on invertebrates. The Troon Golf Links and foreshore for example can support significant numbers of wintering wildfowl and waders, particularly curlew.

3.4.1 Habitat Description

Mudflats and saltmarsh (merse) are found in estuaries, bays and low lying coastal areas. Mudflats, lying between saltmarsh and low water, are a dynamic environment with significant salt and fresh water input which undergo cycles of erosion and sediment deposition.

Salt marshes are areas of low lying vegetation covered by sea water at each tide so the vegetation is therefore highly specialised, with plants adapted to high salinity and cyclical flooding. The vegetation in turn slows water flow, thereby increasing sedimentation. They contain a rich and varied invertebrate fauna and therefore provide excellent feeding grounds for a range of shore birds such as redshank and curlew, both of which breed on saltmarsh.

The most important coastal grasslands for feeding curlew are wet rough pastures, with a relatively short sword adjacent to mudflats and saltmarshes. These grasslands are also rich in invertebrates so provide an important additional winter food source.

The condition of mudflats and saltmarshes is only known for the Cree Estuary (SSSI), where mudflats are currently in good condition but the saltmarshes were deemed to be in poor condition in 2012. The condition of coastal wet grassland is unknown.

3.4.2 Conservation Objectives

The main conservation objectives for mudflats, salt marshes and coastal grasslands are to:

- Identify areas important to wildfowl and waders, particularly curlew, and assess the current condition, vegetation assemblage and past management so the most appropriate management regimes can be identified.
- Maintain the condition of, and minimise disturbance to, these areas.

3.4.3 Management

The main aims of management for mudflats and salt marshes are to:

- Minimising diffuse pollution to prevent nutrient enrichment.
- Reduce impacts of vehicles or mechanical fishing.
- Allow landward retreat where possible to retain the natural flooding/sedimentation cycle.
- Set an appropriate grazing regime according to current condition and management: Too high a grazing level reduces diversity, with a loss of sensitive species, but if a site has been grazed this should continue at an appropriate rate to prevent the development of rank vegetation. The preferred grazing pattern of intermittent light grazing between April and October with 2-3 sheep or 0.7-1.0 young cattle per hectare (~0.5LU/ha) should meet most requirements. Moderate grazing of 5-6 sheep or 1-1.5 young cattle (~1LU/ha) between April and October will be suitable on some sites. When setting the grazing pattern always take account of wild herbivores such as grazing geese.

The main aims for management of the adjacent wet coastal grasslands used by curlew in the winter are to:

- Maintain a short to medium sward, while retaining rushes and rank areas where these are important for breeding.
- Avoid draining/clearing drains in order to maintain wet areas.
- On improved grasslands that have been identified as important foraging areas large scale re-seeding and the use of inorganic fertilizers should be avoided as both can have significant detrimental impacts on invertebrates.

3.4.4 Example Projects

- No specific projects have been identified, however, management for waders is usually well supported by agri-environment schemes.

3.4.5 Considerations

- The need to identify the current condition of the habitat and causes of any natural changes taking place then take appropriate action where necessary.
- Invasive species, for example cord grass, can colonise mud flats and disrupt the local ecology (such as at Fleet Bay).
- Wildfowling, fishing, boating and jet skis can adversely affect the condition of mudflats and saltmarshes if not managed carefully.

3.4.6 Opportunities

- Wigtown Bay Management Committee oversee sustainable management of the bay.
- Solway Firth Partnership prepares schemes of management for SNH for Luce Bay and Sands SAC.
- Actively farmed salt marsh may be eligible for funding under agri-environment scheme.

3.4.7 Further Information

Solway Firth Partnership: www.solwayfirthpartnership.co.uk

Joint Defra / Environment Agency Flood and Coastal Erosion Risk Management R&D Programme Saltmarsh management manual. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/290974/scho0307bmkh-e-e.pdf

Survey of marine features within the Luce Bay and Sands Special Area of Conservation (SAC). SNH Commission Report No. 738. Report available at: https://www.nature.scot/research

4 Transition Zone High Focus Habitats

In a similar vein to the initial High Focus Habitat and Species selection, a prioritisation process involving expert stakeholder engagement was used to select habitats deemed to be of high priority within the Transition Zone of the Biosphere with basis in the priority habitats identified in the Ayrshire and Dumfries and Galloway Local Biodiversity Action Plans (LBAPs). Those habitats already designated as High Focus Habitats in the NHMP were removed – although still important within the Transition Zone, they have been adequately covered in the main part of the plan. The Biosphere Conservation and Land Management Technical Group agreed on habitats which did not occur in the Biosphere and these were removed. The feedback from specialists and Technical Group members led to a shortlist of 5 High Focus Habitats of importance to the Transition Zone.

4.1 Coastal Habitats

The Biosphere includes 280km of coastline to the south and west, most of which is highly scenic and, being a transition area, contains valuable LBAP and UKBAP habitats including: Coastal Cliffs and Slopes, Coastal Saltmarshes (Merse) and Coastal Sand Dunes, which, by their nature, create unique habitats suitable for pioneer and specialised plants.

Coastal SSSI sites include: Borgue Coast, Wigton Bay, Girvan to Ballantrae (Girvan Mains to Turnberry Castle, Turnberry Dunes) and Maidens to Doonfoot.

4.1.1 Habitat Description

Proximity to the sea creates harsh environments in terms of salt spray, wind exposure and geology and the varied topography creates a range of specialised and microhabitats, populated by plants and animals that can survive these conditions.

Conditions can be particularly extreme on the cliffs and slopes along the coast and this has helped preserve the natural environment which has been colonised by specialised plants including Rock Sea Spurrey, Roseroot and Rock Samphire and rare plants and woodland such as old oak woods containing holly and hard fern. These areas are important for many sea birds including Gannet, Fulmar, Cormorant, Guillemot and also Peregrine, Raven and Chough.

Sand dunes create another extreme nutrient poor environment but with high calcium levels, prone to high, drying winds and salt water. Pioneer plants able to colonise this environment include Sand Couch, Sea spurge and Sea holly amongst marram grass, while heather can colonise in more acidic areas to form dune heath.

In the Biosphere there are broadly two coastal wetland types, as described by SNIFFER (2009) ‘A Functional Wetland Typology for Scotland Field Report 2009 (WFD95)’:

Dune Slacks: low-lying areas within dune systems that are seasonally flooded and where nutrient levels are low.

Saltmarsh (Merse): where salt tolerant vegetation colonises soft intertidal sediments of mud and sand, creating a specialised environment. It is a sensitive habitat and may be subject to change, accreting or eroding according to tides, sea level change etc. The initial pioneer plants, such as Common glasswort, trap sediment, building up a substrate that enables other salt tolerant plants such as Sea arrow grass, Sea aster and Sea lavender to develop.

These habitats can be important for a range of invertebrates such as a mining bee and a spider hunting wasp at Torrs Warren SSSI, waders such as Curlew (see Section 5.3), Oystercatcher, Lapwing and Redshank. A number of wildfowl and geese are also closely associated with saltmarsh and may gather in large flocks during the winter. A number of these species are in decline nationally.

4.1.2 Conservation Objectives

- Monitoring of designated sites, species of conservation concern (particularly breeding bird colonies) and saltmarsh accretion and erosion.
- Ensure grazing densities and timing are suitable on farmed areas (see Section 4.1.3).
- Address any issues of eutrophication where possible.
- Education of public to reduce erosion damage by trampling etc.

4.1.3 Management

The importance of saltmarsh has long been recognised with a previous saltmarsh scheme in place along the Dumfries & Galloway coastline now incorporated into the current SRDP agri-environment scheme. The aim is to retain a diverse vegetation across the various area of saltmarsh.

SNH are the main contact point for information on appropriate management and advise that:

- Lower lying, pioneer, areas require little grazing and if over grazed can quickly lose diversity and become unsuitable for birds and invertebrates. In contrast, the mid and upper saltmarsh can soon become dominated by rank grasses if grazing density is too low.
- Management is further complicated by having to move stock according to high tides and not being able to use conventional fencing as this would be quickly washed away.
- Land managers tend to use single strand, sometimes electric, fencing to manage cattle on saltmarsh and limit the time sheep spend on the area.

Suggested grazing densities for these habitats, as described in the SAC Technical Note (TN586) “Conservation Grazing of Semi-Natural Habitats” are:

- Coastal sand dunes: 0.10 - 0.30 LU/ha
- Coastal heath: 0.15 - 0.30 LU/ha
- Saltmarsh: 0.25 - 0.50 LU/ha

4.1.4 Example Projects

- RSPB reserve Crook of Baldoon: https://www.rspb.org.uk/reserves-and-events/reserves-a-z/crook-of-baldoon/
- Solway Firth Partnership SMILE Project: The aim of the Solway Marine Information, Learning and Environment (SMILE) Project is to 'update the 1996 'State of the Solway Review', using innovative communication methods to gather pan-estuary information, learn from stakeholders and promote a better understanding of the Solway Firth ecosystem': www.solwayfirthpartnership.co.uk/planning/smile-project

4.1.5 Considerations

- Coastal erosion of sand dunes and saltmarsh (rates of accretion can increase the habitat if conditions are suitable).
- Over- or under-grazing on saltmarsh
- Scrub encroachment
- Cord-grass colonisation such as at Fleet Bay, though this sometimes develops into more conventional and diverse saltmarsh.
- Pollution such as oil spills, waste effluent, agricultural run-off and plastic accumulation
- Coastal development

4.1.6 Opportunities

- Historically agri-environment schemes have included options for coastal habitats. The current agri-environment scheme (SRDP – Agri Environment and Climate Scheme) includes management for saltmarsh under Wetland Management (with capital items such as fencing and water provision) and management of coastal heath under Heath Management (see Section 4.1.7).
- Increasingly coastal wetlands and being recognised as important carbon stores which may support further restoration and management in the future.
- Solway Review http://www.solwayfirthpartnership.co.uk/planning/smile-project

4.1.7 Further Information

Scottish Rural Development Programme 2014 -2020 Agri-Environment Climate Scheme (AECS): https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/

- Wetland Management (for saltmarsh): https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/wetland-management/
- Heath Management (coastal): https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/heath-management/
- Coastal Embankment Breaching, Lowering or Removal: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/coastal-embankment-breaching--lowering-or-removal/

SNH Commissioned Report 786 - Scottish saltmarsh survey national report https://www.nature.scot/snh-commissioned-report-786-scottish-saltmarsh-survey-national-report

Solway Firth Partnership http://www.solwayfirthpartnership.co.uk/

Saltmarsh Management Manual: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290974/scho0307bmkh-e-e.pdf

Scotland;s Environment, Wetlands: https://www.environment.gov.scot/our-environment/land/wetlands/

Boorman (2003) Saltmarsh Review: An overview of coastal saltmarshes, their dynamic and sensitivity characteristics for conservation and management. http://jncc.defra.gov.uk/page-2347

4.2 Traditional Field Boundaries and Margins

4.2.1 Habitat Description

4.2.1.1 Hedgerows

There has been a historic loss of hedgerows in the UK, with Government grants available for their removal after World War II in the drive to increase food production and create bigger units to accommodate the larger machinery required for operations. This was halted by legislation but in the last 10-20 years the loss has continued through decline and decay in structure. This has been the case within the Biosphere, with over vigorous cutting of hedges, annual cutting and grazing by stock, leading to sparse, gappy hedges offering little in the way of habitat and food for wildlife. Typically within the Biosphere, hedgerows have largely consisted entirely of hawthorn.

Well managed hedges provide vital corridors to enable wildlife to move across the farmed landscape safely, and, with a diverse range of species included in the hedge, provide good habitat (nesting, feeding, roosting etc) for a range of wildlife such as birds (such as Linnet, Yellowhammer, Tree sparrow), insects and small mammals. Bats use hedgerows as part of their flight paths.

Legal Requirements: Under Good Agricultural and Environmental Conditions (GAEC 7):

Retention of landscape features:

- Hedge trimming and/or lopping branches off trees must not be carried out between 1 March and 31 August, inclusive (except for road safety reasons).
- Hedge laying can be carried out from 1st September up to and including March 31.
- No cultivations and application of pesticides can be made within 2m of the centre line of a hedge (GAEC 7).
- Fertilisers or pesticides can be applied to establish a new hedge; this applies from the time the land is prepared for planting the new hedge to the end of the hedge's third growing season.

4.2.1.2 Drystone Dykes

Dykes are a traditional and significant part of the landscape within the Biosphere where stone is plentiful. They too are protected by GAEC 7 with the aim of protecting landscape features and under which it is forbidden to remove or destroy drystane or flagstone dykes or turf and stone-faced banks without the prior written consent of the Scottish Ministers.

The loss of skilled labour and time-consuming restoration requirements have led to many falling into disrepair and being replaced by fencing, but support through agri-environment schemes has helped maintain and restore them. Dykes provide habitat to many small mammals such as stoats, weasels and voles, the latter being a prime food source for Barn owls. Many plants that grow in field margins are hosts for insects and spiders that are beneficial to agriculture and also a food source for many birds and bats.

4.2.1.3 Hedgerow Trees

Hedgerow trees have been lost to some extent through mechanisation of hedgerow trimming. Although many mature trees remain, replacement planting has generally only taken place through agri-environment schemes. Hedgerow trees form an important and much loved part of the landscape as well as providing a habitat for many wildlife species. Many birds also use trees as song posts and all members of the tit family need mature trees to provide them with insects on which to feed. Hedgerow trees can be particularly important for barn owls.

4.2.1.4 Field Margins

Grass margins around fields were largely lost during the push for production post war but now that a 2 metre margin, where no spreading or fertilising should take place, is mandatory around crops and water courses, they have become a feature on every farm again. In both arable and grassland, grass margins can provide a more diverse habitat to the main sward/crop and also act as a buffer zone to the boundary features (hedges, walls, ditches etc.). Increasingly their value is being recognised as a nectar source for pollinating insects, which in turn is recognised as important for crop pollination. Uncut or ungrazed grass margins can provide cover for ground nesting birds and small mammals, and seed for birds.

4.2.2 Conservation Objectives

- Increase connectivity across the farm by using field boundary features to link with other habitats. For example planting a hedge to link two areas of woodland.
- Improve structure and diversity of hedgerows to create a range of habitats and food sources.
- Protect hedgerows, dykes and grass margins from stock to prevent browsing/damage.
- Create a management plan for hedgerows to ensure there are always some providing good habitat and food.
- Improve diversity of grass margins to increase their value to pollinating insects.

4.2.3 Management

4.2.3.1 Hedgerows

- Avoid planting trees and hedges near to habitat used by ground nesting birds to reduce predation opportunities (these are better served by rough grass margins). Knowing the species present can help in designing wildlife corridors, for example great crested newt move between woodland and ponds so a rough grass margin connecting the areas can be vital.
- A well-managed hedge should be around 2m high and 2m thick, tapering towards the top and cut every two or three years in rotation across a farm so there is always habitat and food available. Any gaps should be planted up and the hedge should be protected

from being overgrazed by stock, usually by a fence placed at least 1m from the centre of the hedge, preferably 2 or 3m to provide a good margin beside it. This provides good habitat and allows flowers and fruit to develop to feed birds, insects and small mammals.

- Hedgerow restoration is more important than creating new hedges in terms of benefits to biodiversity. Gaps should be planted up with a mix of species, old hawthorns can be coppiced (cut 5-10 cm above ground level) to allow regeneration from the ground and the hedge should be protected from grazing by livestock, usually by the addition of a stock fence.
- When creating new hedges a range of species should be planted (current SRDP AECS guidance: you must plant with at least three different native flowering species (e.g. hawthorn, blackthorn, dog rose, holly or elder). A list of possible species to plant: is given here: https://www.ruralpayments.org/publicsite-rest/fscontent/repository/portal-system/mediadata/media/resources/trees_and_shrubs_native_to_scotland.pdf
- With the exception of beech and sycamore, planting a non-native species, like Japanese rose (*Rosa rugosa*), would be an offence under the Wildlife Countryside Act.
- Consider laying young hedges (8-10 years) to help thicken up the hedge to make it more stock proof and enhance its benefit to wildlife.

4.2.3.2 Hedgerow trees

Aim for as much diversity as possible in the age structure of trees across the farm. When trimming, coppicing or laying hedges leave standard, or potential standard trees uncut at appropriate spacings (hedgerow trees can be established between 20-50m apart). However, where action is underway to encourage ground nesting, trees should be at no less than 100m spacing to discourage predation of nests by crows, etc.

The most appropriate species to plant will generally be those found growing wild locally. Try to use local provenance stock, as this is most suited to the local conditions. A variety of different tree species across the farm will benefit a greater range of wildlife by giving a variety of flowering and fruiting times and types. Ash and Oak are typical hedgerow species but Ash is currently not planted due to Ash dieback. (Chalara dieback of ash, also known as 'Chalara', is a disease of ash trees caused by a fungus called *Hymenoscyphus fraxineus*. - the fungus was previously called Chalara fraxinea, hence the name of the disease.) Small trees, like holly, rowan and crab apple, are also very valuable, especially for their flowers and rich berry and fruit crops.

4.2.3.3 Drystone Dykes

Maintain dykes in good condition: regularly check dykes and replace any lost copestones to reduce further deterioration. Protect from stock using scare fences.

4.2.3.4 Grass margins

The margin should be left uncut through the season and the benefit to wildlife will be increased if nectar-producing plants are sown within. Particularly in arable situations the strip can be ploughed and sown with a suitable seed mix (native species) alongside sowing the crop. Rank or tussocky vegetation should be cut in August, ideally leaving a sward of about 10-15cm. For field margins alongside water courses please refer to Section 3.3 Fresh Water Habitats.

- Consider sowing beneficial plants in grass margins to provide nectar for insects, important for pollination of crops.
- Leave grass margins uncut until the end of the season to provide good habitat and wildlife corridor.

4.2.4 Example Projects

- The FWAG Working Towards Best Practice Project (Hedgerows) 2004

4.2.5 Considerations

- Poor management of hedges leading to gappy hedge offering little wildlife habitat and lack of replanting
- Loss of hedgerow trees
- High cost of dyke maintenance leading to loss and deterioration of dykes and replacement with fences.
- Inappropriate cutting of hedges by flailing

4.2.6 Opportunities

- Beneficial for stock protection from the elements
- Creating wildlife corridors
- Long term support has been available through agri-environment schemes – management available to all, hedge creation now targeted to specific areas – check current guidance through holding no. (http://targeting.ruralpayments.org/)
- Coppicing or laying of young hedges improves the quality for wildlife (also funded through schemes and courses often available)
- Training courses on dyking run by the South West Scotland Branch of the Dry Stone Walling Society http://www.dswa-sws.org.uk/news/4558030402

4.2.7 Further Information

4.2.7.1 Relevant legislation:

Greening guidance 2018: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/basic-payment-scheme/basic-payment-scheme-full-guidance/greening-guidance-2018/

Good Agricultural and Environmental Conditions (GAECs): https://www.ruralpayments.org/publicsite/futures/topics/inspections/all-inspections/cross-compliance/detailed-guidance/good-agricultural-and-environmental-conditions/

Retention of landscape features (GAEC 7) https://www.ruralpayments.org/publicsite/futures/topics/inspections/all-inspections/cross-compliance/detailed-guidance/good-agricultural-and-environmental-conditions/retention-of-landscape-features--gaec-7-/

Tree Preservation Orders (TPOs): https://data.gov.uk/dataset/58ead064-8273-4a1a-a0da-d10f6c3942f3/tree-preservation-orders-scotland

Tree Felling Licence: https://scotland.forestry.gov.uk/supporting/grants-and-regulations/felling-licences

4.2.7.2 Hedgerow Training

Hedgerow Training: http://www.farmenvironment.co.uk

Hedgerow Training: http://www.traditionalskills.com/courses/view-course/hedge-planting-and-maintenance

4.2.7.3 Management Information

Scottish Rural Development Programme 2014 -2020 Agri-Environment Climate Scheme (AECS): https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/

- Management or Restoration of Hedgerows: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/management-or-restoration-of-hedgerows/
- Creation of Hedgerows: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/creation-of-hedgerows/

- Arable margins and suitable species to sow: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/creation-of-grass-strips-and-water-margins-in-arable-fields/guidance-for-creation-of-grass-strips-and-water-margins-in-arable-fields/
- Restoring Drystone or Flagstone Dykes which form an important landscape feature: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/restoring-drystone-or-flagstone-dykes/

RSPB Advice sheet Hedgerow Management: http://ww2.rspb.org.uk/images/englishhedgerows1_tcm9-133255.pdf

RSPB Advice sheet : Grass margins: https://www.rspb.org.uk/our-work/conservation/conservation-and-sustainability/farming/advice/managing-habitats/field-margins/

Seed mixes for grass margins: http://www.scotiaseeds.co.uk

TCV Handbooks on hedging, fencing, dyking, available to subscribers: https://www.conservationhandbooks.com/handbooks

FWAG technical guidance: http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000HK277ZW.09S7WO19XYI2BGG

Scotland Farmland Report, Plantlife: www.plantlife.org.uk

Dry stone Walling Association http://www.dswa.org.uk

- South-west branch: http://www.dswa-sws.org.uk/
- Scotland Members: www.dswa.org.uk/scotland.asp

4.3 Calcareous and Neutral Grasslands

4.3.1 Habitat Description

Agricultural improvement in the past led to the loss of significant areas of species rich grassland so the remaining areas need careful management.

There are few areas of calcareous (or base-rich) grasslands in the Biosphere as the underlying geology required (base-rich glacial drift, serpentine and limestone) is scarce. They tend to be dry and nutrient poor, though rich in calcium. Small areas are present amongst acid grassland, roadside verges, old limestone quarries and railway cuttings. It is the most species diverse of all grassland types for flowering plants. Typical species include Wild Thyme, Quaking Grass, Fairy Flax and Common rockrose, Meadow oat, Vernal sandwort. Some contain a number of locally scarce species, such as Field Gentian and Hairy Rock Cress. A diverse range of invertebrates can be found, which in the Biosphere can include Common Blue, Small Heath Northern brown Argus and Dark green fritillary butterflies and the Dingy skipper moth. Wax cap fungus and Yellow meadow ant are also found. They tend to be attractive sites with high landscape value. Examples include Bailliewhirr (SSSI), Cleugh (SSSI), Skyreburn (SSSI) and Stranfasket. In South Ayrshire they are found on Serpentinite eg. at Pinbain Burn to Cairn Hill SSSI, Aldons Hill SSSI, Knockdaw Hill SSSI, Littleton and Balhamie Hills SSSI, Knockdolian Hill SSSI.

Likewise there is little species-rich Neutral Grassland remaining in the Biosphere, just pockets in field corners, steep slopes etc., though losses are mostly historic. Neutral grasslands occur on well-drained, fertile soil, typically managed as traditional hay meadows or pastures that have undergone little agricultural improvement, such as heavy fertiliser use and re-seeding. They are often associated with diverse habitat including hedges, dykes, small woods, or upland fringe. They have a high proportion of herbaceous species relative to grasses. Indicator plants include Yellow rattle, Meadow cranesbill, Pignut, Crested dog's tail and Black knapweed and fungi such as Wax cap species – the latter are unable to survive fertiliser and slurry application and it takes at least 30 years for the fungi to return once lost. Examples:

4.3.2 Conservation Objectives

- Further develop restoration techniques
- Raise awareness amongst land-managers of the importance of these grassland habitats and encourage appropriate management.
- Restore traditional management techniques where possible.
- Identify areas where new neutral grassland could be created by reducing soil fertility and seeding with suitable plant species eg upland areas, and reduce fragmentation of existing areas.

4.3.3 Management

- Management is generally low density, or extensive grazing
- Implement a suitable grazing /mowing regime to retain species diversity and sward height (5 – 20cm for neutral grassland, 2 – 15cm for calcareous grassland) – generally having low density or no grazing during summer to allow plants to flower and set seed, aftermath grazing at the end of summer to remove rank growth and create a shorter sward in spring and autumn to allow new growth.
- Exclude fertilisers, slurry, herbicides.
- Ensure the remaining areas are not subject to agricultural improvement.
- Management required to maintain these areas is labour intensive, which is probably the main threat to the remaining areas.

4.3.4 Example Projects

The Water of Lendal to Byne Hill area in South Ayrshire, particularly the Grey Hill Grasslands SWT Reserve, as part of the EU Life Project, has been surveyed, monitored and had suitable management implemented for base-rich grassland.

4.3.5 Considerations

- Under-grazing or abandonment, leading to rank grassland and scrub invasion (eg in quarries)
- Overgrazing leading to loss of tall herbs and shrubs.
- Moving from mowing to summer grazing
- Agricultural intensification/improvement, (eg. fertiliser, slurry or herbicide application, ploughing and re-seeding, silaging (occasional, light application of farmyard manure or lime is less damaging)
- Development: in-filling of abandoned limestone quarries (eg, Eaglesfield lime pits were originally targeted but saved, though others were lost).
- Fragmentation of remaining sites.
- Planting with conifers

4.3.6 Opportunities

- Traditionally has been funded by agri-environment schemes under species rich grassland management and creation.

4.3.7 Further Information

4.3.7.1 Relevant legislation:

Good Agricultural and Environmental Conditions (GAECs):

- Buffer strips along watercourses (GAEC 1)
- Minimum soil cover (GAEC 4)
    - Protecting soil against erosion
- Minimum land management reflecting site specific conditions to limit erosion (GAEC 5)
    - Protecting soil against erosion in certain situations
- Maintenance of soil organic matter (GAEC 6)
    - Maintaining organic levels in soil

Scottish Rural Development Programme 2014 -2020 Agri-Environment Climate Scheme (AECS): https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/

- Species-rich Grassland Management: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/species-rich-grassland-management
- Supporting guidance: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/species-rich-grassland-management/guidance-for-species-rich-grassland-management/

Grassland management guide (SNH): Grassland for plants and animals: https://www.nature.scot/grassland-plants-and-animals

SNH Grassland guide: https://www.nature.scot/guide-types-species-rich-grassland

Grasslands booklet (SNH): https://www.nature.scot/scotlands-living-landscapes-grasslands

Guidance note (SNH): The effects of supplementary feeding on species-rich grasslands: https://www.nature.scot/guidance-note-effects-supplementary-feeding-species-rich-grasslands

Guide to conservation grazing (SAC): https://www.sruc.ac.uk/downloads/file/1128/tn586_conservation_grazing_of_semi-natural_habitats

Plantlife: Grassland gems - Managing lawns and pastures for fungi https://www.plantlife.org.uk/uk/our-work/publications/grassland-gems-managing-lawns-and-pastures-fungi

Management of Wildflower-rich Grassland habitats for Insects (Buglife):
https://www.buglife.org.uk/sites/default/files/Sheet%204_Management%20for%20insects%205_07_1.pdf

Extensively Grazed Grassland; Advice For Farmers (RSPB):
https://www.rspb.org.uk/our-work/conservation/conservation-and-sustainability/farming/advice/managing-habitats/extensively-grazed-grassland/

4.4 Wetlands

4.4.1 Habitat Description

Wetlands are areas of saturated land, either permanently or seasonally and they provide habitat for a wide range of plants and animals. They can also be important areas for water retention (contributing to flood reduction) and purifying as well as for carbon storage. Wetlands can vary widely according to the conditions and include LBAP habitats: Wet Woodland, Swamp, Fen, Marsh, Reedbed, and Coastal Salt Marsh. (For Blanket Bog and Wet Heath please refer to the Biosphere Habitat Management Plan, chapters 2.1 and 2.2 and for Coastal Saltmarsh refer to x.x Coastal Habitats).

Examples within the Biosphere include: Kenmure Holms SSSI/SPA, Ken-Dee Marshes SSSI/SPA, the edges of Wigton Bay, Bladnoch Floodplain LWS, Bogton Loch and Martenham Loch. Species dependent for part of their habitat on wetland include Willow tit, Reed bunting, Hen harrier, Otter and High Focus Biosphere species Curlew, Water vole.

Useful definitions are given by SNIFFER (2009) in 'A Functional Wetland Typology for Scotland Field Report 2009 (WFD95)'[13]. Those found within the Biosphere include:

- ***Wet Woodland (also known as carr):*** Typically comprise wooded areas dominated by alder (Alnus glutinosa) and willow (Salix sp.) on flood plains in a range of situations from islands in river channels to low-lying wetlands alongside the channels. The habitat typically occurs on moderately base-rich, eutrophic soils subject to periodic inundation.
- ***Wet Grassland: vegetation (grassland communities):*** requires consistently high, but not above-surface, water tables i.e. they are wet, terrestrial/semi-terrestrial wetlands. Vegetation is mainly grass species, often with rushes; grasses may be tussock forming. Spring/Flush Groundwater outflow to the surface of a wetland, associated with an obvious sloping topography.
- ***Fens (also known as mires, marshes or fen meadows):*** Generally comprises vegetation (mire communities), which require consistently high, but rarely above-surface, water tables i.e. they are wet, semi-terrestrial wetlands mainly occurring on flat or gently sloping topographies. May be tall herb or lower growing rush and sedge dominated. They are generally botanically diverse and provide good habitat for wetland species.
- ***Swamp Wetland:*** communities comprising emergent vegetation in shallow standing water (summer water table typically more than about 25 cm above ground level). They usually have tall vegetation dominated by one or two species. Fen and swamp often grade into open water at one end and carr at the other and can occur in association with reedbeds. Examples include: Ken-Dee Marshes (SPA/SSSI), Kenmure Holms (SPA/SSSI), Blackpark Marsh, Threave (SPA/SSSI), Carlingwark Loch (SSSI)

[13] https://www.sniffer.org.uk/snifferwfd95-fieldsurveymanual-v1-pdf

- ***Reedbed:*** A Species poor wetland community, comprising predominantly reed. Generally located in shallow standing water (summer water table typically more than about 25 cm above ground level) They provide excellent habitat for many bird species. Reeds are efficient cleansers of water, hence they are used in sustainable drainage systems. They tend to be isolated areas scattered across the biosphere, often within narrow fringes around lochs.

Other wetland habitats include ***Saltmarsh (Merse)*** which occurs where salt tolerant vegetation colonises soft intertidal sediments of mud and sand, creating a specialised environment and ***Dune Slacks*** which are low-lying areas within dune systems that are seasonally flooded and where nutrient levels are low. Please refer to Section 4.1 Coastal Habitats.

Historically many wetlands were drained in an effort to improve agricultural production, very often with poor results, but still causing a loss of diversity. Of those that have been retained many have been poorly managed by overgrazing/cutting or a complete lack of grazing after fencing off from drier pasture, both of which can lead to a loss of diversity, the former by preventing wetland plants to flower and set seed so being grazed out, the latter by allowing more vigorous vegetation, notably soft rush and *Molinia caerula* (‘blow grass’), to become dominant and suppress other species. The loss of plant diversity inevitably leads to a reduction in invertebrates and therefore higher animals, with less food and habitat available.

4.4.2 Conservation Objectives

- Encourage wetlands to be actively managed where appropriate to increase biodiversity through targeted grazing/cutting at appropriate times
- Improve our understanding of wetlands and raising awareness of the benefits of well managed wetlands to wildlife and water management
- Restore drained wetlands by, for example, blocking field drains

4.4.3 Management

- Adjustment of grazing pressure to levels recommended for the specific wetland habitat: Guidance is available within the SAC Technical Note (TN586) “Conservation Grazing of Semi-Natural Habitats” and The Fen Management Handbook. For example:
    - Fen/swamp 0.03-0.1 LU/ha/yr
    - Rush pasture 0.4 LU/ha/yr
- Adjustment of grazing timing so pressure is lowest/grazing excluded during the flowering and nesting season. Generally, low density grazing or stock exclusion for two to three summer months will allow plants to flower and set seed.
- Later summer grazing is often essential, notably when *Molinia caerula* (purple moor grass or ‘’blow grass’) or soft rush are present, to remove rank build-up of vegetation.

- Grazing can continue through the winter if there is sufficient vegetation present and provided the stock are not poaching the ground excessively. Grazing should be discontinued once a suitable sward height is reached (see SNH grassland leaflet): areas of taller vegetation such as patches of rushes can provide vital cover for ground nesting birds in spring, while shorter sward heights can be good habitat for feeding. Some poaching can be beneficial to help plant seed to grow. Very often spring grazing can be beneficial as the young vegetation is more palatable at this time of year.
- Erection of fencing to allow controlled grazing if a suitable grazing regime cannot be achieved without fencing, but this must be accompanied by a grazing or cutting period if required to prevent a build up of rank vegetation.
- A number of techniques can be used to restore the hydrology of previously drained wetlands. This can include breaking field drains, drain blocking (of open drain channels), using peat, plastic or wooden dams, reprofiling drains, to effectively flatten out the drainage channel, and bunding to help hold water on a wetland (for example if a boundary drain needs to be kept clear).
- Scrub removal may be required if trees are becoming dominant. This involves cutting with/without additional herbicide application. Full guidance on scrub management can be found in the Fen Management Handbook.

4.4.3.1 Rush management

Soft rush within a wetland or on wet grassland can, if uncontrolled, swamp other, less vigorous wetland vegetation, leading to poor diversity. Wetlands can soon become rank through lack of management. Grazing with cattle during Spring and Autumn can help open up the wetland and is usually sufficient to maintain diversity within a wetland, though they may need to be shut into the site to graze the rushes. Old, dense clumps of rush are not palatable and may be better controlled by cutting and remove the cuttings. Always take care that the site is not dangerous to stock or stockman prior to management. Cutting may be required if grazing alone does not control the rushes or if grazing is not taking place.

- Cutting all rushes within a wetland/wet grassland should be avoided as this reduces habitat - pockets of rushes provide nesting opportunity.
- If cutting is required, this should be done in late August, to avoid nesting and flowering times and when the ground will be at its driest.
- Within a wetland rushes should only need to be cut if the site is not grazed by cattle and this needs to be carried out sympathetically so as not to damage the wetland flora and fauna.
- In wet grassland where soft rush has become dominant, it often needs to be cut. Aim to leave one third of rushes uncut in a mosaic across the site rather than a strip at the edge as this will retain good habitat for ground nesting birds such as Curlew. Cutting can then continue as required, cutting out some older clumps each year. See also ‘Rush Management - Advice For Farmers - The RSPB’ under further information.

- Cutting can be as effective provide its carried out in the late summer and or early spring and cuttings should always be removed. Account should always be taken of the nesting period, when there should be no cutting and only light grazing. Some taller areas should always be left – aiming for a 30% rush cover in a random mosaic across a rushy area will ensure appropriate nesting habitat is retained.

4.4.4 Example Projects

- EcoCo LIFE project LIFE 13/BIO/UK/000428 (www.ea-cei.org.uk/current-projects/ecoco-life-project/). This included parts of the East Ayrshire Coalfield Environment Initiative area (including Airds Moss SAC/RSPB Reserve and Tappetill Moss). Management work ranged from creating new wetlands, reed bed management and ditch blocking on raised bogs to tree planting and retrofitting green roofs in agricultural and industrial areas.
- The Scottish Wildlife Trust (SWT) manage a number of wetlands as part of their Reserves and have undertaken surveys such as at Bogton Loch (containing nationally rare narrow small-reed and purple small-reed and wood small-reed, which are both locally rare). These reserves can be accessed by the public. https://scottishwildlifetrust.org.uk/
- Development of a Scottish Wetland Inventory: https://www.sepa.org.uk/media/163268/development-of-a-scottish-wetland-inventory.pdf

4.4.5 Considerations

- Soft rush encroachment and dominance
- Scrub (including broadleaf trees and conifers) can become dominant, reducing open wetland habitat
- Drainage, drying out wetland habitats
- Afforestation of areas which are less than 0.5m peat (current planting guidance does not support new planting on deep peat)
- Nutrient enrichment can be an issue as wetlands are naturally draining agricultural fields and any over application of fertilisers or slurry are washed off into the wetland. This can be prevented through correct levels of application and buffer areas catching any excess nutrients before entering the wetland.

4.4.6 Opportunities

- Long term support through agri-environment schemes
- Diversity can be a useful addition for grazers
- Linking areas of wetland by creating wildlife corridors (grass margins, hedgerows etc.) to improve the value to wildlife.

4.4.7 Further Information

4.4.7.1 Relevant legislation:

SEPA guidance:

- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended): https://www.sepa.org.uk/media/34761/car_a_practical_guide.pdf
- Environmental regulation and biodiversity https://www.sepa.org.uk/environment/biodiversity/environmental-regulation-and-biodiversity/

Good Agricultural and Environmental Conditions (GAECs): https://www.ruralpayments.org/publicsite/futures/topics/inspections/all-inspections/cross-compliance/detailed-guidance/good-agricultural-and-environmental-conditions/

- Buffer strips along watercourses (GAEC 1) https://www.ruralpayments.org/publicsite/futures/topics/inspections/all-inspections/cross-compliance/detailed-guidance/good-agricultural-and-environmental-conditions/buffer-strips-along-water-courses--gaec-1-/
- Abstraction of water for irrigation (Protecting water resources) (GAEC 2) https://www.ruralpayments.org/publicsite/futures/topics/inspections/all-inspections/cross-compliance/detailed-guidance/good-agricultural-and-environmental-conditions/abstraction-of-water-for-irrigation--gaec-2-/
- Protection of groundwater against pollution (GAEC 3) https://www.ruralpayments.org/publicsite/futures/topics/inspections/all-inspections/cross-compliance/detailed-guidance/good-agricultural-and-environmental-conditions/protection-of-groundwater-against-pollution--gaec-3-/

4.4.7.2 Management Information

Scottish Rural Development Programme 2014 -2020 Agri-Environment Climate Scheme (AECS): https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/

- Wetland Management: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/wetland-management/

The Fen Management Handbook: https://www.nature.scot/sites/default/files/Publication%202011%20-%20Fen%20Management%20Handbook.pdf

SAC Technical Note (TN586) “Conservation Grazing of Semi-Natural Habitats”: https://www.sruc.ac.uk/downloads/file/1128/tn586_conservation_grazing_of_semi-natural_habitats

Scotland’s Environment, Wetlands: https://www.environment.gov.scot/our-environment/land/wetlands/

Rush Management: Advice For Farmers (RSPB): https://www.rspb.org.uk/our-work/conservation/conservation-and-sustainability/farming/advice/techniques-to-help-wildlife/rush-management/

4.5 Woodland Habitats

4.5.1 Habitat Description

(see also 2.5 Upland Oak and Wet Woodland, 2.4 Montane Heath and Montane Scrub 3.1 Woodland Fringe for Black Grouse and 3.2 Woodlands for Red Squirrel)

A number of native woodland types are listed as LBAP habitats1 including Native Ash, Oak, Birch and Wet Woods, Wood Pastures and Parklands, Upland Ash Woods, Traditional Orchards and Scrub Woods. Native woods within the Biosphere are found largely within river valleys such as the Cree, Ken-Dee and Fleet. Most broadleaved woodlands contain a mix of species and they have a high wildlife value as they, and the wildlife associated with them, have evolved and adapted to the local conditions over a long period.

Native woodlands generally support a diverse range of plants and animals, notably fungi, invertebrates and mammals. Birch trees for example are associated with the fungus Fly Agaric amongst many others.

Birch woodlands are typically found on acidic soils with low fertility, often in upland areas so are suited to many parts of the Biosphere. Birch is a pioneer tree so appears readily in disturbed sites such as forest clear fell, but there are few semi-natural native Birch woods in the Biosphere. Caldons Wood SSSI in Glentrool has areas of upland Birch. Economically it is generally only used for firewood but good quality timber can have many other uses.

Ash woodlands generally have a light canopy cover, allowing a diverse ground flora and typically appear on neutral or alkaline soil, often being found alongside watercourses. They have been a significant feature, along with Oak, as hedgerow and field trees. Within the Biosphere Ash woodlands tend to be small but contribute significantly to biodiversity. Ash trees, however, are currently threatened by ‘Ash dieback ‘(see under Considerations) and this will have a long term detrimental effect on Ash woodlands.

Oak woodlands are discussed under Section 2.5.

Scrub woods are those containing small trees and shrubs such as Gorse, Hawthorn Blackthorn, Hazel, Juniper and Rowan. They are found across a range of sites, such as within field systems, on the edges of woodland or within wetland. (See also 2.4, Montane Scrub). Scrub woodland can provide excellent habitat for a range of wildlife including birds such as Willow Warbler and the threatened Yellowhammer.

Veteran trees – typically old and often damaged trees – are an important part of the landscape, often present within native woodlands. A recent project found the Biosphere to be a significant

area for native crab apples (most are hybrids) and it is hoped seed from these can be grown on so native crab apples can be grown within native woodlands (see under Further Information).

4.5.2 Conservation Objectives

- Increase total area of native woodland in the Biosphere
- Increase connectivity between existing native woods through suitable habitat creation and new planting.
- Bring existing unmanaged areas of native woodland back into back management to ensure ongoing natural regeneration and diversity.

4.5.3 Management

As discussed for wet woodland and upland oak (Section 2.5) suggested actions for both new planting and management of exiting native woodland are:

4.5.3.1 New native woodland planting

Suggested Actions:

- Establishment of new native woodlands should not be carried out in locations where it would compromise priority open ground habitats.
- Mixtures of appropriate species native to the region should be used as opposed to single species, where possible using stock of local provenance.
- Trees should be planted in groups 10-30m across rather than in lines, to create a more natural effect. The spacing also allows for future natural regeneration and should be highlighted in any woodland scheme grant application.
- Shrub (understorey) species should be planted alongside the trees.
- Approximately 20% of the ground should be left unplanted and linked to the surrounding open habitats.
- Trees should be protected against damage by herbivores by appropriate fencing, tree guards or shelters, or densities of grazing animals should be kept low.
- Depending on circumstances weeding or thinning might be required.

4.5.3.2 Management of established semi-natural/native woodland

Suggested Actions:

- Key biodiversity features should be identified and safeguarded during the management operations.
- Management should focus on reducing any immediate threats to key biodiversity (e.g. reducing excessive shade).
- In even aged stands opportunities should be sought to diversify the woodland structure.

- Planting and/or control of grazing by herbivores will be required in woodlands where natural regeneration is slow or absent.
- When restocking by under planting, local provenance should be used, to retain the local genetic variety and reduce biosecurity risks.
- Stocking rates should reflect site conditions, history of the site and woodland objectives. Recommended planting density to regenerate a native tree canopy is 500 – 1000 trees/ha. SRDP Forestry Grant Scheme 2014-20 provides options ranging from 500 to 1600 tree/ha for native woodland.

4.5.4 Example Projects

- Carbon sequestration benefits of new native woodland expansion in Scotland, Scottish Forest Alliance[14]
- The search for Scotland's native forest apple Worrell (2017): http://sustainableforestry.org.uk/assets/downloads/Worrell-Crab-Apple-article-October-2017.pdf
- The Orchard Project - South West Community Woodlands Trust: www.swcwt.org/orchard-project.html
- Scottish wildlife Trust Knowetop Reserve (boardwalks and bird boxes were made from spruce trees cut down on site) https://scottishwildlifetrust.org.uk/reserve/knowetop-lochs/
- Wood Of Cree Nature Reserve, Dumfries & Galloway (RSPB). 200,000 trees have been planted in a project to double the size of southern Scotland's largest remaining ancient oak woodland: https://www.rspb.org.uk/reserves-and-events/reserves-a-z/wood-of-cree/

4.5.5 Considerations

- Southern Scotland contains a significant proportion of Ash trees within Scotland (mostly within private woodland) and Ash dieback (a disease caused by the fungus Hymenoscyphus fraxineus and previously called Chalara fraxinea hence the term ‘Chalara dieback of ash’) was first confirmed as present within the Biosphere in 2015. Although at a relatively low level compared to other parts of the UK, it is now present in a number of sites within the Biosphere (check the Interactive map: http://chalaramap.fera.defra.gov.uk/ for current status). As a consequence of this disease, the planting of Ash is currently not being grant funded. It is thought that only a very few resistant trees will remain in the long term and its loss will have a significant detrimental effect on woodland biodiversity. (Assessment of potential impacts in Scotland: https://scotland.forestry.gov.uk/images/corporate/pdf/chalara-impact-report-scotland.pdf). An action plan can be viewed at: Chalara action plan for Scotland: https://scotland.forestry.gov.uk/images/corporate/pdf/chalara-action-plan-scotland-2017.pdf

[14] http://sustainableforestry.org.uk/assets/downloads/CFCSFAcarbonsequestration.pdf

- The latest information is available at: Chalara ash dieback in Scotland - Forestry Commission Scotland: https://scotland.forestry.gov.uk/supporting/forest-industries/tree-health/chalara-ash-dieback
- Seed banking is taking place to preserve the genetic range, alongside research to combat the disease
- Loss of scrub on farmland in order to retain Basic Payment Scheme grant on the land. Note: Land with scrub on can still be claimed under this scheme provided there is grassland amongst the scrub ie it can be grazed. Open scrub is generally better for wildlife.
- Dominance by aggressive species such as Sycamore and non-natives such as Rhododendron.

4.5.6 Opportunities

- The current Scottish Government Target of 10,000 hectares of trees planted per annum is backed up by grants under the Scottish Forestry Grant Scheme in recognition of both the need to produce timber and sequestration of carbon by trees.
- Collaboration on native woodland network expansion with the Central Scotland Green Networks initiative for which the northern part of the Biosphere is eligible.

4.5.7 Further Information

Scottish Rural Development Programme 2014 -2020 Forestry Grant Scheme:
https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/forestry-grant-scheme/

An Assessment of Planted New Native Woodland in Scotland 1989 – 2011 (Worrell et al., 2015):
https://scotland.forestry.gov.uk/images/corporate/pdf/new-native-woodlands-assessment.pdf

The Woodland Trust: https://www.woodlandtrust.org.uk/

TCV Handbooks on tree planting and aftercare, available to subscribers:
https://www.conservationhandbooks.com/handbooks/

The Native Woodlands of Scotland: Ecology, Conservation and Management (Wilson 2015):
www.euppublishing.com/userimages/ContentEditor/1439825640956/Native%20Woodlands.pdf

Forest and Woodland Strategies:

- Dumfries and Galloway: https://www.dumgal.gov.uk/media/17433/Dumfries-and-Galloway-Forestry-and-Woodland-Strategy/pdf/Forestry_and_Woodland_Strategy_April_FINAL1.pdf
- Ayrshire: https://www.east-ayrshire.gov.uk/Resources/PDF/A/AyrshireandArranForestWoodlandStrategy2014.pdf

5 High Focus Species

This section refers to the individual High Focus Species of the Biosphere. These species, although many of which are species of conservation concern at the national level (Table 2), were identified through consultation as being particularly important in the Biosphere. The following section outlines the current known status of the species within the Biosphere, the primary threats to the species, the conservation objectives, example projects and opportunities which could help support the species and halt their decline within the Biosphere.

Table 2 Conservation designations of the Biosphere High Focus Species. For a comprehensive account of designations see Conservation Designations for UK Taxa (JNCC) http://jncc.defra.gov.uk/page-3408.

High Focus Species	Conservation Designation(s)
Black Grouse	Annex 2.2 of Birds Directive The IUCN Red List of Threatened Species (2010) Biodiversity Action Plan UK Priority Species
Golden Eagle	Annex 1 of Birds Directive Bird Population Status - amber of Red data categories - birds (not based on IUCN criteria) Annex A of EC Cites Appendix 2 of Convention on Migratory Species Lower risk - least concern of Global Red list status Schedule 1 Part 1 of Wildlife and Countryside Act 1981
Curlew	Bird Population Status - amber of Red data categories - birds (not based on IUCN criteria) Annex 2.2 of Birds Directive Biodiversity Action Plan UK Priority Species Near threatened Global Red list status
Golden Plover	AEWA Annex II of Convention on Migratory Species Annex 1 of Birds Directive Annex 2.2 of Birds Directive Lower risk - least concern of Global Red list status
Red Squirrel	Priority Species of Biodiversity Action Plan UK list of priority species Schedule 5 of Wildlife and Countryside Act 1981
Water Vole	Priority Species of Biodiversity Action Plan UK list of priority species Schedule 5 Section of Wildlife and Countryside Act 1981
Brown Trout	Priority Species of Biodiversity Action Plan UK list of priority species
Juniper	Priority Species of Biodiversity Action Plan UK list of priority species
Downy Willow	Nationally scarce of Rare and scarce species (not based on IUCN criteria) Vulnerable of Red listing based on 2001 IUCN guidelines Priority Species of Biodiversity Action Plan UK list of priority species

5.1 Black Grouse

5.1.1 Current Status

Black grouse (*Tetrao tetrix*) is a UK Biodiversity Action Plan priority species and species listed on the Annex II/2 of the European Birds Directive. It is also listed on the Red list of birds of conservation concern and has special protection under Annex 1 of the EC Birds Directive, Appendix II of the Bern Convention & Schedule 1 of the Wildlife and Countryside Act 1981. In Europe, the breeding population is estimated to number c.2.5 to 3.2 million breeding pairs, equating to c.7.5 to 9.6 million individuals (BirdLife International 2004). Europe forms 25-49% of the global range. The UK population is estimated to be about 5,100, less than 1% of the European population, with a short term trend of declining by 22% from 1995-2005 and a long term decline of 58% from 1980-2005. Globally numbers are decreasing (IUCN[15]).

Historically, Dumfries and Galloway held a significant proportion of the black grouse population in Scotland. In recent decades, there has been a huge reduction in numbers due to loss of moorland habitat to mature forestry and over grazing of remaining moorland. Combined with other factors, such as collisions with fences and predation, the remaining populations have become fragmented and isolated. Black grouse declined by 29% between the two national surveys in 1995/96 and 2005, but this decline was even more pronounced in south west Scotland with a decline of 49%. It is now estimated that Dumfries and Galloway is home to less than 200 lekking males. (Dumfries & Galloway Recovery Project[16]).

The preferential woodland fringe black grouse habitat is limited within the Core Area and Buffer Zone. Despite this, the Biosphere supports an important healthy population of black grouse, albeit much reduced from a vastly lower population than earlier last century. Numbers are particularly well recorded in the Galloway Forest Park (including Ayrshire) and the 2014 survey revealed that there were 37 leks, an increase of 10 from 2013, and 58 lekking males (52 in 2013). There was a maximum of 5 males at a lek. Elsewhere in D&G numbers had fallen in this period[17].

5.1.2 Ecology and Habitat Requirements

Black grouse is an upland species requiring a range of habitats to provide forage and shelter for roosting and nesting. The ideal black grouse habitat mosaic would comprise a woodland area with well-spaced trees and a scrub layer with species such as birch and willow, adjacent to moorland, with well-developed ericaceous vegetation (notably heather, cotton grass and blaeberry) and open wet peatland habitats with abundant invertebrate populations (e.g. blanket bogs, wet heaths, flushes and fens, purple moor grass and rush pastures). It is essentially a woodland fringe species, utilising

[15] BirdLife International 2012. Lyrurus tetrix. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>. Downloaded on 30 July 2015.
[16] http://www.blackgrouse.info/recovery/dumfriesgall.htm (2007)
[17] RSPB Dumfries and Galloway Black Grouse Summary (*pers comm.*)

both woodland and open ground habitats and their interface. Relevant High Focus Biosphere habitats therefore are: blanket bog, upland heathland, purple moor grass and rush pastures and wet woodland.

During the breeding season males display at traditional lek sites to attract females, with the majority of nests typically found within a radius of 1.5km from the lek site. Black grouse nest on the ground, in tall vegetation (heather or rushes), which provides shelter and cover from predators. Black grouse diet changes throughout the year depending on the availability of forage and comprises principally shoots of ericaceous plants, tree buds, flowering heads of cottongrass and berries. During the chick rearing stage the presence of habitat rich in invertebrates is particularly important as this is the sole food of black grouse chicks. Optimal management of open ground habitats is therefore crucial as heavy grazing and/or extensive burning renders such habitats unsuitable for the species.

The weather during the breeding season can have a significant effect on the chicks' survival, affecting year by year numbers: RSPB monitoring has been undertaken to assess this. Encouragingly, recent studies show that conservation work has helped increase Black Grouse populations[18].

5.1.3 Concerns

- Loss of habitat due to over/under grazing, agricultural intensification, draining of bogs and afforestation.
- Habitat fragmentation due to afforestation, leading to unviable populations.
- Collisions with fences put up to exclude deer/stock from woodlands.
- Predation, mainly by foxes and crows.
- Human disturbance of lekking birds has been identified as a severe problem at some isolated sites, though not in the Biosphere area.
- Climate as, although outwith management control, wetter breeding seasons may adversely affect black grouse breeding success as young chicks are susceptible to cold, wet weather.

5.1.4 Conservation Objectives

Maintain and enhance the breeding population in the Biosphere through targeted management in the core and buffer zones, and through targeted advice in the transition zone.

5.1.5 Management

In addition to the management measures detailed for the relevant High Focus Habitats (Table 1) in the previous sections, black grouse require specific management to safeguard and enhance its population as the species has undergone a significant decline. Black grouse management is most

[18] http://www.blackgrouse.info/recovery/dumfriesgall.htm

effective within 1.5km radius of the lek site, a distance within which most of the nest sites are found, but management across suitable habitat within the Biosphere can potentially help their expansion.

The recommended management actions for Black Grouse within the Biosphere are:

- Enhancement of existing open habitat such as bog, heathland and wet areas to provide a diversified structure, particularly in conjunction with:
  - Expansion of suitable habitat and habitat networks;
  - Restructuring of existing woodland adjacent to moorland, using species such as birch and willow, to achieve low tree density (creating a woodland fringe) and planting of new woodland at low density in these areas;
  - Marking or removing deer fences where Black grouse are present;
  - Predator control.

5.1.6 Example Projects

- Black grouse population status and trends within the Core and Buffer Zone are monitored by RSPB and Forestry Commission Scotland (FCS), both of which co-ordinate and undertake annual black grouse surveys and lek counts in a collaborative initiative. RSPB also co-ordinates lek counts and works collaboratively with private landowners and volunteers in various part of the Transition Zone, particularly upper Nithsdale.

- FCS Woodland Fringe Initiative aims to increase the extent of this habitat to benefit black grouse (see Section 3.1). The FCS Woodland Fringe Initiative is informed by the result of black grouse surveys and monitoring and targets areas where black grouse occur. The project particularly focuses on monitoring the success of the establishment of selected woodland fringe sites on previously afforested areas with a mosaic of open ground and native broadleaved/conifer species, replicating the natural climatic tree line and bog ecology.

- The Black Grouse Trial Management Project in the Galloway Forest Park and the Fort Augustus area, 2007-2013 (SNH, RSPB, FCS) was a collaborative project investigating the effect of ‘added value’ management of commercial forest on the black grouse population within the selected areas of Galloway Forest Park. Management included a range of options, such as blocking forest drains, creation of woodland fringe habitat, delay of restocking, fence removal and planting native broadleaves. Plots with targeted management were paired with plots comprising similar habitat, where no targeted management was undertaken. The success of the project has been monitored through annual lek surveys, vegetation response and predator abundance. The management project ended in 2013, although lek surveys continue.

- Dumfries and Galloway recovery project: a partnership between the RSPB and SNH, assisted by FCS. The Black Grouse Recovery Project, led by RSPB identified heathland

restoration and enhancement, bog restoration, fence marking and native woodland creation as important prescriptions for key Black Grouse leks. Work was undertaken in Galloway and Nithsdale and continues where supported by SRDP.

- 'Black grouse conservation in southern Scotland' research project: a joint SNH/Game & Wildlife Conservation Trust (GWCT)/Southern Uplands Partnership (SUP) initiative[19]. RSPB and FCS are now also collaborating on this project, which aims to identify key areas for future targeting of management incentives in the southern uplands.

- Game and Wildlife Conservation Trust (GWCT) Black Grouse Research focusing on identifying factors that are causing declines and initiating management to restore numbers.

5.1.7 Opportunities

- Creation of upland habitat networks and the significant expansion of woodland fringe in the Galloway Forest District.
- Potential PhD Research project on Upland Habitat Networks of the Biosphere.
- Black grouse is currently a priority species in the current SRDP agri-environment scheme and funding is available for predator control and habitat management and expansion.
- Encourage habitat management enhancements as part of wind farm mitigation.
- Increase habitat mosaic when restructuring forests.
- Promote habitat management for black grouse with land managers.
- GCWT research into Black Grouse populations in Southern Scotland.

5.1.8 Further Information

BirdLife International 2012. *Lyrurus tetrix*. The IUCN Red List of Threatened Species. Version 2015.2. www.iucnredlist.org

Species Action Framework Handbook, Black grouse: http://www.snh.gov.uk/protecting-scotlands-nature/species-action-framework/saf-handbook/

Dumfries and Galloway Black Grouse Recovery Project Website: http://www.blackgrouse.info/recovery/dumfriesgall.htm

Black grouse conservation review Conservation effort in Scotland Robert, Hawkes (2013) Available at: https://www.rspb.org.uk/Images/Report3ConservationeffortinScotland_tcm9-357334.pdf

RSPB Black Grouse Conservation Project: Conservation Review 2009-2012. Available at: http://www.rspb.org.uk/whatwedo/projects/details/357335-black-grouse-conservation-review-work-20092012

[19] SNH report (Warren, P., Atterton, F., Baines, D. & White, P). In review. Black grouse conservation in southern Scotland. Scottish Natural Heritage Commissioned Report No 741.

Game and Wildlife Conservation Trust (GWCT) Black Grouse information and research http://www.gwct.org.uk/game/research/species/black-grouse/

Scottish Natural Heritage Commissioned Report No. 456. Monitoring of woodland fringe biodiversity: the bird communities of the interface between conifer plantations and moorland in the Galloway Forest Park and their relationships with woodland fringe habitats (2014). http://www.snh.org.uk/pdfs/publications/commissioned_reports/456.pdf

Forestry Commission Scotland (2008). Action for Black Grouse. Available at: http://scotland.forestry.gov.uk/images/corporate/pdf/fcs-action-blackgrouse.pdf

SNH Commissioned Report 545: Spatial and structural habitat requirements of black grouse in Scottish forests. Available to download at: http://www.snh.gov.uk/publications-data-and-research/publications/search-the-catalogue/publication-detail/?id=2033

SNH Commissioned Report 289: East Ayrshire Black Grouse Lek Distribution 2007: An Analysis of Current Status and Trends. Available to download at: http://www.snh.gov.uk/publications-data-and-research/publications/search-the-catalogue/publication-detail/?id=1484

Forestry Commission (2012) Fence Marking to Reduce Grouse Collisions. Information available at: http://www.forestry.gov.uk/PDF/FCTN019.pdf/$FILE/FCTN019.pdf

5.2 Golden Eagle

5.2.1 Current Status

Golden eagle (*Aquilla chrysaetos*) is listed in Annex 1 of the Birds Directive and on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). It is also listed in the Red list (2013) of birds of conservation concern. The UK population was estimated to be just 440 breeding pairs (4% of Europe's population) in 2003 with a short term trend of increasing and a long term trend of being stable 1982-2003. A national survey was undertaken in 2015 and this is expected to show an increase across northern Scotland. The global population is classed as stable[20].

Golden eagle is an upland bird species and the second largest bird of prey in the UK. While historically found throughout the uplands, golden eagle populations have declined due to loss of habitat and persecution, with current distribution in the UK restricted to Scotland. Within the Biosphere, the population has declined from four breeding pairs in 1980 to 2 breeding pairs in 2015, due primarily to loss of open ground and moorland habitat to conifer afforestation[21] but possibly also due to reductions in hares and rabbits. Winter carrion could also be an issue (D&G Raptor Study Group).

5.2.2 Ecology and Habitat Requirements

Golden eagle requires large expanses of open ground where there are abundant prey and suitable locations for nesting, such as crags or trees. Golden eagles are territorial and defend their territory, the core part of their home range. Home ranges have to be large enough to sustain a breeding pair and their young. Golden eagles are also slow breeders and their breeding success rate is often low.

Golden eagles are opportunistic feeders feeding on a wide range of prey, typically including grouse, hares and rabbits, deer and goat calves and carrion. It is therefore important that habitats supporting the above species are managed well. High Focus Habitats that may support golden eagle in the Biosphere include upland heath, raised and blanket bogs, acid grassland, montane scrub and heath and open areas within large woodland blocks.

5.2.3 Concerns

- Fragile population
- Habitat fragmentation/loss to forestry
- Persecution/disturbance
- Low productivity

[20] BirdLife International 2013. *Aquila chrysaetos*. The IUCN Red List of Threatened Species. Version 2015.2. Available at www.iucnredlist.org

[21] Marquiss, M., Ratcliffe, D.A. & Roxburgh, R. (1985). Breeding success and diet of Golden Eagles in southern Scotland in relation to change in land use. Biological Conservation 34, 121-40.

- Poor food supply

5.2.4 Conservation Objectives

To maintain and enhance the small and fragile breeding golden eagle population in the Biosphere, with an aspirational target of four breeding pairs.

5.2.5 Management

In addition to habitat management measures detailed for the relevant High Focus habitats in sections 2 and 3, golden eagle may require more specific management actions to safeguard and enhance their fragile population, such as:

- Supplementary winter feeding with carrion.
- Improving foraging opportunities by increasing the extent of open ground habitats and thereby prey e.g. mountain hare.
- Public education to reduce conflict with people.
- Creation of woodland fringe habitat and designed open ground corridors within large woodland blocks.

5.2.6 Example Projects

- There is an ongoing collaborative effort between Forestry Commission Scotland (FCS) and the Scottish Raptor Study Groups (South-West Scotland Groups) to protect and monitor the resident breeding pairs. During the breeding season, nest sites are under surveillance and feathers are submitted to Natural Research DNA project.

- During the winter, supplementary food (deer and wild goat carrion) is provided by FCS to support the birds and to ensure the birds' prime condition for the breeding season so far as possible. Two eaglets have been satellite-tagged (in 2010 and 2015) to study their movements and inform conservation measures for the species in the area.

- Open Habitat Mapping by FCS is a project to map all open unafforested ground under FCS ownership across Scotland. The result of the project is a comprehensive record of open ground, mapped to UK BAP Priority habitats level (where applicable) and from 2009 onwards also to NVC level.

- Bog restoration by FCS is increasing the percentage of open space within large woodland blocks.

- Current forest restructuring by FCS is recreating links between fragmented open ground to increase the scale of contiguous open range habitat.

- The Southern Upland Partnership (SUP) hosted Southern Scotland Golden Eagle Project (https://www.goldeneaglessouthofscotland.co.uk/). A partnership project between Scottish Government, SUP, RSPB Scotland, SNH, FCS, Buccleuch Estate and Scottish Land & Estates which aims to enhance the breeding golden eagle population across the area. This will involve working with Scottish Raptor Study Group to release young golden eagles from elsewhere in Scotland into suitable habitat. This could have positive implications for the small population of the Biosphere.

5.2.7 Opportunities

- Education and liaison with land managers to minimise disturbance.
- Potential PhD Research project on the provision of Upland Habitat Networks in the Biosphere.
- Open Habitat Mapping by Forestry Commission Scotland could be used to target areas for open habitat restoration and condition improvement.
- Creation of upland habitat networks, particularly through the significant woodland fringe project in Galloway Forest Park.
- Increased areas of open habitats (eg. forest to bog and heathland restoration in the core/buffer zones).
- The new South of Scotland golden eagle project, a partnership between Scottish Land & Estates, RSPB Scotland and Buccleuch Estates, working along with SNH.
- Potential for reintroduction of mountain hares and rabbits as sources of live prey.
- Consider providing winter carrion in selected areas.

5.2.8 Further Information

Scottish Natural Heritage Commissioned Report No. 626 (2015) Golden eagles in the south of Scotland: an overview. Available at:
http://www.snh.org.uk/pdfs/publications/commissioned_reports/626.pdf

Scottish Raptor Study Group http://www.scottishraptorstudygroup.org/goldeneagle.html

South of Scotland Golden Eagle Project http://www.goldeneaglessouthofscotland.co.uk/

5.3 Curlew

5.3.1 Current Status

The Eurasian Curlew (*Numenius arquata*) is a UK Biodiversity Action Plan priority species listed on the Annex II/2 of the European Birds Directive, the Amber list of birds of conservation concern (BOCC) and the IUCN 2015 Red list. The UK breeding population, now at 68,000 (28% of the European population) decreased by 59% in the UK over the period 1980-2010 with a 38% decline over the period 1999-2010 (IUCN 2015[1]). In Europe as a whole the species is in decline.

There is no data on local trends, but in 1990 Ratcliffe[22] estimated that over 5,000 pairs of Curlew had been lost across the Southern Uplands to afforestation alone, whilst recent research has shown that curlews decline and have poorer breeding success on moorland close to woodlands[23].

5.3.2 Ecology and Habitat Requirements

Curlew, the largest European wading bird, utilises different habitats throughout the year. Curlew is a ground nesting bird, and during the nesting season from April through to July, need rough tussocky, not too dense vegetation, and can be found in heathlands, purple moor grass grasslands, bogs, fens and rush pastures and on agricultural grasslands with suitable vegetation structure. The diet of a curlew during the breeding season consists almost entirely of worms and insects. The winter season is spent in flocks in coastal regions on mudflats, saltmarshes and coastal grasslands and feed on insects as well as crustaceans and molluscs. They are typically solitary outside the breeding season but can form large flocks.

5.3.3 Concerns

- Loss of suitable breeding and over-wintering habitat such as moorland, to afforestation and intensive agriculture
- Predation at nesting and chick rearing stage

5.3.4 Conservation Objectives

- To improve knowledge of current breeding population size through increased surveying and recording.
- Maintain and enhance the breeding curlew population in the Transition zone through provision of advice and encouragement to join SRDP.
- Improve management and protection at breeding and over wintering sites.
- Establish numbers and distribution of breeding curlew through surveys.

[22] Bird Life of Mountain and Upland (Cambridge University Press, 1991 ISBN 0-521-33123-4)
[23] Douglas *et al.,* 2014. Upland land use predicts population decline in a globally near- threatened wader. Journal of Applied. Ecology, 51, 194–203.

5.3.5 Management

In addition to the habitat management measures detailed for the relevant habitats described in Section 3.4, curlew require specific management to safeguard and enhance its population.

The recommended management actions to support a stable population of curlew are:

- Predator control, including corvids and foxes. Funding opportunities for some areas of the Biosphere through SRDP.
- Reduction of grazing in selected areas to retain cover and prevent trampling in the breeding season (levels of 0.35-1LU/ha help reduce trampling of nests[24]).
- Retain patches of taller vegetation for nesting when cutting rushes.
- Later cut for silage/hay (delay until July) to ensure provision of cover during the breeding season.
- Cutting silage/hay in a bird friendly manner by avoiding cutting during the nesting period (April – July) and cutting in a way which leaves some areas of taller vegetation for refuge.

5.3.6 Example Projects

- In recognition of the global importance of the UK's curlew population and its current decline, the RSPB has launched a curlew recovery project. The Society manages Barclye, part of Wood of Cree Reserve, in an effort to maintain breeding curlew and, along with black grouse, the species is a focus for targeted advice in upper Nithsdale and parts of east Ayrshire, which still hold significant populations. The RSPB also have a trial management project underway on and around their reserve at Airds Moss.

- SNH site condition monitoring and specific studies such as the Monitoring of Moorland Fringe biodiversity report (2014)[25] and British Trust for Ornithology (BTO) volunteer breeding bird surveys.

- The Nith and Lugar Water Catchment Improvement Project[26] aimed at linking important, but fragmented, habitats at an opencast coal mining site near New Cumnock, to create an integrated habitat network by restoring land on an opencast coal mining site near New Cumnock to wet grassland. This created a habitat for breeding wading birds such as lapwing, snipe, curlew, redshank and oystercatcher and included water vole surveys.

[24] Green, R.E. (1986) The management of lowland wet grasslands for breeding waders. Unpublished report. RSPB, Sandy, UK

[25] Scottish Natural Heritage Commissioned Report No. 456. Monitoring of moorland fringe biodiversity: the bird communities of the interface between conifer plantations and moorland in the Galloway Forest Park and their relationships with moorland fringe habitats (2014).
http://www.snh.org.uk/pdfs/publications/commissioned_reports/456.pdf

[26] http://www.centralscotlandgreennetwork.org/delivering/project-archive/nith-and-lugar-water-catchment-improvement

5.3.7 Opportunities

- The current Scottish Rural Development Programme Agri-Environment and Climate Scheme (SRDP AECS) provides funding to farmers to reduce harvesting to a single cut for silage/hay after August 1st in order to prevent loss of cover for curlew and other ground nesting bird species during the chick rearing period.
- Open habitat mapping by Forestry Commission Scotland could be used to target some areas for open habitat restoration and condition improvement.
- Creation and extension of open upland habitat networks through changes in forestry management in the Galloway Forest Park.
- Encourage predator control and late cutting of hay/silage in key breeding areas.

5.3.8 Further Information

BirdLife International 2012. *Numenius arquata*. The IUCN Red List of Threatened Species. Version 2015.2. Available at www.iucnredlist.org

Bird Life International Species Fact Sheet. Available at:
http://www.birdlife.org/datazone/speciesfactsheet.php?id=3012

RSPB Advice for Farmers and curlew advisory sheet available to download at:
http://www.rspb.org.uk/forprofessionals/farming/advice/details.aspx?id=203886

5.4 Golden Plover

5.4.1 Current Status

Golden plover (*Pluvialis apricaria*) is a species listed on the Annex I of the European Birds Directive and also listed on the Amber list of birds of conservation concern. Globally the species is in decline[27] with the Breeding Bird Survey (2014)[28] showing the population for golden plover in the UK declined by 25% between 1995 and 2013.

The distribution of golden plover within the Biosphere is likely to be limited to the uplands, particularly of the of the Core and Buffer zones during the summer breeding season. During the winter months they move to both the Solway and Ayrshire coast. The current status of the population in the Biosphere is not well understood as the species is not well recorded.

5.4.2 Ecology and Habitat Requirements

Golden plover is a species which breeds in the uplands and winters in the coastal regions on mudflats and sandflats. In the uplands it occupies a variety of habitats which provide forage and shelter, such as bogs and heathland with high abundances of sphagnum moss and short heather. Golden plover is a ground nesting species and it shows a preference for nesting in short sward vegetation (up to 15cm). In the UK it has an affinity with managed grouse moors, where sward height is being kept relatively low by muirburn. The diet of a golden plover consists predominantly of insects, earthworms, spiders and some plant material (berries and seeds).

5.4.3 Concerns

- Loss of suitable habitat
- Predation of nests and adults
- Susceptibility to severe weather conditions
- Disturbance of nesting sites

5.4.4 Conservation Objectives

- Encourage recording of golden plover to improve knowledge of current breeding population size and distribution.
- Maintain and enhance the breeding golden plover population in the Biosphere.
- Reduce disturbance through raising awareness of the species though interpretation.
- Establish numbers and distribution of breeding golden plover through surveys.

[27] BirdLife International 2012. *Pluvialis apricaria*. The IUCN Red List of Threatened Species. Version 2015.2. Available at www.iucnredlist.org

[28] The Breeding Bird Survey 2014
http://www.bto.org/sites/default/files/u16/downloads/reports/bbsreport14.pdf

5.4.5 Management

In addition to management measures detailed for the relevant habitats in the previous sections (see Table 1), golden plover require specific management actions to halt further decline and support existing populations.

The recommended management actions for golden plover are:

- Predator control, with opportunities for funding through SRDP.
- Maintain a suitable low sward in existing breeding sites.
- Reduce the sward height in new areas where this would not compromise the provision of other important habitats (eg. blanket bog, purple moor grass and rush pasture).

5.4.6 Example Projects

- SNH site condition monitoring and specific studies such as the Monitoring of Moorland Fringe Biodiversity report (2014)[29]

- BTO volunteer Breeding Bird Survey

5.4.7 Opportunities

- Open Habitat Mapping by Forestry Commission Scotland could be used to target areas for open habitat restoration and condition improvement.
- Creation and enhancement of upland habitat networks.
- SRDP moorland management funding.
- Wader surveys to establish breeding numbers and distribution.

5.4.8 Further Information

Breeding Bird Survey Scotland data available at: http://www.bto.org/volunteer-surveys/bbs/latest-results/population-trends

[29] Scottish Natural Heritage Commissioned Report No. 456. Monitoring of moorland fringe biodiversity: the bird communities of the interface between conifer plantations and moorland in the Galloway Forest Park and their relationships with moorland fringe habitats (2014).
http://www.snh.org.uk/pdfs/publications/commissioned_reports/456.pdf

5.5 Red Squirrel

5.5.1 Current Status

The red squirrel (*Sciurus vulgaris*) is a UK BAP priority species and a species listed on the Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). There are estimated to be 120,000 in Scotland, about 75% of the UK population (Saving Scotland's Red Squirrels, SSRS 2015). The species is present from Ireland, Spain and Portugal in the west, through continental Europe, Russia, Mongolia, and north-east China to the Pacific coast. Globally it is classed as stable but is declining in UK, Ireland and Italy[30]. The red squirrel is native to the UK while the closely related grey squirrel is non-native, being introduced to the UK from North America in the 19th century.

5.5.2 Ecology and Habitat Requirements

Red squirrel is a native squirrel species associated with woodland habitats. Unlike the non-native grey squirrel, the red squirrel can be found in both large tracts of coniferous forest as well as broadleaved woodlands.

Squirrel shelters are called dreys and resemble large nests, and are usually built high in the braches of tall trees. The diet of a red squirrel comprises predominantly of seeds (pine, spruce, larch) and nuts, however, it may also feed on berries, fungi and eggs. The diet preference of the grey squirrel is for large-seeded broadleaved species such as beech, oak and sycamore, and they are likely to out-compete red squirrel in broadleaved woodlands with these species. Red squirrel conservation is more likely to succeed in broadleaved woodlands comprising small seeded species (birch, rowan, willow, alder and ash) or in coniferous woodlands (semi-natural or commercially planted).

Grey squirrels not only out-compete the smaller red squirrels, but also carry the squirrel poxvirus, which is highly pathogenic to red squirrels. Grey squirrels can carry the virus without being affected, and UK studies have shown that apparently healthy grey squirrels have been exposed to the virus and may be carriers[31]. To date in the Biosphere the virus has been detected primarily in the Nith catchment at Thornhill, Moniaive and Sanquhar. Other than the threat posed by grey squirrel, the main predators of red squirrels are birds of prey, such as goshawks and pine marten and domestic cats in urban areas.

Red squirrels are found throughout the Biosphere but the forests supporting red squirrels within the Buffer zone around New Galloway, Laurieston and the southern end of the Galloway Forest Park have been identified as the priority area for grey squirrel control in the Scottish Strategy for Red

[30] Sandro Bertolino, Heikki Henttonen, Boris Kryštufek, Holger Meinig 2007. Sciurus vulgaris. The IUCN Red List of Threatened Species. Version 2015.2.
[31] McInnes, C. J., Wood A. R., Thomas K., Sainsbury A. W., Gurnell J., Dein F. J., et al. 2006. Genomic characterization of a novel poxvirus contributing to the decline of the red squirrel (Sciurus vulgaris) in the UK. Journal of General Virology. 87(8):2115 - 2125.

Squirrel Conservation, with some areas identified as stronghold forests and a priority for habitat management. In addition, the Nith catchment has been identified as a priority for grey squirrel control as well as a small discrete area around Maybole. Forestry Commission Scotland has an ongoing programme of extensive monitoring for grey squirrel presence, testing for squirrel pox virus and grey squirrel control.

Management to benefit this species will have to be considered when drafting management proposals for other priority species and priority habitats, as these might be mutually exclusive.

5.5.3 Concerns

- Habitat loss
- Habitat fragmentation
- Threat from grey squirrels (competition and squirrel poxvirus)

5.5.4 Conservation Objectives

In addition to habitat management measures detailed in section 3, Red Squirrel require specific management action to maintain and enhance its population as the species has undergone a significant decline.

The recommended management actions for Red squirrel are:

- Grey squirrel control
- Red squirrel priority areas for management

5.5.5 Management

Primary management for the red squirrel is appropriate woodland management and creation (see Section 3.2 Woodlands for Red Squirrel) with some areas being appropriate for grey squirrel control.

5.5.6 Example Projects

- FCS Grey squirrel monitoring and control project aims to safeguard the interest of a red squirrel population. The project involves monitoring of commercial plantations for presence of non-native grey squirrel (*Sciurus carolinensis*) using hair tubes and camera traps and eradication of grey squirrels using humane methods of dispatch.

- Cree Valley Community Woodlands Trust (CVCWT) manages a number of FCS-owned woodlands on behalf of FCS. As part of their work and engagement of communities and volunteers, they carry out a number of monitoring initiatives. Relevant to Red squirrel is work on biological recording and non-native invasive species. http://www.creevalley.com/

- Work of Saving Scotland's Red Squirrel Project to promote community and land owner control of grey squirrel populations and monitoring of red squirrels. http://scottishsquirrels.org.uk/about/in-your-area/

- SRDP 2014-20 forestry grant: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/forestry-grant-scheme/sustainable-management-of-forests/grey-squirrel-control/

- RSPB Scotland carryout monitoring for grey squirrel on the Wood of Cree reserve in liaison with South Scotland Red Squirrel Project with additional effort being explored at Ken Dee Marsh reserve.

- Forestry Commission Scotland is continuing research into red squirrel densities in Galloway Forest Park and the impact of invading greys. Research into the density of pine marten is underway in the Fleet red squirrel stronghold site and if there is any indication of natural control of grey squirrel by pine marten as observed in Southern Ireland.

5.5.7 Opportunities

- Saving Scotland's Red Squirrels work on the new South Scotland Priority Areas for Red Squirrel Conservation (PARCs) Project, in Nith Valley, Culzean and the Glenkens and Galloway. This is part of a network of 8 priority networks in South Scotland to protect significant red squirrel populations through the development of greater "community" responsibility for grey squirrel control/red squirrel protection.
- Forest restructuring to create a diversified food supply.
- Use of small seeded broadleaves in main conifer woodlands to reduce grey penetration by limiting amount of large seeded broadleaves of large seeded broadleaves in conifer forests, the habitat is less attractive to grey squirrels.
- Promoting recording of grey and red squirrel sightings with Savings Scotland's Red Squirrel Project.
- Designated Scottish Wildlife Trust project officer for the South West who can help support applications to SRDP for grey squirrel control and woodland management.

5.5.8 Further Information

Red Squirrel in South Scotland project http://www.red-squirrels.org.uk/

Saving Scotland's Red Squirrels Project http://scottishsquirrels.org.uk/

5.6 Water Vole

5.6.1 Current Status

Water vole (*Arvicola amphibius*) is a UK Biodiversity Action Plan priority species and a species listed on the Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). Globally it is considered to be stable, but it has suffered a dramatic decline in the second half of the 20th century in Britain due to habitat degradation and fragmentation and due to predation by introduced American mink[32].

In Ayrshire, between 1989 and 2006, it is estimated that water vole have disappeared from 93% of surveyed sites although more extensive surveying is required in the region. General recording suggests that the water vole is present in almost every 10km square covering the Core and Buffer zones, reflecting the widespread presence of suitable habitat, but much more surveying is required across the Biosphere to gain an accurate record of water vole distribution.

5.6.2 Ecology and Habitat Requirements

Water vole is a species associated with both lowland and upland environments. In the lowlands water voles are generally associated with slow-flowing streams and ditches with luxurious marginal vegetation and are present in some intensively farmed and urban areas. Losses in the lowlands, where predation by mink has been significant, however, been high. In the uplands water voles occupy a different niche, they are found in slow-flowing narrow moorland streams with peaty channels on flat or gently sloping ground, with streamside vegetation of rushes and sedges, but without any significant shading by trees. Typically such habitat is found in the upland areas with significant deposits of peat and slope gradient no greater than 3%.

Water voles are the largest of the British vole species and the Scottish water vole is genetically distinct from those in the rest of the UK and thought to be descended from migrants from northern Iberia. They are amphibious mammals, dividing their time between water and land, where they occupy shelters known as burrows, located close to the edge of a stream. Although they may live for two to three years, many only live for five months due to predation. Young are born between April and September and they will have three or four litters in a season. They live in central colonies with small satellite colonies, which are defended as territories, but will move between colonies if theirs is predated or becomes unviable. Water vole diet consists of plant species associated with water margins, predominantly rushes, but also grasses and sedges. In winter time, when food is in short supply, they are known to feed on roots and bark of trees. Although the most significant predated is the American mink, they are also predated by stoats, weasels, heron.

[32] http://www.iucnredlist.org/details/2149/0

5.6.3 Concerns

- Expansion of non-native American mink (*Neovison vison*) is a major threat to water vole, as mink are known to wipe out entire water vole colonies.
- Lack of data on mink populations in the uplands which, atypically, could be a significant strong hold of the water vole in the Biosphere due to predation by mink in the lowlands
- Water vole habitat in upland situations is susceptible to grazing and poaching by wild herbivores and livestock by removing suitable vegetation and eroding watercourses.
- Wildfire and inappropriate burning on peatland areas that destroys the waterside habitat and nesting sites.
- Flooding of the burrows through urbanisation or flood defence works.
- Habitat degradation and fragmentation due to agricultural intensification (such as overgrazing of water margins, ditch cleaning, drainage of wetlands) and urbanisation. Isolated colonies have reduced viability and are more vulnerable to mink predation

5.6.4 Conservation Objectives

The conservation objectives for water vole in the Biosphere are to:

- Improve the understanding of water vole distribution throughout the Biosphere by co-ordinating and starting new monitoring and recording projects.
- Identify key pressures on the population of the biosphere. For example, establishing if mink are a threat to water vole in the uplands.

5.6.5 Management

Water vole require specific management to safeguard and enhance the population as the species has undergone a significant decline due to increases in the mink population and the loss of suitable habitat and habitat networks.

In addition to management outlined for the relevant habitats in the previous sections (see Table 1) water vole management should:

- Increase areas of suitable habitat by appropriate waterside management.
- Include mink monitoring and trapping.
- Ensure that where cleaning of ditches is necessary, work is undertaken following best practice guidance (eg. cleaning one third of one side at a time, surveying prior to undertaking any work and avoiding ditch clearing between April and September if water vole are present).
- Consider fencing of watercourses to prevent over grazing of the margins and devise a suitable grazing/cutting regime to maintain an optimal waterside habitat for water vole.

5.6.6 Example Projects

There have been a number of research projects involving water vole in the Core and Buffer zones. Different locations have been surveyed by different organisations, including the Cree Valley Community Woodland Trust (CVCWT), Ayrshire Rivers Trust (ART) and Galloway Fisheries Trust (GFT). Projects which have involved work to support water vole include:

- Mink trapping projects run by Galloway Fisheries Trust and Forestry Commission Scotland

- Ayrshire Rivers Trust carried out the Carrick Invasive Species Project (CISP) focused on sustainable control of invasive non-native species within Carrick area, including the catchments of rivers Stinchar and Doon. The two year project commenced in 2012, focusing on Japanese knotweed, Himalayan balsam and mink control to help benefit a range of wildlife including water vole. Work included repeated surveys of invasive plants and monitoring of water vole populations using volunteers trained through the project. There had been sporadic sightings of mink previously but no data. As part of the project mink rafts were built and 12 animals were trapped. Good records of water vole populations were recorded on the Upper Stinchar (see http://www.ayrshireriverstrust.org/cisp/).

- Holm Wood Riparian Project: Run by Cree Valley Community Woodlands Trust (CVCT), they undertook monitoring for water vole and mink and waterside restoration such as creating new ditches, fencing watercourses and thinning bankside conifers.

- The Nith and Lugar Water Catchment Improvement Project aimed at linking important, but fragmented, habitats at an opencast coal mining site near New Cumnock, to create an integrated habitat network by restoring land on an opencast coal mining site near New Cumnock to wet grassland. This created a habitat for breeding wading birds such as lapwing, snipe, curlew, redshank and oystercatcher and included water vole surveys. http://www.centralscotlandgreennetwork.org/delivering/project-archive/nith-and-lugar-water-catchment-improvement

- The Nith District Salmon Fishery Board has been successfully trapping mink throughout the River Nith for over a decade. Fishery board staff utilise live traps, set them in the winter/spring of the year to reduce the population of American mink prior to their breeding season. They have also worked alongside the Coalfield Environment Initiative trapping mink as part of a project to enhance the biodiversity in areas that are hard to access: this was primarily aimed at water voles.

- People's Trust for Endangered Species run a UK wide water vole monitoring project: which the general public can get involved in. Further details at: http://ptes.org/get-involved/surveys/countryside-2/national-water-vole-monitoring-programme/

5.6.7 Opportunities

- The Landscape Partnership bid by D&G Council within the Dee catchment which includes improvements to water quality e.g. Blackwater of Dee and supporting the work of the Galloway Fisheries Trust.
- Education and public engagement, as water vole are an engaging species and a relatively rewarding species to survey for.
- Encouragement of major development projects, such as wind farms, to include habitat management plans for water vole.
- Bog restoration which can improve water quality.
- Restructuring of coniferous woodlands to increase width of open riparian corridors.
- Habitat restoration projects which are increasingly being considered at the catchment scale.
- Ongoing Mink survey and control (Forestry Commission Scotland.)

5.6.8 Further Information

The Woodland Trust Water Vole Fact Sheet: http://www.wildwoodtrust.org/files/water-voles-info.pdf
Water Vole Conservation Handbook, 2nd ed., Wildlife Conservation Research Unit, Oxford

Proceedings of the Water Voles in Galloway & South Ayrshire symposium held at the CatStrand in New Galloway on 8th November 2012. Edited by Malcolm Ginns MIEEM . Available at: http://www.creevalley.com/publications/

The Mammal Society Water Vole Species Account: http://www.mammal.org.uk/species-factsheets/Water%20vole

Strachan, R. and Moorhouse, T. (2006) *Water Vole Conservation Handbook*, 2nd ed., Wildlife Conservation Research Unit, Oxford

5.7 Brown Trout

5.7.1 Current Status

Brown trout (*Salmo trutta*) is a UK BAP priority species and can be found in rivers and lochs throughout the Biosphere. Although brown trout are found widely across the Biosphere, populations have suffered severe declines in the past due to modifications to their freshwater environment, such as the installation of dams and weirs along rivers, reduced water quality and latterly the spread of invasive species such as the American signal crayfish which predate trout. Acidification, through land use and atmospheric deposition, has also had significant impact in some areas, with some lochs such as Loch Enoch suffering complete extinctions. There is however, considerable work being undertaken to improve habitat quality so recent years have seen an increase in numbers and a return of trout to many waterways and lochs.

5.7.2 Ecology and Habitat Requirements

Brown trout is a fish species associated with a variety of habitats, including rivers and streams, large lochs and upland lochans. Trout have two different life cycle patterns; the first, limited to migrating within freshwater environments only and known as brown trout and the second, anadromous form (migrating between freshwater and sea environments), known as sea trout.

In terms of the species' conservation value, the most valuable are populations associated with isolated freshwater systems, which are often genetically unique and can be dated back to post-glacial period.

The life cycle of a brown trout involves a gradual migration of juvenile trout from their nursery areas in small burns down into larger rivers and lochs where they may stay until they reach the adult stage. They require clean well-oxygenated water and different water depths at different development stages and have a preference for flowing water in their pre-adult stages. Riverbeds with the right size of gravels, water flow and habitat for feeding and shelter from predators are crucial in the spawning, egg development and juvenile growing life stages.

Suitable water quality is required for trout to spawn and grow successfully. Acidification is a concern in many Galloway river headwater areas where poorly buffered underlying soils and large scale conifer planting (which can scavenge pollutants) have resulted in low pH levels. Low pH conditions will kill eggs and young life stages of trout.

5.7.3 Concerns

- Acidification of freshwater systems
- Siltation of gravel beds as a result of bank erosion or poor forestry practice
- Artificial barriers to fish migration

- A lack of good draped overhanging riparian vegetation

5.7.4 Conservation Objectives

To continue to improve habitat and water quality throughout the Biosphere, to protect existing populations of brown trout and to enable them to repopulate waterbodies where past extinctions have occurred.

5.7.5 Management

In addition to habitat management measures detailed for oligotrophic lochs and other fresh water habitats in sections 2 and 3, brown trout require specific management actions to safeguard and enhance its population as the species has undergone a significant decline.

The recommended management actions for Brown trout are to:

- Improve water quality by reducing inputs to freshwater systems
- Restructure of surrounding conifer forests to higher ecological standards especially to develop diverse riparian zones
- Where necessary consider exclusion of livestock from water course edges to prevent erosion
- Remove man-made barriers to fish migration
- Stop inappropriate stocking of brown trout which may interbreed with indigenous stock

5.7.6 Example Projects

- Brown trout study of the Galloway and Carrick Lochs (led by Queen's University of Belfast) investigated over the course of two years (2011/2012) the populations of brown trout in 24 lochs and 51 river locations within the Galloway and Carrick area. Using population genetics it investigated how environmental factors impact on colonization, individual movement, population structure, and genetic diversity of trout in the area.

- SEPA monitoring of inorganic chemistry, metals chemistry, invertebrates in freshwater ecology, phytoplankton in freshwater ecology (only lochs), macrophytes in freshwater ecology, loch morphology for freshwater ecology, chironomid pupal exuviae in freshwater ecology (only lochs), algae in freshwater ecology, morphology (RHS) in freshwater ecology, rapid assessment of invertebrates for freshwater ecology.

- Fish populations (as well as other biological and physical and chemical parameters) are being monitored in the Round Loch of Glenhead, Loch Grannoch and Dargall Lane as part of the UK-wide Acid Waters Monitoring Network[33].

[33] http://awmn.defra.gov.uk/sites/index.php

- Galloway Fisheries Trust (GFT) High Cree project involved creation of limestone gravel spawning beds to increase and improve spawning opportunities for salmonids. Effects of liming are monitored by a number of methods, including water quality testing, egg box research, electrofishing and visual surveys (http://www.gallowayfisheriestrust.org/liming-project-high-cree-water-fleet.asp).

- GFT Big Water of Fleet project involved two different liming techniques, hydrological source liming (application of lime powder over areas which are watercourse sources) and limestone sand addition (adding of limestone sand into small watercourses. Sand is then being washed down the watercourse during flood events). Effects of liming treatments are monitored by electrofishing and water quality sampling and are also covered by SEPA's own sampling sites.

- Annual GFT electrofishing surveys to monitor trout populations,

- Programme of habitat enhancement measures across a range of rivers. In 2015, volunteers worked with GFT to cut away conifer tree regrowth, loosen silted spawning beds and plant deciduous trees around the Little Water of Fleet. Previously GFT removed a number of manmade barrier stopping trout from spawning in the inflowing burns around Loch Fleet.

- GFT Genetic sampling is being undertaken by GFT on the rivers Bladnoch, Luce, Dee, Fleet, Cree and Urr and involves collecting samples from a number of sites across the river catchment in order to obtain information on genetic diversity of species within the river catchments. On a less detailed level, genetic sampling is also carried out as part of European programme aiming to collect genetic samples from each river, enabling identification of any caught fish down to the river level.

- GFT Celtic sea trout project focuses on rivers Luce, Cree and Water of Fleet and investigates the factors and mechanisms leading to development of two forms – brown trout and sea trout – of the same species, as it is believed that migration of trout into the sea is associated with condition experienced in the freshwater environment.

- Ayrshire Rivers Trust (ART) Carrick Invasive Species Project (CISP) focuses on sustainable control of invasive non-native species within Carrick area, including the catchments of rivers Stinchar and Doon. Further details given in section 4.6.4.

- ART Electrofishing surveys are carried out in order to monitor the fish stocks in the Ayrshire rivers. The Core monitoring sites are monitored at least once every three years and further monitoring sites include routine monitoring sites and investigative sites.

- Genetic sampling is being undertaken by ART on the Ayrshire rivers in order to obtain information on genetic diversity of species within the river catchments.

5.7.7 Opportunities

- Landscape Partnership bid by D&G Council within Dee catchment to improve water quality e.g. Blackwater of Dee and to support the work of the Galloway Fisheries Trust.
- Forest restructuring to open up stream sides and establish permanent riparian corridors of broadleaved species such as aspen, alder and willow.
- Bog restoration on previously planted deep peat sites could have positive implications for water quality.
- Ongoing improvement to riparian habitat during forest restructuring.

5.7.8 Further Information

Galloway Fisheries Trust http://www.gallowayfisheriestrust.org/

Ayrshire Rivers Trust http://www.ayrshireriverstrust.org/

The River Annan Trust http://www.riverannan.org/

Scottish Natural Heritage Species information: http://www.snh.gov.uk/about-scotlands-nature/species/fish/freshwater-fish/trout/

The Wild Trout Trust: http://www.wildtrout.org/content/trout-facts

5.8 Juniper

5.8.1 Current Status

Juniper (*Juniperus communis*) is a UK Biodiversity Action Plan priority species. The High Focus juniper type in the Biosphere is a prostrate form of *Juniperus communis* associated with montane scrub habitats, above the treeline, so has a limited distribution in the UK. In the Biosphere it is restricted to parts of the Galloway Hills and the population is scattered and in small and/or over mature populations with little regeneration. A Dumfries and Galloway-wide survey of juniper was conducted between 1998 and 2000 and the total extent of juniper in the Biosphere was estimated at 340 specimens, with the best remnant juniper population found on Kirriereoch Hill, to the north of the Merrick.

5.8.2 Ecology and Habitat Requirements

Juniper is a dioecious plant, which means that individual plants are either male or female so it is not self-fertile. It is a shade-intolerant evergreen shrub, capable of survival in both acidic and alkaline and generally dry soils, which flowers from May to June, producing seeds that are slow to germinate, usually requiring two winters of dormancy before germination. Typical growth is only 2-5cm a year and flowering and seed production begins when the plants are 7-10 years old. Individual plants can reach over 100 years of age.

5.8.3 Concerns

- Grazing pressure from wild herbivores and livestock.
- The low density of the current population in the Biosphere, combined with the dioecious character of the species (plants are either male or female), has implications for species' reproductive ability in a declining and spatially dispersed population.
- Damage caused by wild fires.
- Juniper disease, caused by *Phytophthora austrocedrae*, a fungus-like organism that infects the plant through the root system causing the foliage to deteriorate and eventually die. This is known to be present within one site in Southern Scotland and extreme biosecurity measures are needed to prevent infected stock arriving in the Biosphere[34].

5.8.4 Conservation Objectives

The primary conservation objective for dwarf juniper in the Biosphere is to identify and maintain existing stands and increase its extent in appropriate areas to make the population more viable and less vulnerable to events such as wildfire or outbreaks of disease.

[34] Further details can be found here: http://www.forestry.gov.uk/paustrocedrae

5.8.5 Management

Juniper will benefit from management measures recommended for the montane habitats discussed in Section 2.4. Juniper requires specific management to safeguard and enhance its population as the species has undergone a significant decline, largely caused by overgrazing and muirburn.

The recommended management actions for Juniper are:

- The reintroduction of juniper from local stock, from a wide genetic base, to appropriate areas will often be needed to secure minimum breeding populations of 50-100 plants, with appropriate protection from grazing where required.
- Adjustment of grazing pressure to levels recommended for montane habitats.
- Establishment of stock-proof enclosures to remove grazing threat to existing juniper.
- Within woodlands, fencing, deer control, selective felling and conservation grazing may all help to support regeneration.

5.8.6 Example Projects

- Forestry Commission Scotland (FCS) and Cree Valley Community Woodlands Trust (CVCWT) have an on-going willow, juniper and aspen project which is securing the remnants of these once much widespread species and returning them once more to the Galloway Hills. Willow and juniper cuttings, taken from plants within the Galloway Hills, are grown on in nurseries before planting out in deer-proof enclosures in suitable sites such on the southern slope of Bennan, in an area of felled forestry, and above the current forest edge along the path to the summit of Merrick, creating a woodland fringe effect. In-situ regeneration is anticipated and new plants will be used for further cuttings for establishment within the Galloway Forest Park. With establishment success being monitored. To date, over 4,000 juniper trees have been grown from the "Galloway collection" and been returned to the Galloway Hills. Because of the very slow growth rates, the juniper programme is aiming to raise and plant 2,000 juniper trees annually.

- The FCS deer and wild goat monitoring and control project involves an annual deer and wild goat count and control (cull) to prevent damage to commercial forest and valuable upland habitats. Counts are carried out annually using a variety of methods, including visual counts from a helicopter or dung counts. Counts and control are carried out as part of deer and wild goat management strategy for the Galloway Forest District.

- The FCS Woodland Fringe Monitoring project focuses on monitoring the success of establishment of designated woodland fringe sites on previously afforested areas, comprising of a mixture of open ground and native broadleaved/conifer species, replicating the natural climatic tree line. The long term aim is to create a mosaic of naturally variable habitat where trees grow on the better soils and heath habitat thrives in the open areas. This will create a

very varied upper tree line, soften the boundary between woodland and open hill, and provide a permanent habitat network for a wide range of species.

5.8.7 Opportunities

- Creation of woodland habitat networks in the Galloway Forest Park
- Funding for woodland creation and management through the SRDP Woodland Grant

5.8.8 Further Information

Mearns, R. (2001). Juniper, *Juniperus communis* in Dumfries and Galloway. In the Transactions of the Dumfriesshire and Galloway Natural History and Antiquarian Society, LXXV. Available at: http://www.dgnhas.org.uk/transonline/SerIII-Vol75.pdf

Botanical Society of the British Isles Species Account for juniper: http://sppaccounts.bsbi.org.uk/content/juniperus-communis-1

Planting juniper in Scotland: reducing the risk from *Phytophthora austrocedrae* guidance note: http://www.forestry.gov.uk/pdf/juniper-planting-guidance.pdf/$FILE/juniper-planting-guidance.pdf

Cree Valley Community Woodlands Trust http://www.creevalley.com/

5.9 Downy Willow

5.9.1 Current Status

Downy willow (*Salix lapponum*) is a UK Biodiversity Action Plan priority species and is one of the willow species associated with montane scrub habitat, a rare resource within the Galloway Hills and the Biosphere. Although it is one of the more common montane willow scrub species due to its ability to grow on acidic soils, it is now extremely rare in the Southern Uplands being found only in Galloway and in a small part of the Moffat hills. It is thought to have been part of a considerably more extensive habitat that once cloaked the Galloway Hills.

5.9.2 Ecology and Habitat Requirements

Downy willow is small a dioecious species, with individual plants being either male or female, growing to at most 1m. Willow seeds are extremely short-lived and require the presence of suitable micro-conditions for successful establishment. This includes bare ground and mobile scree where seedling establishment lacks competition. Downy willow also spreads vegetatively and can persist.

Downy willow and other montane willow species are susceptible to grazing pressure and therefore the existing stands are limited to locations that are less accessible for grazing animals, such as on steep crags and rocky ledges. Individual plants can survive many years under grazing and will respond favourably to relief from grazing. Downy willow and other montane willow species are also susceptible to wildfire so are also usually limited to areas fire has not reached

5.9.3 Concerns

- Grazing pressure from wild herbivores and livestock.
- Damage caused by wildfires.
- As the population is small, population viability is reduced due to the limited ability to produce viable seed.
- The risk of random events, such fire and rockfalls, can lead to the loss of individuals which is significant in a small population.

5.9.4 Conservation Objectives

As with juniper, the conservation objective for downy willow in the Biosphere is to maintain existing stands and increase its extent in appropriate areas to make the population more viable and less vulnerable to events such as wildfire or outbreaks of disease.

5.9.5 Management

Downy willow should benefit from management measures recommended for the montane habitats, described in Section 2.4. In addition, it requires specific management to safeguard and enhance the long term viability of the population in the Biosphere:

- Adjustment of grazing pressure to levels recommended for montane habitats.
- Establishment of stock-proof enclosures to remove threats from grazing.
- Reintroduction of downy willow from local stock to appropriate areas protected from grazing.

5.9.6 Example Projects

- The Forestry Commission Scotland (FCS) willow project is successfully speeding up the process of establishing local willow species in the designated woodland fringe areas, increasing the coverage of locally rare montane scrub habitat. As part of the project, willow cuttings have been collected from remnant populations and grown on in local nurseries to create "stock beds" at low elevations. These bushes are then multiplied through vegetative propagation and the resultant small trees planted out within woodland fringe and montane woodland sites. FCS's initiative to restore montane willow scrub is underway in the Biosphere Core and Buffer area in numerous locations, including the large (275ha) exclosure under the summit of Bennan to the south of Merrick, as part of the Native Woodland Fringe project.

- FCS Woodland fringe monitoring project: see Section 4.8.4 for further details.

- FCS Deer and wild goat monitoring and control project - see Section 4.8.4 for further detail.

5.9.7 Opportunities

- Creation of montane woodland habitat networks will greatly extend the occurrence of this species, with other components of the montane scrub flora, and hence improve resilience to random losses.
- Conditions suitable for downy willow will suit other montane willow species including creeping willow (*Salix herbacea*) which is also present at higher levels in the area.

5.9.8 Further Information

Online Atlas of British and Irish Flora Species Account:
http://www.brc.ac.uk/plantatlas/index.php?q=node/4054

6 Useful Resources

Galloway and Southern Ayrshire Biosphere website: http://www.gsabiosphere.org.uk/

Dumfries & Galloway Local Biodiversity Action Plan: https://www.dumgal.gov.uk/media/19945/Local-Biodiversity-Action-Plan/pdf/Local_Biodiversity_Action_Plan.pdf

Ayrshire Local Biodiversity Action Plan: https://www.south-ayrshire.gov.uk/sustainable-development/lbap.aspx

SNH Website: www.nature.scot

SNH Site Link (for information on protected areas): https://gateway.snh.gov.uk/sitelink/

Scotland's Environment Web: http://www.environment.scotland.gov.uk/

Joint Nature Conservation Committee (JNCC) for information on relevant habitats and species: http://jncc.defra.gov.uk/

Scottish Rural Development Programme 2014 -2020 schemes: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/

Independent farm conservation advice: ScotFWAG: www.scotfwag.co.uk