Grazing Regimes for Nature Recovery:

Experience from 25 years of agri-environment agreements in the Lake District's high fells

Natural England Lake District Team, 2020

Cover photographs:

Ashness Fell, Borrowdale (part of the Armboth Fells SSSI)

Herdwick sheep on Buttermere Fells SSSI

Galloway cow in Ennerdale

Natural England

Murley Moss

Oxenholme Road

Kendal

LA9 7RL

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Summary

- Healthy habitats in the Lake District's high fells deliver a range of public benefits including biodiversity, filtration of water, moderation of water flows, helping to reduce landslips, carbon storage and capture, contributing to health and wellbeing and are part of the area's landscape, history and culture.
- By the early 1990s, farm subsidy regimes had led to high levels of grazing over most of the Cumbrian fells and this had led to deterioration and loss of many upland habitats and a reduction in the public benefits they provided.
- Natural England staff in Cumbria have many years of experience of working on upland agri-environment schemes and SSSIs– in some cases going back 25 years and adding up to over 150 'person-years' of work in the uplands. This report draws on this experience as well as data gathered as part of formal SSSI assessment.
- Habitats have recovered best under low grazing pressure. Recovery of existing SSSI habitats has been universally good below a year-round average of 0.4 ewes/ha. Good recovery has sometimes been seen up to an annual average of about 0.5 ewes/ha. No sites stocked at or above an annual average of 0.6 ewes/ha have fully recovering habitats. Habitat response varies between sites; factors affecting this are discussed in this report.
- To achieve different objectives, for example to restore scrub, woodland, tall herb vegetation or radically alter vegetation structure, it is necessary for sheep grazing to be at even lower levels (or excluded for a period of time). The responses of a range of habitats to altered grazing regimes is reviewed.
- A variety of management regimes is welcome. Changes to grazing by hardy cattle (instead of just sheep) have been highly beneficial and light pony grazing may also have similar effects.
- Ecological restoration of sites with relatively good remnant vegetation is straightforward, just requiring appropriate stocking rates. Sites in poorer ecological condition may need more complex interventions. (eg reintroduction of missing species or disturbance to dominant species)
- Successful agreements are often where farmers have adopted low input/low output systems. Reducing nutrient inputs has major ecological benefits.
- Reducing costs is key to achieving economic sustainability but the whole sector is still subject to severe economic threats. A summary of feedback received from farmers is included in this report.

Key Challenges for the future:

- We need to enable farmers to continue with agro-pastoral traditions and good land management – and to feel valued for doing so – without keeping the high number of sheep that became the norm in the latter part of the 20th century. The focus needs to be on quality of stock, increasing farm profitability (often though reducing costs), good soil and water management, cattle, ponies, hay meadows and other wildlife rich habitats, management of trees and expansion of woodland, scrub and wood pasture.
- Where sheep numbers are reduced, red deer can increase. Coordinated and targeted deer management is already important in the Lake District (especially in the east) and the need for this is likely to increase.
- People need nature recovery. Robust and healthy habitats will help reduce the severity of the climate crisis by storing carbon in vegetation and soils and can also help society to cope with an inevitably changing climate by slowing the flow of floodwater and reducing the risk of erosion and landslips. We need grazing regimes in the fells that result in nature recovery, and these should be based on experience of what has (and has not) worked over the last 25 years.

1. Contents

Annexes are in a separate document:

Annex 1: Stocking Rates in HLS agreements on the Lake District High Fells SAC at December 2017
Annex 2: A selection of successful schemes with exclosures for trees and scrub
Annex 3: Current Soil and Water research - Lake District National Park
Annex 4: Common Standards Monitoring on SSSIs
Annex 5: Example stocking calendars achieving 0.05LU/ha

2. Introduction

There is a climate crisis and a biodiversity crisis both caused by the ways humans use natural resources – including the land and the life that it supports. To quote Natural England's Chairman, Tony Juniper, there has been "an unravelling of the web of life on which we all depend"

This report is about the composition and vitality of the layer of vegetation that clothes the Lake District fells. This is crucial for:

- Biodiversity
- Natural filtration of drinking water
- Moderating water flows
- Holding the land together and helping to reduce landslips and sediment supply
- Carbon storage and capture
- People's experience of the fells (health and wellbeing)
- Historic and cultural significance including continuation of traditional farming

People love the Lake District Fells for many reasons. To some they are a workplace, to others a playground. Some people can trace their family history for many generations and link it to specific places here, others are relative newcomers and many more visit for short periods of time. Some people want peace and quiet, others want high adrenaline excitement. Many look to tourism to provide an income for their families. Some people are interested in wildlife or geology, some in history, some people view it as their duty to produce food here and others are concerned with providing clean drinking water. Increasingly people are concerned about the floodwater that flows off the fells and land slips that can block roads and disrupt watercourses. Perhaps most significantly there is a growing consensus that we must do all we can to limit the magnitude of climate change.

We acknowledge all of these interests. Management of the land and of the vegetation that covers it affects everyone.

This report is written primarily to help local farmers and partner organisations to understand Natural England's work related to grazing in the Lake District's high fells. It:

- Explains the environmental effects of grazing on the Lake District's high fells and why this matters
- Describes Natural England's involvement with agri-environment schemes in the Lake District over the last 25 years
- Gives a summary of our data on the condition of sites under different grazing regimes and captures some of the experience of Natural England advisors (several advisors have worked here for 20 years or more and collectively, current advisors have over 150 years' experience of working in the Cumbrian uplands)
- Draws conclusions (based on data and experience) about the type of grazing regimes that bring about desired environmental results
- Summarises comments we have received back from farmers and others on the impacts of agri-environment schemes, and responds to these
- Includes some commentary on farm economics
- Makes recommendations for further study
- Looks at the future and some of the challenges that lie ahead for those of us involved in land management in the Lake District

3. Background

3.1 Biodiversity

The Lake District high fells include steep, sharp mountains including England's three highest massifs (Scafell, Helvellyn and Skiddaw). These are mainly composed of acidic rocks and large areas are covered in heathlands and acid grasslands. However, there are also mineral intrusions which give rise to astonishingly flower-rich areas, most notably on Helvellyn and Honister. It also includes land with a more rounded topography, some of which is blanketed by peat and supports 'blanket bog' habitat. There are large areas of such deep peat on Shap Fells, Armboth Fells and the 'back-of-Skiddaw'. England's highest mountains have important populations of arctic-alpine species including alpine saxifrage, scrubby cinquefoil, alpine mouse-ear and alpine catchfly. There are remnants of various types of woodland and scrub including Atlantic oak woods, juniper scrub and montane willows. This land is subject to very high rainfall, catching precipitation from the Atlantic coast, feeding clean-water tarns and allowing the land to support vegetation particularly rich in mosses, liverworts and lichens. The variety of vegetation types supports breeding birds including merlin, ring ousel, whinchat, peregrine, raven, short-eared owl and snipe.

Above: Skiddaw from Ashness Fell. It has extensive heathlands including a distinctive type of vegetation near the summits that is specially adapted to high altitude conditions, containing characteristic plants like stiff sedge and dwarf willow.

Most of the best areas for wildlife are included within the 27,000ha **Lake District High Fells Special Area of Conservation (SAC)**. This is composed of 10 Sites of Special Scientific Interest: Armboth Fells, Birk Fell, Buttermere Fells, Helvellyn and Fairfield, Honister Crag, Pillar and Ennerdale, Scafell Pikes, Shap Fells, Skiddaw Group, Wasdale Screes. (For a map, see https://magic.defra.gov.uk/)

The Lake District High Fells SAC Conservation Objectives and Management Advice[1] are available online.

The same habitats also occur in the fells beyond the SAC but often in poorer or more fragmented condition. This report focuses largely (but not exclusively) on the land within the SAC because this is where we hold the most monitoring data.

Further background information is contained in the introductory chapters of the Flora of Cumbria[2] and Ratcliffe (2002).[3]

3.2 Climate Change

Adaptation: According to the Met Office (UKCP18)[4], the climate in the Lake District is expected, on average, to become warmer and wetter in winter and hotter and drier in summer, with more extreme weather events including droughts and floods. These changes are already evident. Human society will need to adapt to these changes; see sections on flooding, erosion and landslips and water supply below.

Biodiversity will also be affected. We need to minimise other causes of harm to habitats and species and also ensure that there is sufficient space and habitat connectivity to allow them to move to locations where conditions may be more suitable (eg higher up the hill or in a shadier place). For some useful basic principles, see: England Biodiversity Strategy Climate Change Adaptation Principles: Conserving biodiversity in a changing climate, Defra 2008[5]
A wealth of further information and guidance is given in Natural England's on-line publications on Climate Change.

Mitigation: climate change is caused by elevated levels of certain gases (particularly but not exclusively those containing carbon, eg carbon dioxide and methane)[6] which trap heat in the atmosphere. Mitigation means either reducing emissions or increasing storage of these gases. See section on Carbon below.

3.3 Flooding

Extreme rainfall events have become more common in the Lake District with UK rainfall records set during Storm Desmond in December 2015 (341mm in 24 hours at Honister Pass and 405mm in 48 hours at Thirlmere)[7].

There was severe flooding in Cumbria in 2005 (over 2500 properties affected), 2009 (2239 properties) and as a result of Storm Desmond in 2015 (7080 properties)[8]. Cockermouth,

Keswick, Kendal, Carlisle and many smaller settlements have been severely affected on one or more occasions. Much (though in the case of Carlisle, not all) of this flood water has flowed off the Lake District Fells. People have had to move out of their homes, electricity cut off, businesses have lost money, roads have been blocked and bridges destroyed.

If there is denser vegetation in a catchment, this contributes towards "hydrological roughness" which is a factor known to slow the flow of water through that catchment[9]. This general principle is clear, but measuring the exact effects of specific examples of vegetation change, is highly complex[10, 11]. A summary of the current state of knowledge about Natural Flood Management is given in: Working with Natural Processes to reduce flood risk - The evidence behind Natural Flood Management, Environment Agency, 2017[12] and The Scottish Environment Agency's Natural Flood Management Handbook[13] - note that in terms of geomorphology, the Lake District has more in common with Scotland than much of the rest of England.

See also: Note on Natural Mitigation of Flood Risk by the Parliamentary Office of Science and Technology[14]

Soil permeability is also important; if water can soak in to the ground then the rate at which it contributes to flooding will be reduced. Work by Nick Chappell[15] of Lancaster University shows that soil permeability is greater closer to the trunks of broadleaved trees.

There is much research work currently being carried out on this subject, much of it in the Lake District. See section 8.14 and Annex 3.

3.4 Erosion and Landslips

Intense rainstorms can also cause erosion[16]; both diffuse soil erosion and more catastrophic landslips which can destroy property, roads and bridges. Diffuse soil erosion is clearly reduced when the soil is covered by dense vegetation[17]. This may be most significant at high altitudes where vegetation grows extremely slowly and grazing can easily lead to vegetation loss. The causes of landslips are complex and at least partly related to underlying geology, but a dense and robust covering of vegetation, and particularly the presence of deep-rooted species such as broadleaved trees and shrubs, helps reduce the risk.

Left: One of the many landslips that occurred in the Lake District Fells during Storm Desmond in 2015. This one was at Coledale, above Braithwaite near Keswick. Many properties in the village were flooded in the storm and the landslip resulted in large amounts of sediment being washed downstream and into the village. A large tree planting project is now attempting to improve land stability

3.5 Water Supply

United Utilities is the largest private land owner in the North West. It owns and manages 57,000 Ha across the region, primarily in the uplands, and of this total 16,000 Ha falls within the Lake District National Park. It owns 16,000 Ha of catchment land at Thirlmere and Haweswater but actually takes water from about 36% of the National Park. These catchments supply over 30% of the North West's drinking water every day, this equates to over 2.5 million people in Cumbria, Lancashire and in major urban centres such as Manchester.[18]

Catchment land is the primary filter and so the condition of the land has a fundamental impact on the raw water quality in the reservoirs. Damaged and degraded peat soils result in elevated levels of Dissolved Organic Carbon (DOC) and damaged and degraded vegetation results in increased frequency and severity of erosion leading to amplified turbidity (suspended particulate material). Both of these result in increased treatment costs, energy consumption, chemical use and waste material production at water treatment works. Both problems are exacerbated by extreme rainfall events.

A dense and robust cover of vegetation helps to reduce the risks to raw water quality by slowing the release of water from the catchment, increasing infiltration rates and so helping to ensure that clean water reaches reservoirs and other water bodies. United Utilities consider that catchment management is the essential first step in ensuring that they are able to supply clean water to the people of the NW[19]. See Section of United Utilities website on catchment management.

Clean water is also essential for good ecological quality of wetland and freshwater habitats of the Lake District. Excess fine sediment smothers aquatic invertebrates and fish eggs.

Above: Dense vegetation in the catchment of Ennerdale helps stop sediment washing into the reservoir, even in times of flood [Photo: United Utilities]

3.6 Carbon

One of the main reasons that we face a climate crisis is because human activities have been increasing the concentration of carbon in the atmosphere[20]. There are many sources of increased atmospheric carbon, the most significant of which is the use of fossil fuels. However, land management also has a part to play.

Carbon is held within vegetation and soils[21]. There is carbon in above ground vegetation, roots, bacteria, fungi and organic matter (humus) within the soil. Conversely, if soils are lost through erosion (as can happen when they are not protected by vegetation or when they are heavily trampled by people or livestock) carbon is lost to the atmosphere.

Peat is a significant carbon store and much attention has been focused on blanket bog management in recent years. Peat is formed when vegetation grows in wet, acidic conditions and therefore is unable to rot (oxidise) when it dies. Dead vegetation accumulates as peat. This requires a high water table and presence of species that hold water and promote suitable conditions such as the bog mosses (*Sphagnum* mosses).

However it should also be remembered that there are very large areas of shallow peat in the Lake District which are likely to be at greater risk of drying out and oxidising. On the whole,

these have not been subject to drainage and the main influences on their condition are climate and grazing.

Other non-peat soils also contain a surprisingly high quantity of carbon, particularly if they contain a diverse and healthy microbial population.

For further information, see the Natural England Research Report: Carbon Storage by Habitat: Review of the Evidence of the Impacts of Management Decisions and condition of carbon stores and sources.[22]

The Government is committed to achieving net zero emissions of 'greenhouse' gases by 2050. In the recent general election campaign the Conservative Party proposed to plant 30 million trees per year by 2025 and also to restore peatland habitats.

3.7 People's experience

As mentioned in the introduction, people live in or visit the Lake District for a multitude of reasons. However, wildlife, scenic beauty and tranquillity are high on the list for many. Greater variety in type and structure of vegetation and the sight and sounds of the birds and insects that go with it results in higher landscape quality and a wilder and richer experience. To quote Sir David Attenborough: "It seems to me that the natural world is the greatest source of excitement; the greatest source of visual beauty; the greatest source of intellectual interest. It is the greatest source of so much in life that makes life worth living"

Left: Birkrigg Oaks, on the side of Causey Pike, near Keswick

3.8 Landscape, History and Culture – agro-pastoral traditions

The Lake District National Park's purposes are to conserve and enhance the area's natural beauty, wildlife and cultural heritage and to promote opportunities for the understanding and enjoyment of the special qualities of the National Park by the public. While carrying out these purposes it also has a duty to seek to foster the economic and social well-being of the communities within the National Park. See the Lake District National Park Partnership Management Plan[23] for further details.

In 2017, the majority of the Lake District National Park gained World Heritage Status[24] for the following:

- A landscape of exceptional beauty, shaped by persistent and distinctive agro-pastoral traditions which give it its special character
- A landscape which has inspired artistic and literary movements and generated ideas about landscapes which have had global influence and left their physical mark
- A landscape which has been the catalyst for key developments in the national and international protection of landscapes

Further details of the World Heritage Nomination can be found on the Lake District National Park Website[25]

Above: The agro-pastoral landscape of upper Borrowdale showing inbye (bright green fields in valley bottom) intakes (walled enclosures on sides of fell) and fells in the foreground and background.

A **traditional high fell farm** will have limited 'inbye' (fertile, enclosed fields in the valley bottom), some intakes (agriculturally unimproved land on the fell but enclosed from the open fell) and access to a fell (which may or may not be common land).

However, there is considerable variation, with farms in the high valleys being different from those on the edges of the fells with access to the Solway Plain or Eden Valley. Farms are constantly changing through the buying, selling and renting of land. Farmers have often bought or rented additional inbye, often outside of the Lake District. This means that there is considerable variation in how important the fell land is within each farmer's business (ie those with large amounts of good inbye may not be as reliant on fell land)

Further background on upland agricultural systems is given in Mansfield 2011[26]. The economics of the farming system are discussed further in section 9.3 below

Common land is an important component of the agro-pastoral tradition of the Lake District. It is land owned by a person or organisation over which other people (commoners) have legal rights, including the right to graze livestock. See: Foundation for Common Land Website.

The Common Land we see today is what remains of a medieval system of land management, where large open areas were managed communally. Over the centuries some pieces of common land were 'enclosed' by walls or fences and brought under the management of an individual farm, but in Cumbria's uplands, large areas were never enclosed. One third of England's common land is in Cumbria. Two thirds of the Lake District High Fells SAC is common land.

Under the 1965 Commons Registration Act, rights to graze areas of common land were recorded on Commons Registers. These usually recorded the number and type of animals each farm could graze. Earlier in history, grazing rights were often organised by the principle of 'levancy and couchancy' ie a farm would have rights to put as many animals out on the common as it had capacity to support on that farm during the winter. However, the 1965 Act rights registration process contained few checks and balances on what was registered and arguably caused as many problems as it solved. See Rodgers et al, 2010[27].

The two most common **sheep** breeds on the high fells are Swaledales and Herdwicks[28], with a few Rough Fell flocks on the eastern fells. However, other sheep breeds are also kept, with larger animals such as Cheviots and Lleyns becoming more common.

Cattle grazing has long been practiced in the fells, as evidenced by entries in Commons Registers, place-names (eg cowpasture) and other historical records. However, numbers of cows have reduced since World War 2. Traditional hardy breeds such as Galloways, shorthorns and highland cattle are particularly suited to the harsh conditions on the fells.

Before the advent of mechanised transport, farms (and the area's many mines) were dependent on horses and **ponies**. Herds of ponies, particularly the hardy fell pony breed were once kept as breeding stock on many Cumbrian Fells. Herds are now few and far between but many individuals still keep a few ponies on fell land.

A **heft** (or heaf) is an area of fell occupied by a particular sheep flock. This is of particular importance on the large open commons of the high fells, where each individual common can be large and where boundaries between commons are unfenced – so the potential area open to a given sheep could be enormous. Farmers need to know where their own animals are likely to be so that they can be gathered back in. On most commons each farm with a right to turn animals out will have its own traditional heft but changes to hefts can and do occur as flock sizes and shepherding practices change. Hefts have no formal legal status and are often undocumented.

Sheep are, to some extent, territorial and lambs learn their heft from their mother. In subsequent years, they have a tendency to return to the same area of fell. It is also said that adjacent flocks tend to hold other flocks in place, with sheep from adjacent flocks tending not to mix. However, the system is not perfect. Some sheep wander more than others. Walkers, dogs and aircraft can cause sheep to scatter. Flocks have varied in size over the years and sometimes where a flock has become very big, it may spread out and disrupt the hefts of adjacent flocks. Similarly, differences in stocking density on adjacent commons can result in animals drifting to the area with the lower stocking rate. In addition, hefting does not entirely over-ride the natural tendencies of animals wanting to be on better grazing or the more sheltered side of the hill.

Manorial records show that disputes over hefting are as old as the system itself. For examples of this (and much other information on the early history of farming in the fells) see "The Harvest of the Hills" by Angus Winchester[29].

Left: Swaledale ewe

It is often said that wethers (castrated male sheep, which used to be kept for wool and mutton) were more territorial than ewes (females) and were better at maintaining hefts. It is now rare for wethers to be kept due to the lack of demand for their products.

Further historical information is contained in Terry McCormick's book "Lake District Fell Farming: Historical and Literary Perspectives, 1750-2017"[30]

A report [redacted], revised August 2018[31] aimed to map all of the hefted flocks grazing the Lake District Fells. It found over 420 hefted flocks grazing in the Lake District.

Further information about environmental, economic and social indicators is given in the Lake District National Park Partnership's State of the Park Report, 2018

4. The Effects of Grazing on Upland Vegetation

Most plants can withstand a certain amount of grazing but some species are much more sensitive than others. Tall-herbs such as wood cranesbill[32], globeflower[33], roseroot and water avens[34] and arctic alpines including alpine cinquefoil[35], alpine mouse-ear and alpine saxfrage are among the most sensitive. Dwarf shrubs like heather[36] and bilberry[37] are a little more resistant – but will still die if they are grazed too much for too long. Mature trees and shrubs may be fairly tough but their seedlings are not, and even quite modest levels of grazing prevent regeneration.[38]

Left: close-up of heath vegetation, including heather (tiny leaves and pink flowers) crowberry (straight shoots with small, linear, bright green leaves and black berries) and cowberry (broad, rounded leaves).

Other species may not be eaten very much but are physically delicate and can only survive limited trampling or other physical disturbance. Bog mosses (*Sphagnum*) fall into this category and are of particular concern because they have a key role in the formation of peat bogs.[39]

Left: Blanket bog vegetation with bog mosses, heather and cotton grass

Grass-like species, which have their growing tips down at the base of the plant, tend to be the most resistant to grazing.

In addition, plants vary in how attractive they are as food for grazing animals; some are lush and tasty whilst others are tough and/or lacking in nutrition.[40] It is no surprise that grazing animals generally take more of their favourites and leave the others. Sheep are more selective than cattle[41, 42, 43], they can use their small mouths to nip off the most appealing species. Cattle tend to just rip up large mouthfuls and there is some recent evidence that Highland cattle (and possibly other hardy breeds) are less selective than more productive breeds[44]. (See section 8.4 for the effects of cattle grazing we have observed in Cumbria) Ponies are capable of being quite selective grazers but they are not ruminants and so their digestion is less efficient than cattle or sheep and they therefore need to eat greater volumes of vegetation. Compared to sheep, they eat a lot more coarse vegetation and their efficient incisors can produce shorter 'lawns'. [45, 46]

When sheep grazing levels are high, the above factors combine to result in loss of sensitive and/or tasty plants and their replacement with a few unappealing and resistant ones; in the Lake District particularly mat grass (*Nardus stricta*) and heath rush (*Juncus squarrosus*) and, mainly on deep peat, purple moor-grass (*Molinia caerulea*) or hare's-tail cottongrass (*Eriophorum vaginatum*).

Above: high levels of grazing have resulted in dominance of mat grass (Nardus stricta). If other plants have been lost entirely, this can retain dominance even when grazing levels are subsequently reduced.

Thus, continued heavy grazing leads to progressive loss of diversity of plants and also a simplification of vegetation structure[47, 48] – taller and deeper rooted plants and thick mats of mosses may be absent. This has knock-on effects on rates of water run-off and soil loss[49] and the animals that can live there such as insects[50] and birds[51].

Conversely, if grazing is very light or absent, the process of natural succession[52] normally occurs. At lower altitudes all but the very wettest areas would become woodland, whereas at higher altitudes there would be lower-growing scrub or heaths. However, the starting condition of the vegetation also has an influence (see section 8.5).

It should also be noted that plant growth rates are affected by a range of environmental variables, perhaps most significantly by temperature. As a rough 'rule of thumb', air temperature decreases by an average of 6.5°C for each 1000m of altitude gain[53]. High altitudes also tend to have poor, thin soils. This means that plant productivity decreases significantly with altitude – Lake District mountain tops (and indeed shady, north facing slopes) produce very little for animals to eat.

Ecologists generally consider that moderate grazing pressure can increase plant diversity in productive environments by reducing competition between plants and increasing establishment opportunities. However, this is not the case in low productivity environments, such as mountains, where competition is limited by stress (such as cold, drought, poor soils)[54]. In low productivity environments, grazing and trampling may simply damage whatever plants are able to survive there; and can even lead to complete loss of vegetation and soil cover.[55]

Above: at high altitudes, where vegetation grows very slowly, too much grazing can cause loss of vegetation cover and soils

A great deal of information on the changes between different vegetation types that occur under different management regimes can be found in the volumes describing the National Vegetation Classification (NVC)[56] – see particularly the sections on 'zonation and succession' in the accounts for each vegetation community. More accessibly, summaries are given in the 'management' sections of each community account in An Illustrated Guide to British Upland Vegetation by Averis et al.[57]

5. Grazing on the Lake District High Fells

Numerous factors affect the ecological condition of the Lake District High Fells and these are summarised in the Site Improvement Plan for the Lake District High Fells SAC. [58]

The same issues also apply more widely across the rest of the fells in the Lake District.

However, the activity with the biggest influence on the ecological health of the Lake District fells is sheep grazing. We do not ignore other factors but this report is focused on grazing.

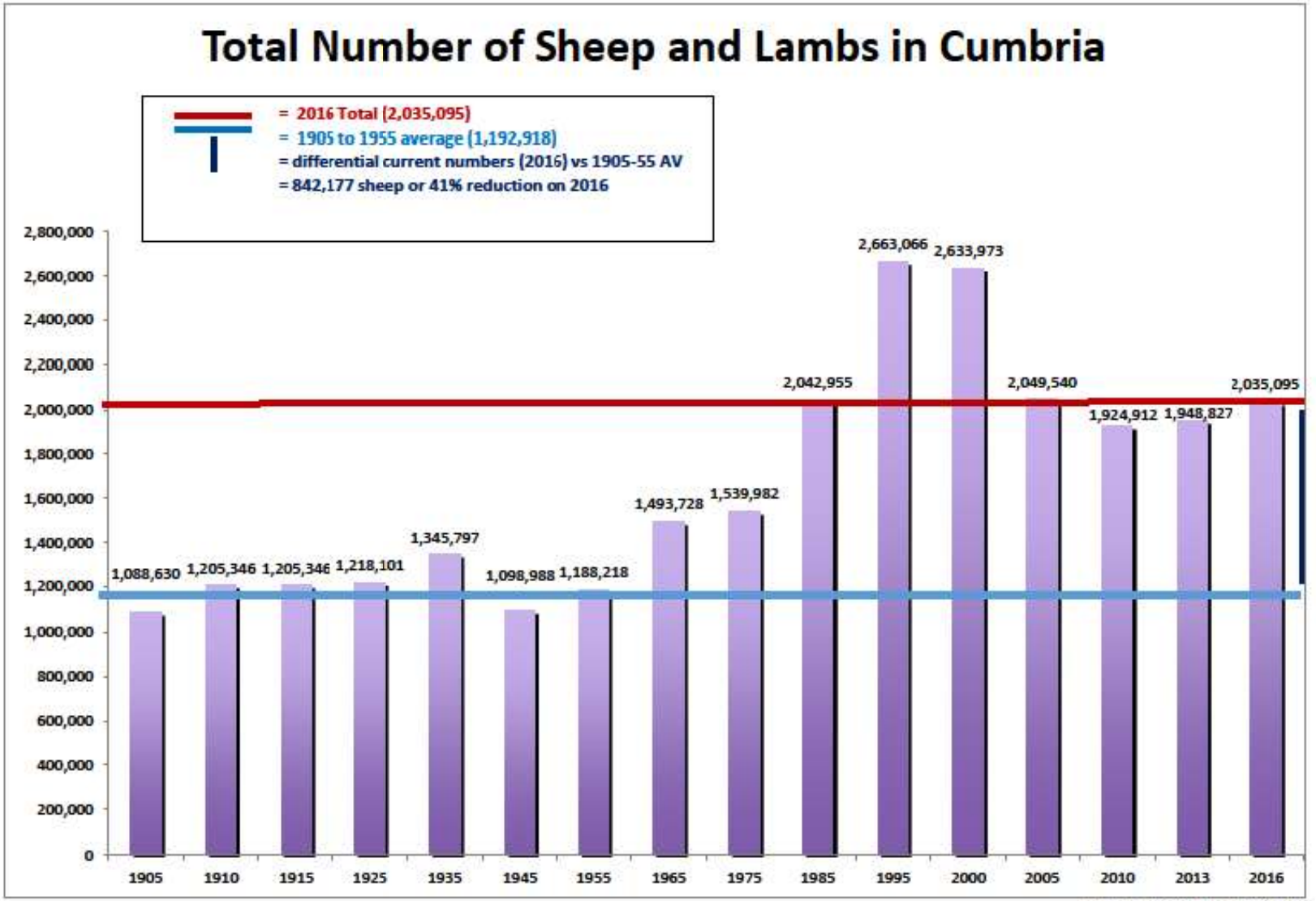
Lake District High Fells SAC Site Improvement Plan:

The text on inappropriate grazing reads as follows: "In recent times, sheep grazing has had by far the biggest man-made impact on the condition of almost all of the features in the SAC. Although flock sizes have reduced considerably over the last decade or so, sheep still have impacts in certain localities and on the more sensitive features. Some palatable vegetation receives a high localised pressure with sheep congregating to graze some habitats. Seasonality of grazing is also important because grazing outside of the growing season has greater impacts on habitat condition than grazing when vegetation is actively growing. Some habitats in some locations would benefit from the replacement of some or all sheep by cattle as cattle have different habitat impacts."

In general, in response to the subsidy regimes in place at the time, sheep numbers in Cumbria more than doubled between World War 2 and the early 1990s. Numbers declined by nearly a quarter between their peak in about 1995 and 2016 but would need to decline by a further 30% to return to their pre-war average. See graphs overleaf.

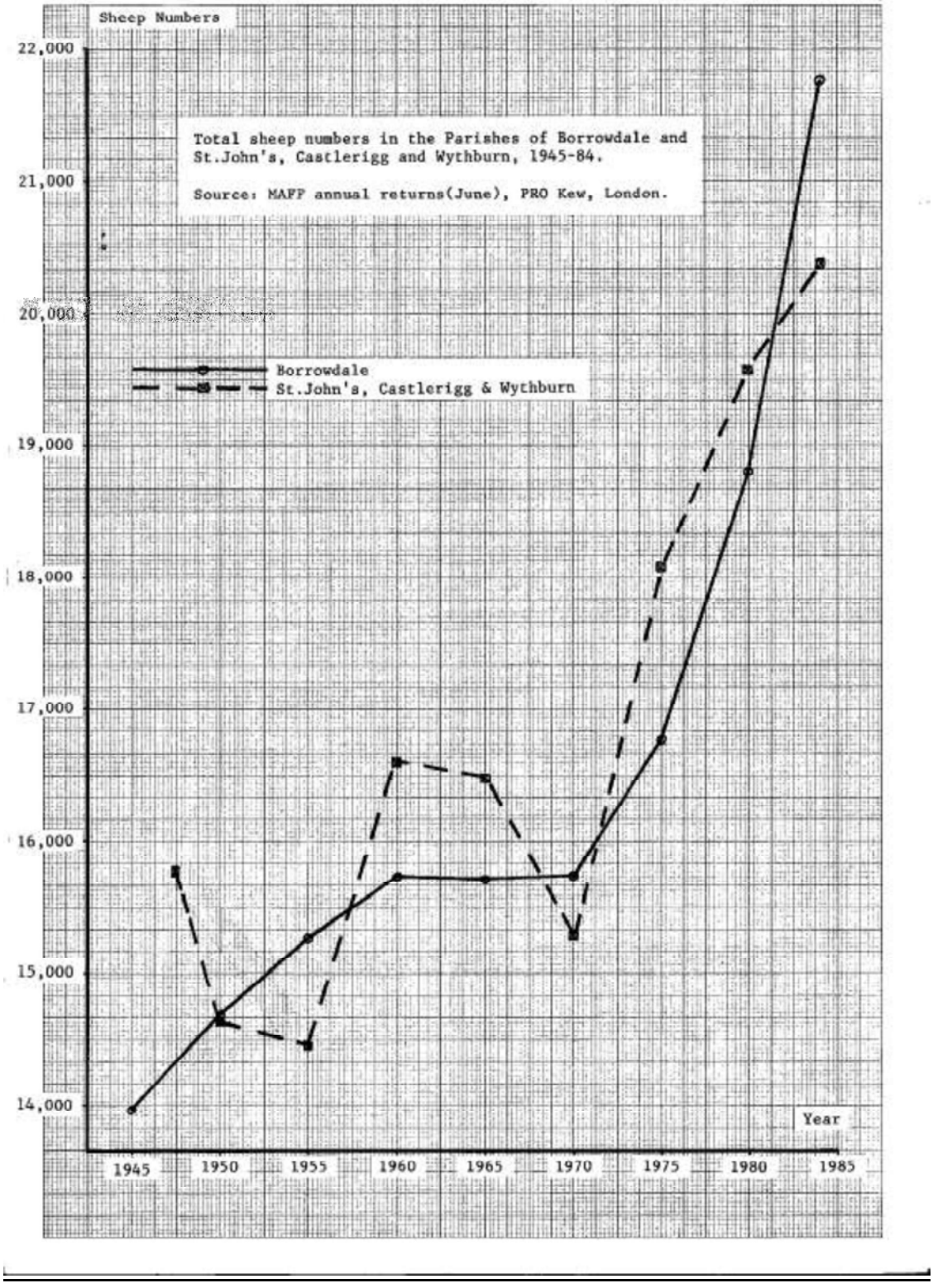
High grazing levels up to the 1990s led to the deterioration, fragmentation and reduction in area of habitats such as blanket bog, dry heath, woodland and scrub. In 2000, only 9% of the Lake District High Fells Special Area of Conservation (SAC) was considered by English Nature to be under a grazing regime likely to achieve habitats in good condition.[59]

Total Number of Sheep and Lambs in Cumbria



Source: RSPB, using Defra data

The graph below shows changes in sheep numbers in two parishes within the Lake District high fells from 1945 to 1984. In Borrowdale, numbers increased by over 55% in this period and are likely to have continued to increase up until the mid 1990s.



6. History of Agreements for Nature Recovery

For several decades, Natural England and its predecessors have worked with farmers to reach agreement over how fells will be managed to improve their value for nature. The various types of agreement available at different times are shown in the following table:

Table 1: Types of agri-environment agreements in the Lake District High Fells over time

Years when agreements were started	Duration of each agreement	Name of scheme	Notes
Before 1993	Variable	SSSI compensatory agreements	Individually negotiated agreements, usually to compensate farmers for not increasing grazing pressure. Very few agreements in the fells due to limited budget
1993-2004	10 years each (some farms had two successive agreements)	Environmentally Sensitive Area Scheme (ESA)	Scheme had a limited choice of options, each with a set prescription and payment rate. The lower tier prescriptions were aimed at habitat maintenance and the higher tier at habitat restoration. Uptake of higher tier prescriptions was relatively low in the fells
Mainly 2003-2006 in the fells	Variable but often 5 years	Sheep and Wildlife Enhancement Scheme (SWES) and Wildlife Enhancement Scheme (WES)	Often used as a 'top-up' to ESA agreements on SSSIs, paying for additional management over and above that specified by the ESA. SWES agreements provided payment as an up-front capital sum – which farmers were able to spend on adapting their businesses For reviews of agreements offered during this period see: '*English Nature's Sustainable Grazing Initiative in Cumbria: A summary of English Nature's work in the Cumbrian Uplands from 2002-2005'* [60] and 'English Nature's Sustainable Grazing Initiative in Cumbria: *A review of the success of grazing agreements for upland SSSIs' (2006)*[61]
2006-2014	10 years but with some potential for extension	Environmental Stewardship. The highest tier of this relevant to SSSIs was Higher Level Stewardship (HLS)	HLS agreements could be tailored for individual sites/farms. These were usually underpinned by Upland Entry Level Stewardship (UELS) agreements which included a specific option to support commons associations
2018 onwards	5 or 10 years, depending on options taken up (10 years on moorland)	Countryside Stewardship (CS)	Fell options only available through Higher Tier. Individually negotiated management but some aspects less flexible than HLS. Commons Associations supported through a specific supplement.
Piloting due to start 2021, full rollout 2024	Unknown	Environmental Land Management Scheme (ELMS)	Will be public money for public goods, but few details yet known

Where reductions in grazing pressure were required to achieve scheme objectives, these have been achieved through flock reductions, the removal of stock from the fell in the winter (off-wintering) or a combination of the two.

In many cases, changes in grazing regimes have happened in stages, for example with some changes made under the ESA, followed by additional measures under SWES and then HLS.

Above: Recovering heathland on Bassenthwaite Common, a site where successive changes to grazing management were made through successive ESA, ESA plus SWES, and HLS agreements

Changes also took place in the farm subsidy regime during this period, most significantly, farm subsidies were decoupled from production in 2003. This meant that headage payments, such as the Sheep Annual Premium Scheme (which provided a payment per sheep) were replaced by the Single Farm Payment and then the Basic Payment Scheme, which provided a payment per hectare of eligible land.[62, 63] This removed most of the economic incentive to keep large numbers of sheep and made agri-environment agreements more attractive.

Under HLS, there is a base payment for agreed moorland management and additional payments for off-wintering (removing stock from the fell during the winter months). Higher payments could be provided for the creation of woodland and scrub and capital payments were available for necessary infrastructure such as fencing. Some agreements also provided incentives for cattle grazing.

At the time of writing, HLS agreements that have reached their expiry date but satisfy a number of set criteria can be extended, for one year at a time. One of the key criteria is that the agreement must be achieving its environmental objectives. These objectives are set out in each HLS agreement as a series of 'Indicators of Success' for each HLS option. The decision as to whether HLS agreements can be extended for another year is made annually by Ministers and so far has been announced the autumn before the start of the calendar year in which agreements expire.

HLS agreements that are not extended can be replaced by Countryside Stewardship as they expire but these agreements have not yet been in place long enough to be expected to show significant change on the ground. Many HLS agreements in the Lake District run on until 2023 or 2024.

The main priority for Countryside Stewardship Higher Tier is to protect and enhance the natural environment, in particular:

- biodiversity (the diversity of wildlife)
- water quality.

Other outcomes supported are:

- woodland improvement
- flood management
- the historic environment
- landscape character
- genetic conservation
- educational access
- climate change adaptation and mitigation.

7. Methods for determining grazing regimes that will achieve nature recovery

There are two basic methods for calculating stocking rates to achieve habitat restoration.

The first is to do a theoretical calculation based on the productivity of the different vegetation types present on the site and the amount of this that can be utilised by grazing animals. In other words you measure what area you have of each vegetation type, then calculate how much useable vegetation each is likely to produce, then work out how many animals this is likely to support.

Guidance on how to do this, including stocking rates that may be appropriate for different vegetation types and on the amounts of vegetation consumed by different types of grazing animal, is given in guidance by Natural England and its predecessors[64, 65]

Note that this gives an **average** stocking rate over the year. Decisions then need to be made about how this will be achieved in practice, ie type of stock, timing of grazing and other management factors (as described further in section 8 below). A stocking calendar is agreed with the farmer that translates this into actual maximum and minimum numbers of sheep, cattle and/or ponies that can be on the site at different times throughout the year. An additional step on common land is to work out how this grazing is allocated to the different commoners involved.

The second method is to try a grazing regime in practice and then subsequently adjust it according to the condition of habitats that is achieved. This is known as 'adaptive management'.

The first is useful when management has been a long way away from achieving site objectives – it is the best way of estimating the magnitude of any changes to grazing that need to be made.

The second is more useful when the grazing levels have been closer to those required to achieve the required habitat objectives It is not skewed by differences between the theoretical models and reality (eg through altitude, aspect, soils, weather) or by errors in measurement of different habitat types. A variant of this is to look at grazing regimes tried on sites similar to the one is question.

As time goes on, and successive agreements are reached on a site (or similar sites), adaptive management should allow management to be improved each time, so that habitat objectives are achieved.

8. Response of Lake District high fell habitats to altered grazing regimes

Many factors can affect how habitats on a given piece of land respond to an altered grazing regime. Here we consider:

- Stocking rate
- Stock distribution
- Seasonality of grazing
- Livestock type
- Starting conditions
- Observations about selected habitats (heaths, scrub and woodland, wood pasture, arctic alpines, tall herbs, blanket bog)
- Vegetation and water
- Deer

In this section, we mainly consider the response of SSSI sites as these are the sites with the most comprehensive condition assessment data.

Each SSSI is designated for one or more 'features', typically habitat types or species. Each SSSI is also divided into a series of geographical 'units'. Within each unit, Natural England assesses the condition of all the features that are present, by assessing a pre-defined set of attributes for each feature. See Annex 4 for further details of this methodology.

The objectives of an HLS agreement have always included getting any SSSI features into good or recovering condition.

The area of land covered by each agri-environment agreement may include one or more SSSI units

8.1 Stocking Rate

The SSSI condition assessment data (as at March 2018) has been summarised for each HLS agreement in the Lake District to show whether all, some or none of the ecological features are in good or recovering condition (ie achieving objectives, partially achieving objectives or not achieving objectives). Current SSSI condition data can be viewed online.

Data on the grazing regimes in place in the corresponding agri-environment agreements (as at March 2018) has also been collated.

The full data is shown at Annex 1. It is summarised in the chart below. Note that the stocking rate shown is the maximum annual average rate (for example where a site grazed at a maximum of 1 ewe/ha for 6 months with complete off-wintering for the remaining 6 months would have a maximum annual average rate of 0.5 ewes/ha). This assumes that

these are small hill ewes (Herdwicks or Swaledales) and that each ewe is accompanied by a lamb at foot and that one replacement hogg is kept for every 3 ewes. [i]

It can clearly be seen that habitats have responded better where the grazing pressure is lower. Habitat response has been universally good below a year-round average of 0.4 ewes/ha. It may still be good up to an annual average of about 0.5 ewes/ha. As the stocking rate increases above this, however, habitat response rapidly declines. No sites stocked above an annual average of 0.6 ewes/ha are achieving all of their habitat objectives.

Some sites are grazed at rates significantly below an annual average of 0.4 ewes/ha. This is usually because they contain particularly unproductive vegetation (such as blanket bog, montane heath and/or a lot of rock). In one case, it is because the vegetation was so severely degraded by past grazing levels that complete removal of grazing was felt to be the only option to get significant recovery.[ii]

[i] Note that when calculating stocking rates for agreements we use Livestock Units to enable us to take into account details such as different breeds and different proportions of hoggs kept. Data we have collected in LU has been translated back into ewes/ha for the purposes of this report by multiplying by 10. (A small hill ewe plus lamb at foot is 0.08LU and a hogg is 0.06LU, so 1 ewe plus lamb at foot plus 1/3 of a hogg = 0.1 LU). In Herdwick flocks, where sheep generally do not become breeding ewes for an additional year, all shearlings (sheep that have been sheared once) are counted as ewes from tupping time, whether tupped or untupped.

[ii] None of the failures to achieve objectives are due solely to the presence of particularly rare or sensitive habitats (such as tall herb vegetation as described in section 8.12). In all cases, there were also widespread habitats such as dry heath that were failing to recover.

Note however, that what is recorded here is the maximum stocking rate set out in the agreement, not necessarily what has actually happened on the ground. Many sites are likely to be grazed at a rate below the maximum permitted by the agreement. Grazing at a rate above the maximum is likely to be rare (and would be a breach of the agreement), but can occur in some locations where stock encroaches across management boundaries.

If this sample was extended to include more sites outside of the SAC, there would be more instances of higher levels of grazing (above an annual average of 0.6 ewes/ha), but we have not been able to do such detailed monitoring of these sites. **We know of no examples, whether SSSI or not, where a grazing level at or above an annual average of 0.6 ewes/ha has allowed good habitat recovery.**

The results above are as would be expected from our previous experience of the impacts of different grazing regimes. The successful grazing rates quoted above are the same as those chosen back in the early 1990s for the ESA, 'Tier 2 Heather Fell' prescription; rates designed to achieve good vegetation recovery (see table 2 below).

The higher rates above are close to the ESA 'Tier 1 Heather Fell' rates (1.5 ewes/ha in summer and a year-round average of 0.85, when off-wintering was included) which were designed to achieve habitat maintenance, not recovery. Monitoring of ESA agreements showed no evidence of habitat restoration occurring where Tier 1 prescriptions were followed (Nisbet and Glaves, 2010[66]). **When stocking rates similar to these are followed, habitat recovery should not be expected.**

The data at Annex 1 are useful when defining appropriate grazing regimes. It enables us to look at what grazing regimes have been successful on sites similar to that under consideration.

Table 2: Lake District ESA stocking rates

ESA Tier	Tier name	Objective	Stocking rate description	Annual average stocking rate (ewes/ha)[i]
Tier 1, part 4	Grass Fell	To maintain as grassy fell	Up to 2 ewes/ha year-round	1.57[(ii)]
Tier 1, part 5	Tier 1 Heather Fell	To maintain existing heather	Up to 1.5 ewes/ha with 25% removed Oct-Feb	1.10
	Tier 1 Heather Fell with off-wintering		As above but with all stock removed Dec-Feb	0.85
Tier 2C	Tier 2 Heather Fell	To restore heather	Up to 0.67 ewes/ha with 25% removed Oct-Feb	0.48
	Tier 2 Heather Fell with off-wintering		As above but with all stock removed Dec-Feb	0.38

[i.] This was calculated in LU/ha then converted back to ewes/ha by multiplying by 10 (see footnote on p27). in all cases it has been assumed that:

- Ewes were off the fell for a month for lambing and a month for tupping
- Number of hoggs was 33% of number of ewes
- Hoggs were removed Oct-Feb

[ii.] For Tier 1, part 4, the prescription didn't specify that hoggs needed to be removed in winter, so numbers could have been higher than this

8.2 Stock distribution

On a heavily grazed fell, sheep will tend to reach all parts of it, eating any vegetation they can find.

We have often observed that a reduction in grazing pressure leads to patchier grazing, with sheep pulling back from wetter or less nutritious habitats (particularly blanket bog), remote parts of sites (furthest away from farm holding or fell gate) and inaccessible areas (crags and sometimes areas which have become less inaccessible due to vegetation such as tall heather or gorse scrub). There are some areas that sheep will continue to favour such as some mountain tops (perhaps to get away from flies), areas with better grazing ('sweeter' bent and fescue grasses which are generally on more mineral-rich soils), sheltered places and areas close to the fell gate. Topography may combine with flock sizes and shepherding effort ie steep valley sides or rivers can help to 'hold' particular flocks in particular places. Scientific studies have recorded some similar results[67].

This patchiness of grazing pressure can have both advantages and disadvantages, depending on how it relates to the habitats present. In practice, low grazing pressures can mean that certain parts of the fell remain more-or less ungrazed – this is good if those ungrazed areas include blanket bog, montane heath, arctic alpine plants, tall herb vegetation or trees and

shrubs. However, if the more heavily grazed areas include any of the above habitats or if grazing is above the threshold for maintenance of dwarf shrubs like heather and bilberry, this can be problematic.

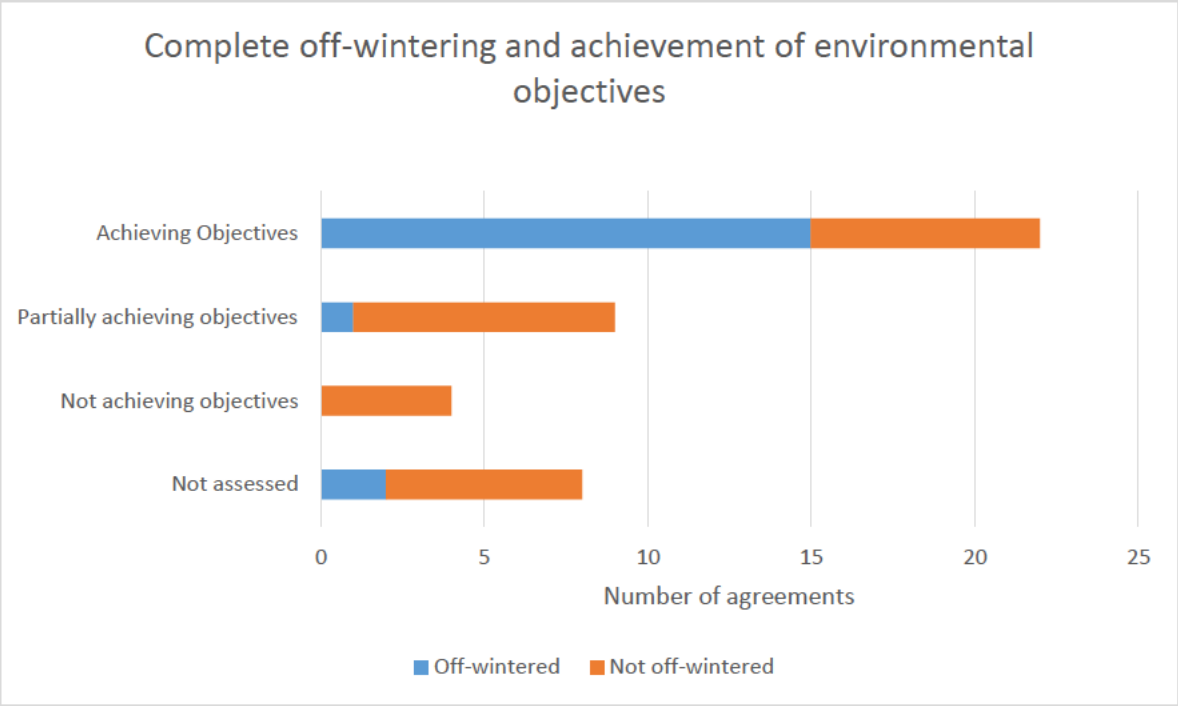
This has been observed recently though assessment of the Buttermere Fells SSSI. Here the patchiness of habitat recovery is obvious, with some areas recovering well and other areas not recovering at all. The patchiness of recovery on the Buttermere Fells is likely to be exacerbated by the topography, the way that hefts are aligned with particular valleys or ridges and the fact that there is considerable disparity between the sizes of the biggest and the smallest flocks. We are currently working with the graziers to try to address this.

8.3 Seasonality (Off-wintering)

Grass only grows when the temperature exceeds 5.6°C. The temperature in the fells is lower than this for much of the year and there is little plant growth from October to April. The removal of sheep during this period is known to have major benefits for certain habitats[68]. When grass is not growing, any remaining grass rapidly loses its nutritional value and selective grazers like sheep turn their attention to other plants, especially heather and bilberry and any other plants (including the rare arctic alpine species) which have any green material through the winter or emerging early in the spring. Ensuring that sheep are away at this time means that a much wider range of species are able to flourish. Cattle are less selective and may therefore have less variation in their seasonal grazing impact.

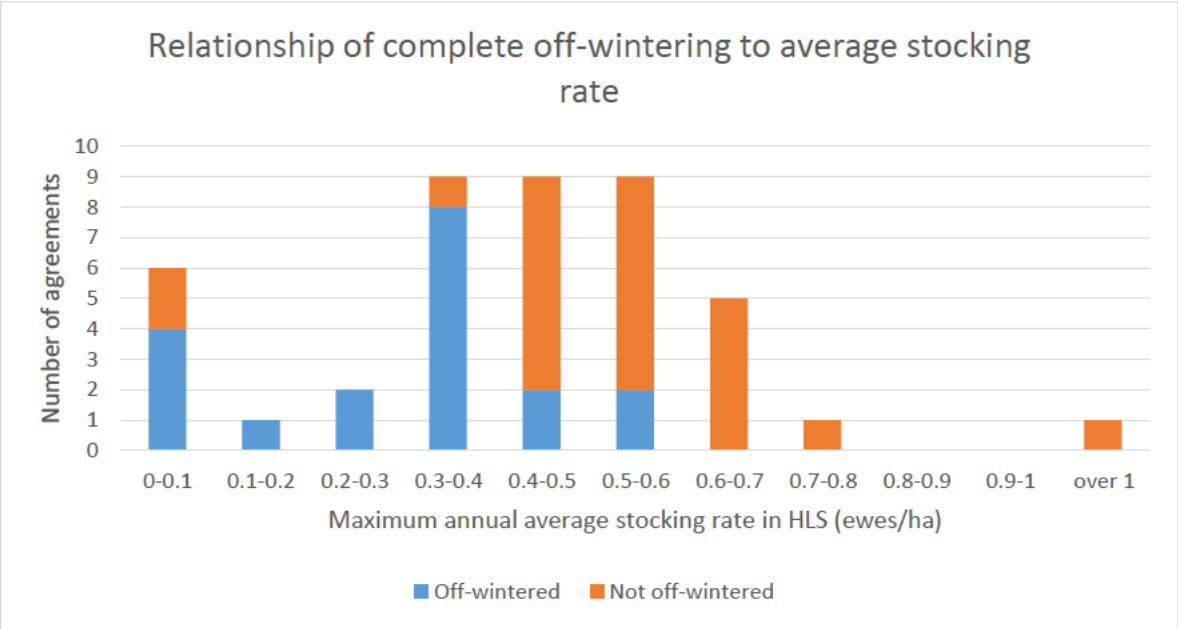
Our analysis of agreements shows that 68% of agreements that are achieving their environmental objectives include complete off-wintering of sheep from November to March. Only 11% of the agreements that are partially achieving their objectives include complete off-wintering over the same period. None of the agreements which are not achieving their objectives include complete off-wintering.

Note that this analysis is a little simplistic in that many HLS agreements contain partial off-wintering (where part of the flock is taken off in the winter months or all of the flock is taken off for a shorter period)



This apparent link between off-wintering of sheep and improvement in habitat condition is in line with what we would expect in theory and is certainly supported by our observations that vegetation on fells without winter grazing can 'bounce back' rapidly.

However, it should also be noted that off-wintering and stocking rate are not independent of each other (see chart below). Low stocking rates have often been achieved by removing stock in winter rather than reducing flock sizes to the same extent as would otherwise have been necessary. If flocks are small, then their impact in winter will be less than of a larger flock. It is not easy to disentangle from this data the precise role of off-wintering in habitat recovery.



8.4 Cattle

As outlined in Section 4 above, sheep, cattle and ponies graze in different ways. Results of cattle grazing have been reviewed from agreements in Ennerdale, Wasdale and on Helvellyn where distinct benefits of extensive grazing of traditional cattle in the Cumbrian uplands can be seen. Most of the agreements combine cattle and sheep grazing although there are some sections of Pillar and Ennerdale SSSI where the grazing is only by cattle.

Across these agreements, and in other agreements focussing on similar habitats in intakes, swards show improving structural diversity. This means tussocky and rough areas as well as areas of short swards. The heavier cattle have broken up areas of uniform short sward making regeneration niches for flowers and tree regeneration. Longer areas of sward show improved flowering of grasses, sedges and herbs and there is no evidence that cattle selectively remove palatable flowers or young tree seedlings.

The black Galloway cattle in Ennerdale are free to graze high on the fells and in the forests and grasslands of the valley bottoms. In the summer they have been grazing mixed heath and acidic grassland high on the Pillar Ridge – at altitudes up to around 700m. Land both above and below the fell wall, which has been cattle grazed for more than a decade, is now showing greater habitat diversity with a mixed landscape of heather fell, open species-rich grassland, valley mire and flush, with some areas of birch and gorse scrub and crucially, lots of 'edge' where these habitats mix together.

Above: Extensive year-round grazing of Galloway cattle in Ennerdale has improved sward condition and increased habitat diversity

The approach has enabled some climate change adaption of western Atlantic oakwoods by securing conditions for regeneration at higher altitude than the existing woodland. This has provided a wider range of climatic conditions for the woodland, tall fern stands and rich moss and lichen flora.

Cattle-grazed fell agreements have also shown a reduction in stands of less palatable grasses (see section 4 above). This has included impacting on purple moor-grass (*Molinia*) stands on the Western Fells and on Helvellyn, impact on matt grass (*Nardus*). This is clearly due to the less selective grazing actions of cattle and the desire of traditional breed cattle to secure significant volumes of fibre in their diet.

Cattle have been healthy and in good condition at the end of the grazing season. Some supplementary feed has been used in Ennerdale where the grazing is outside year round. Some minor feeding of beet/cake has been used to help with handling and to call in the cattle to check their condition. However, supplementary feeding is not a major part of the system. The cattle grazing typified here is low input-low output where winter housing costs can be minimised by grazing late into the year when weather and forage permits.

The cattle graze on open access land and across footpaths. There have been no known problems with interactions between public and livestock.

8.5 Starting conditions

The starting condition of the habitats influence how well they are able to recover. For example, on heathlands, recovery appears to depend on the frequency and condition of remaining dwarf shrub plants (like heather and bilberry). When enough (albeit supressed) heather and bilberry plants remain, a simple reduction in grazing pressure is all that is required for them to bounce back into a dominant role in the habitat. This has been observed following grazing reductions on many sites including parts of Buttermere and Derwent Fells Commons, Caldbeck Common, Lonscale Fell, Birkbeck Common and the Armboth Fells.

When these key species are entirely absent, recovery is much less certain and dependent on conditions being right for these species to recolonise. This may require additional measures to reintroduce desired species (eg from seed) and if grasses such as mat grass (*Nardus stricta*) have become dominant, it may also be necessary to reduce the dominance of these grasses by some sort of physical disturbance (such as cutting, scarification or from the hooves of large herbivores such as cattle or ponies). This is a bigger issue on the non-SSSI sites, but does also apply to some parts of some SSSIs.

Where heather is undergoing regeneration from seed, this happens best in the complete absence of sheep[69]. Our observations reinforce the view that the quickest way of getting recovery of severely degraded habitats may be to exclude grazing completely for a period of time.

One option for heathland expansion that we have not yet fully explored in the Lake District (used more in other areas of the country) is fencing plots from stock and then scarifying and reseeding. If areas were well chosen, this could occur with minimal disturbance to farming systems, landscape and to public access, but it would be expensive, labour intensive and

could risk initiating soil erosion. It may often be better value for money to concentrate on tree and scrub projects instead of heathland.

8.6 Heaths

Heath is one of the most widespread vegetation types on the high fells. It includes any vegetation dominated by dwarf shrubs such as heather (*Calluna vulgaris*) or bilberry (*Vaccinium myrtillus*), except for when this occurs on deep peat. (Any habitat on deep peat is categorised as blanket bog – see section 8.13)

Dry heath can contain heather, bilberry, crowberry (*Empetrum nigrum*), cowberry (*Vaccinium vitis-idaea*) and bell heather (*Erica cinerea*). It is often underlain by a rich mixture of mosses, lichens and liverworts. Observations on the recovery of heath following grazing reductions are included in 8.5, above. However, there are still very large areas of fragmented or degraded heaths in the Lake District – and also areas where these habitats have been lost altogether.

It is perhaps worth including here our observation that, following a reduction in grazing pressure on a large site, some areas of degraded heaths may recover quite quickly (within 2-5 years) but then the site appears to reach a new equilibrium, with other areas remaining in degraded condition. Further reductions in grazing pressure may be required to achieve further restoration. Caldbeck Common was one example of this, with initial reductions made in 2003 and more in 2013.

On shady, north-facing slopes that receive a lot of rainfall heaths can develop into a form with a particularly deep and lush moss layer, known as Atlantic heath[70, 71]. However, this can only develop where grazing levels are very low – *Sphagnum* mosses are very sensitive to trampling[72] and dwarf shrubs are restricted in height if grazed.

Right: Atlantic heath in an ungrazed area above Whinlatter Pass. This has a knee-high, spongy layer of mosses and liverworts, that grows as high as the surrounding heather, bilberry and crowberry plants. This habitat will absorb a lot of rainwater and slow the flow of water down the hill.

Montane heath occurs in the very harsh conditions found at high altitudes (above 600m)[73][74]. It can be dominated by heather or bilberry but such dwarf shrubs occur as a very low-growing mat. These are interspersed with lichens (especially reindeer moss; *Cladonia spp*) and mosses such as woolly fringe –moss (or woolly hair-moss, *Racomitrium lanuginosum*). On high mountain plateaux, montane heaths tend to be dominated by mosses (particularly wooly fringe-moss) and sedges and contain high altitude specialists like stiff sedge (*Carex bigelowii*) and the tiny dwarf willow (*Salix herbacea*).

Writing in his 2002 book[75], the influential conservationist, Derek Ratcliffe says that since the 1950s, 'fringe-moss heath has almost entirely disappeared from the Lake Fells – the result of the relentless treading, manuring and grazing of sheep, which do not eat the moss, but pull it up by plucking at small plants growing through the carpet". He also says, "This loss of the high-level *Racomitrium* heaths is the most complete and conspicuous vegetational change on the Lake Fells in my lifetime".

Unfortunately, Derek Ratcliffe did not live to see the results of reductions in grazing levels on some of these mountain-tops. Although many Lake District mountain tops still have poor vegetation cover, the montane heath on the summits of Broad End (Skiddaw), and on Caw Fell to Haycock (on the Pillar Ridge) where grazing is much reduced are now in much better condition, with thriving carpets of woolly fringe-moss, stiff sedge and dwarf willow.

Left: Dwarf willow is a tiny mountain-top specialist, characteristic of montane heath. It thrives on Broad End (Skiddaw) where grazing levels are now low.

At moderate altitudes, many forms of woodland and scrub have heath understories. A healthy and well-functioning upland ecosystem would be expected to contain an intimate mixture of heath, trees and shrubs.

Heaths in good condition provide nectar and other food for numerous invertebrates. These in turn are important for birds. One striking example is the large, furry oak eggar moth caterpillar which is a crucial food source for breeding merlin (a small bird of prey, confined to heathlands). Heaths also provide cover for nesting birds such as merlin and red grouse, and the berries of bilberry and crowberry are important for many birds, including ring ousel (a mountain blackbird). Heaths also support small mammals which provide food for birds such as short-eared owl and hen harrier.

8.7 Trees, woodlands and scrub

These habitats are amongst the most fragmented on the fells and yet they are vital for birds and invertebrates. There have been numerous projects to allow tree and shrub regeneration including areas fenced out from grazing and also the use of individual tree 'cages'. See Annex 2 for examples of successful schemes. All have been carefully designed to complement the landscape by restoring features that have been degraded or lost.

The majority of exclosures have been successful, though this has usually required significant effort, especially fence maintenance and removal of stray sheep. This work has variously been carried out by farmers themselves or in partnership with organisations such as the National Trust, Lake District National Park Authority, United Utilities and the Woodland Trust. The setting up of clear aftercare arrangements has been key to success. A few projects have been less successful, especially where fence and tree shelter maintenance has been lacking and/or (in areas with red or roe deer) where effective deer management has not been in place, but Natural England officers have been visiting these and working on solutions with the land managers involved.

In most cases, exclosures have been planted with trees and shrubs, however a few, especially where there was already some existing woodland cover, have been left to natural regeneration. Examples include Dash Falls (between Uldale and Bassenthwaite Commons), Keskadale Wood (Derwent Fells Common) and Young Wood (Mungrisdale Common). Natural regeneration does occur and arguably results in visually more attractive patterns of trees and shrubs than would be achieved by planting. At Young Wood, regeneration of juniper has been particularly striking; with birds apparently carrying seeds across from the juniper scrub on the hill opposite. However, natural regeneration is slow. Tree growth slows markedly with altitude and extreme patience and long periods of stock exclusion (and in some areas effective deer management) are necessary if the higher altitude schemes are to achieve results (much longer than would be allowed in conventional forestry schemes).

The planting of trees in individual 'cages' (most often on the fells in wire mesh cages) has had mixed results. It can be a very effective way of establishing trees and shrubs in areas where they are missing whilst avoiding some of the perceived impacts of fencing. However, if grazing around them (either by sheep or red deer) is still relatively heavy, trees can remain 'trapped' in the cage and unable to grow properly. Larger 'cages' containing several trees are likely to be more effective, although requiring more labour to install.

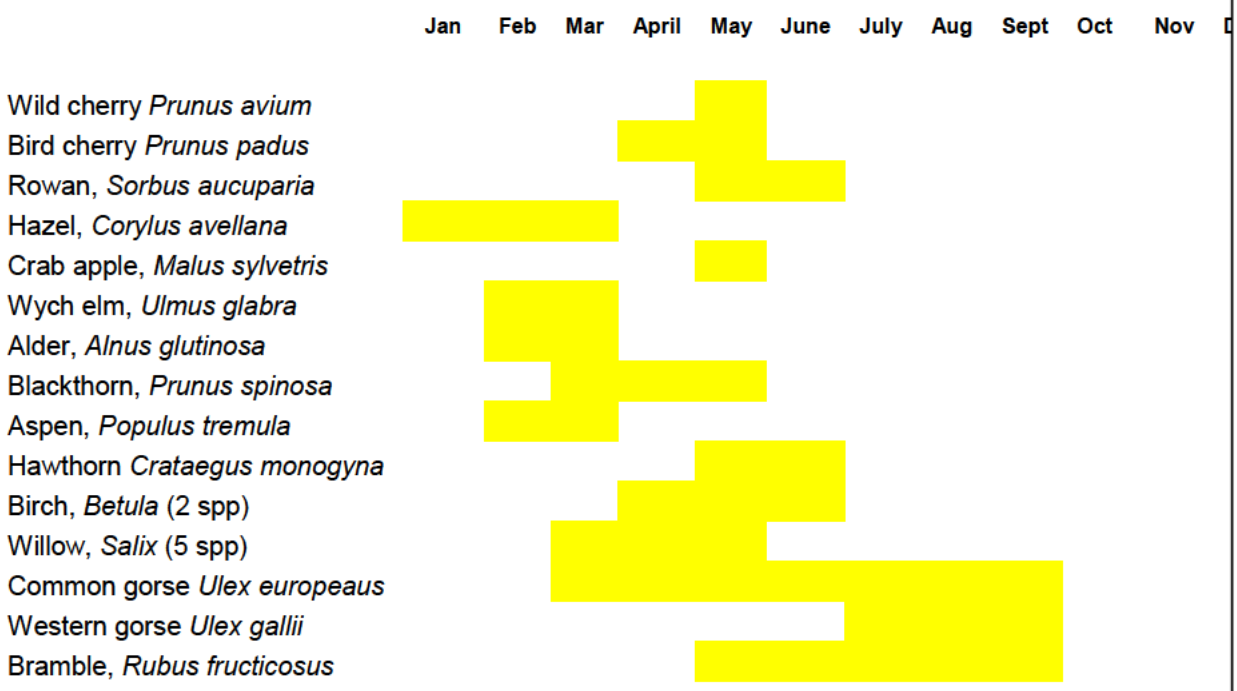
The advantage of fenced exclosures is that they allow the regeneration of a wide range of natural vegetation, not just the trees and shrubs. This can include heath vegetation, ferns, mosses and the diverse and colourful flora that is otherwise only found on inaccessible rock ledges. This is of very high biodiversity value and, in this wet part of the country, the lush, bulky (often mossy) vegetation that builds up is likely to have significant effects on slowing water flows, filtering water and building up soils. The other enormous advantage of exclosures is that natural woodland processes are established – including natural regeneration of trees and shrubs, making the woodland ultimately self-sustaining.

Above: Dash Falls, between Bassenthwaite and Uldale Commons has been fenced off since 2000 and shows excellent natural regeneration of trees, scrub and lush ground flora

8.8 Trees, scrub and pollinators

Native trees and scrub provide flowers that feed a great number of insects. These are a key part of the food chain, feeding other invertebrates, birds and small mammals. If you add in other ground flora species which also appear in woodland exclosures, particularly wild angelica and devil's-bit scabious, this effect is even further magnified. Different insects require different types of flower and at different seasons through the year. A diversity of flowering plants will therefore give the best results. The chart below shows the flowering periods of typical upland scrub species.

Flowering period of typical upland scrub species



[*Source: Simon Stainer, Natural England, using flowering periods given in The Wild Flower Key by Francis Rose*]

Above: Wild angelica with bumblebee in exclosure at Dash Falls. Angelica often grows along Lake District becks, but grazing can stop it flowering.

8.9 Trees, scrub and birds

Trees, scrub and associated vegetation provide food (insects, seeds and berries), shelter, nesting habitat and songposts for many species of birds. Birds that can benefit from additional trees and shrubs on the fells are listed below:

Table 3: Bird species likely to benefit from tree and scrub planting:

Species	Specific relationships / use of scrub	NERC principal importance *	Status**
Tree pipit	Song perches and foraging during breeding season	✓	Red
Lesser redpoll	Foraging and nesting habitat.	✓	Red
Linnet	Foraging and nesting habitat	✓	Red
Chaffinch	Foraging and nesting habitat	x	Green
Cuckoo	Foraging and host species nesting habitat	✓	Red
Yellowhammer	Song perch, foraging and nesting	✓	Red
Reed bunting	Song perch, foraging and nesting	✓	Amber
Grasshopper warbler	Refuge, foraging and nesting habitat	✓	Red
Spotted flycatcher	Foraging, refuge and nesting	✓	Red
Willow warbler	Song post, foraging and nesting (scrub ground layer)	x	Amber
Willow tit	Foraging and nesting habitat	✓	Red
Marsh tit	Foraging and nesting habitat	✓	Red
Blue tit	Foraging and nesting habitat	x	Green
Great tit	Foraging and nesting habitat	x	Green
Coal tit	Foraging and nesting habitat	x	Green
Wren	Foraging and nesting habitat	x	Green
Robin	Foraging and nesting habitat	x	Green
Dunnock	Foraging and nesting habitat	✓	Amber
Black grouse	Winter refuge and feeding	x	Red
Song thrush	Song perch and nesting habitat	✓	Red
Ring ouzel	Refuge and pre-migration feeding	✓	Red
Whinchat	Foraging and song post	x	Red
Stonechat	Song post, nesting and foraging	x	Green
Merlin	Nesting (scrub edge)	x	Red
Long-eared owl	Nesting	x	Green

* Previously Biodiversity Action Plan (BAP) species

**Red and amber lists accessed at https://www.bto.org/our-science/publications/psob

[Source: [redacted], South Lakes Ecology]

Above: Scrub provides a huge amount of bird food; juniper, rowan and hawthorn berries feed numerous birds, and provides the fuel that enables ring ousels to return to Africa for the winter

8.10 Wood pasture

There is a debate amongst ecologists as to exactly what Britain's ancient landscape looked like – before it was managed by humans. However, as the landscape included herds of large herbivores (including auroch, a type of wild cattle) there was probably a complicated mixture of dense woodland, scattered trees, scrub and more open areas.....something resembling what we might now call wood pasture. See Frans Vera's book[76].

Certainly there are a very large number of species that appear to have evolved to live in mosaics of mixed habitat. Wood pasture is of particular importance for dead wood and the associated invertebrate fauna found in the veteran trees, together with nectar, pollen and berries provided by the large canopies that characterise open-grown trees (see sections 8.8 and 8.9 above). Species-rich ground flora, whether grassland, heathland or woodland ground flora, can provide additional nectaring opportunity.

Nowadays, wood pastures are often found around the edges of the fell land, including within intakes. It can often merge with woodland – or feather out into the open fell habitats.

There is a history in Cumbria of branches from holly and ash from these type of habitats being cut and used as winter fodder for livestock. Tree fodder would have been particularly important when the weather was too wet to make hay (quite often!). Recent research has shown that willow trees could be used to optimise production in lambs because it has particularly high concentrations of cobalt and zinc: Tree leaves for livestock.[77]

Many of these wood pastures are now in poor condition with no regeneration to replace declining numbers of veteran trees and a loss of a species-rich ground layer. Scattered ancient thorn trees form a long-lived remnant of what was once a diverse mix of scrub and tree species and show us that this habitat was once more extensive in our landscape.

A number of upland agreements have been established to restore or create wood pasture in Cumbria. These agreements – such as at Rydal and Glenamara Park - are characterised by grazing of cattle at suitably low levels to secure regeneration of trees. These agreements have not included sheep grazing as sheep selectively graze tree regeneration and can lead to reduced floral diversity in the ground layer. The sites selected for this option still supported a number of open grown ancient and/or veteran trees. We have also encouraged restoration where new sites could buffer the site or buffer other woodland habitats, thus providing for improved and increased woodland edge and potentially linking sites at a landscape scale. This buffering of degraded sites also helps provide increased resilience to climate change. A single site with pony grazing (Great Mell Fell) appears to be working well and there may be opportunities for further pony-grazed sites in the future. However, the grazing level here is very low; with a higher density of ponies there is a risk that browsing could threaten regeneration.

These restoration projects, some of which have included supplementary tree planting, are extremely long term goals but even without the presence of veteran trees, newly created

wood pasture has been seen to develop a diverse and beneficial habitat structure within a few years.

Above: wood pasture at Glenamara Park, showing a healthy mixture of mature trees, dead wood, shrubs and (crucially) new tree seedlings and saplings

8.11 Arctic alpine plants

The Lake District is the most important English stronghold for Arctic and Alpine plants. The populations are small and have been affected by Victorian plant collecting and heavy sheep grazing. This means that many populations are restricted to steep and inaccessible cliffs rather than along stream-sides and around mountain tarns where the ecological conditions are more suitable. Arctic Alpines are vulnerable to the impacts of climate change but they do have the capacity to adapt by spreading to new areas if they are given the chance to flower and set seed.

A ten year partnership project has successfully mapped and recorded the most important localities and through this has established a baseline against which the impacts of climate change can be measured. The project has also carried out life-cycle analysis for the most important species. This means identifying the barriers to successful reproduction and spread and then addressing them. Examples might be isolated populations, poor seed dispersal, lack of suitable ungrazed habitat or genetic inbreeding. The project has successfully addressed some of these issues and together with partner and volunteer effort seen significant expansion of the populations of species such as downy willow, alpine catchfly and alpine saxifrage.

However, despite these gains, the distribution of these species is still limited to areas that are largely inaccessible to grazing. Further changes to grazing management would encourage their further spread and enhance their capacity to adapt to climate change.

Arctic-alpine plants;

Above: alpine catchfly and mossy saxifrage

Left: downy willow above Red Tarn, Helvellyn

8.12 Tall herbs

This is a rare and beautiful vegetation type (characterised in the National Vegetation Classification as type U17: *Luzula sylvatica-Geum rivale* tall-herb community). In summer, it is a riot of colours and textures. It can grow wherever there are relatively deep and mineral-rich soils, but is very sensitive to grazing. Many of the flowering species are quickly lost if they are subject to any significant grazing pressure. It has been estimated that there is only about 12ha of this habitat in England, almost all of it in the Lake District.

At Helvellyn, tall herb vegetation characterises the high and steep headwalls of the north- and east-facing corries. Stands of tall and colourful herbs tumble down cliff slopes and steep stream-sides. Rare arctic-alpine plants such as alpine cinquefoil and holly fern grow in this habitat. Reductions to sheep grazing have helped reduce impacts from sheep wandering into the high crags. However, where suitable soils occur in areas more accessible to sheep grazing, the habitat is not found, or occurs in a very degraded form.

This habitat also occurs on the crags facing Honister Pass. Natural England has worked with the Slate Mine Company to protect it from damage from development of their via ferrata. Significant areas of these crags are so steep that sheep cannot access them and the grazing regime is light enough that sheep are not under pressure to try to reach many of the peripheral areas. However, we believe there is potential to expand this habitat on the slopes beneath the crags.

The other most important place for this habitat is the crags beneath High Street, on Mardale Common. The RSPB, working together with the Alpine Garden Society, have created a 35-hectare grazing exclosure below the crags to keep out both sheep and deer. The fence was only erected in the winter of 2016/17, but the response has been rapid. In the areas closest to the crags, early-purple orchids and lush carpets of mossy saxifrage have appeared. Devil's-bit scabious, goldenrod, wood cranesbill, wild angelica and lesser meadow-rue now pick out the stream sides where seeds have been washed down from above. Bees and butterflies are seen making use of the abundant nectar sources.

The Mardale exclosure, with its expanding communities of tall herb vegetation, shows that this community is only confined to cliffs and ledges by grazing pressure. There is opportunity to expand and restore this rich habitat by exclusion of sheep. Light cattle grazing is more compatible with restoration and expansion of tall herb communities due to the combination of cattle being less likely to venture onto the steepest ground and their less selective grazing behaviour (see sections 4 and 8.4).

Above: Tall herb vegetation on Helvellyn. Evidence from Mardale shows that, given the right management, this habitat could expand considerably [photo: Bart Donato, Natural England]

8.13 Blanket Bog

Blanket bog is vegetation on deep peat[78] (40cm depth is often used as a rule-of-thumb, although the same vegetation type can occur on shallower peat when conditions are right).

Peat is made from the waterlogged remains of vegetation that is unable to decay. It therefore contains a large amount of carbon[79]. Like other dense vegetation types, blanket bog acts as a large 'sponge' retaining water and slowly releasing it.[80]

The vegetation layer is crucial to the formation and maintenance of the peat beneath. Bog mosses (*Sphagnum*) in particular alter water chemistry and create the wet, acid conditions necessary for peat formation. If the vegetation cover is lost (in the Lake District fells this is usually through grazing or trampling by livestock or people) then underlying peat will dry out, oxidise and erode. High water tables are also important for peat formation.

In the past, peat was a very important source of fuel for local people- who may not have had access to wood as this was usually owned by the landlord. A great deal of peat was cut for fuel, even from some quite high and remote fells and the physical scars can still be seen in the peat today.

Much work has been done to mend the physical condition of blanket bogs (by blocking old drainage ditches and remodelling the surface of eroded bogs). This has been achieved through agri-environment agreements and also work by United Utilities and Cumbria Wildlife Trust. This physical work is not reviewed in detail here as the focus of this report is on grazing. However, to be successful, such works must result in healthy growth of blanket bog vegetation and for this to occur, appropriate grazing regimes must also be in place. There is no point carrying out physical restoration works if the original cause of the vegetation loss has not been addressed.

Due to the mineral-poor, acidic growing conditions, blanket bog is not very productive. As referred to in section 8.2 above, when stocking rates are low enough, stock will tend to avoid it and graze elsewhere. The exception is in spring, when cottongrass (*Eriophorum spp*) flowers. These flowers are nutritious and attractive to sheep. Some farmers refer to cottongrass as 'draw-moss'; we have variously been told that this is because it draws sheep out onto the bog or because sheep draw the flowering stems out of the plant.

The main blanket bog areas in the Lake District High Fells SAC on Armboth Fells, Shap Fells and Skiddaw Forest are all grazed at low levels, from zero grazing to an annual average of 0.38 ewes/ha. These grazing levels do seem to be resulting in good recovery of blanket bog vegetation, although it is perhaps worth noting that at the upper end of this range, the fells in question also have areas of grassland and dry heath within the grazing units (so the sheep are likely to be spending most of their time on these other, drier habitats).

Above: Flowering cottongrass on blanket bog in Skiddaw Forest. Cottongrass is refered to as 'draw-moss' by some farmers, perhaps because its nutritious flowers 'draw' sheep out onto bogs in spring time

8.14 Vegetation and water

As described in section 3.3, the type and structure of vegetation undoubtedly affects how water flows through the landscape, with dense (rough) vegetation generally slowing flows and filtering sediment, trees altering soil permeability and deep roots knitting soils together.

There is much current research to increase understanding of these effects and to try to better quantify them. Current soil and water-related research in the Lake District is listed at Appendix 3.

Trees and scrub along watercourses also help keep them cool in a changing climate and improves the ecology of rivers as falling leaves provide food for many aquatic organisms. See the Woodland Trust's manual, "Keeping Rivers Cool"[81].

Above: Equipment being used by Stephanie Bond of Water@Leeds, as part of a PhD study to measure the rate of flow of water through different vegetation types [Photo: Stephanie Bond]

8.15 Deer

Both red deer and roe deer are an important and valued part of the Lake District's wildlife. However, as they lack significant predators, their populations can build to levels that have undesirable impacts.

Roe deer generally prefer woodland cover and are territorial. Preferential browsers, they can prevent woodland regeneration and have a significant impact on ground flora, particularly bramble. They can find areas were other stock have been excluded, even several kilometres from existing woodland (where the area is not regularly travelled by people) and browse any unprotected regeneration or planted trees. However, their territorial nature means that once numbers have been significantly reduced it can take time for them to recolonise, provided there is not a larger source population nearby. Therefore, management in the Lake District's more isolated woodlands is relatively straightforward.

Red deer graze and browse and will spend time foraging both in woodland and on the open fell. Their grazing tends to be more evenly distributed across habitat types than sheep[82].

In the presence of sheep, red deer may graze more of their less preferred types of vegetation and/or they may seek out areas with fewer sheep (i.e. inside enclosures that have been erected to enable tree regeneration). They can range over large areas and management needs to be coordinated at the landscape scale. At present, they are mainly in

the north-east of the Lake District (Shap, Martindale, Thirlmere and Borrowdale). There is a North Lakes Red Deer Group which coordinates management over much of this area, and management is predominantly under the control of the larger landowners. In recent years red deer have been expanding to the west and south west of this area. This is of significant concern due to the additional grazing impact red deer will have in areas where sheep stocking rates have been reduced to aid vegetation recovery. Without appropriate management, this additional herbivory may be significant enough to halt or reverse any recovery which has been made to date.

Red deer numbers appeared to increase during the foot-and-mouth epidemic of 2001, when deer control was not possible, but they also tend to produce more young when food is plentiful after sheep numbers have been reduced. In some places they have caused problems with tree regeneration, and this is particularly likely where natural regeneration is relied upon and/or tree shelters are not used. In the Highlands of Scotland, tree regeneration is generally thought to occur when deer grazing is less than about 5 red deer/km^2 (0.05 deer/ha) if no other grazing animals are present (for example, see Trees for Life Red Deer Facts). In the Lake District, control of deer is made a condition of agri-environment agreements where necessary, and Natural England also works with bodies such as the North Lakes Red Deer Group, Forestry Commission and National Trust to encourage effective coordination of such control. If we want full nature recovery, good deer management will remain essential.

Above: Red deer are a valued Lake District species but as they lack natural predators, their populations can build to damaging levels [Photo [redacted], Natural England]

9. Other impacts of agri-environment agreements

9.1 Nutrient flows: feed and fertiliser

In nature, a lack of key nutrients, often nitrogen and phosphorus, limits plant growth. Increasing their availability by importing fertilizer and feed (as well as other sources such as sewage and atmospheric deposition of Nitrogen) shifts the advantage from diverse slow-growing, stress-tolerating plants to a few fast-growing, competitive ones. This in turn means that habitats are fundamentally altered and many species are lost. This is the main factor behind the much quoted loss of 97% of species-rich grasslands in England and Wales between 1932 and 1984[83]

When nutrients run off the land and end up in water, they feed algae which then shade out aquatic plants and deplete oxygen levels when they start to decay. This kills off the characteristic plants and animals, including invertebrates and fish. Algal blooms (which occur when high nutrient levels coincide with warm weather) can be toxic to people and other animals – and resulted in the cancellation of the Great North Swim in Windermere in 2010.

Due to the key role of these nutrients in the functioning of ecosystems, as much attention should be given to the nitrogen and phosphorus cycles as is given to water and carbon cycles. For further explanation see Hopkins, 2018.[84]

If there are higher numbers of stock on the fells than can easily be supported by the vegetation that naturally grows on the farm, then importation of feed and fertiliser will be necessary. Systems which do not require this – often termed 'High Nature Value Farming' result in healthier habitats on the fells, inbye and downstream water bodies. This would also have been the traditional form of agriculture before it was possible to import large amounts of feed or fertiliser; hence the ancient principle of levancy and couchancy (see section 3.8 above).

9.2 Whole Farm impacts

A further effect noted by Natural England advisors is that when the size of the fell flock (and other livestock enterprises on the farm) is comfortably within the capacity of the inbye to produce natural vegetation (even when stock are off the fell, for example at lambing and tupping times) then there will be more space for nature on the farm as a whole. For example, if a farm has to accommodate a lot of ewes at lambing time, it makes it difficult for the farmer to 'shut-up' (remove stock from) any hay meadows in early spring. This is the very time of year when wild flowers are putting their energy (that they have stored over winter) into new growth and flowering shoots. If these plants are routinely heavily grazed during this period then they will disappear and meadows will become grassy and species-poor[85]. Farms that are stocked comfortably within their capacity are also more likely to be able to accommodate other valuable conservation measures such as well-vegetated (ungrazed) riverbanks, naturally functioning floodplains (storage of floodwater), wide hedgerows and sensitively manged wetlands.

9.3 Economics of Fell Flocks

Farm income consists primarily of subsidy (Basic Payment Scheme) plus any agri-environment payments plus income from the sale of farm products (in the case of a fell flock this is sheep sales). Wool was once the major product from these fell flocks (and was the main driver for their establishment), but nowadays, the costs of shearing usually exceeds the price received for the wool. Expenditure includes fixed costs such as buildings and rent and variable costs such as labour, medical and vet costs, feed and fertiliser.

Agri-environment agreements can provide a substantial contribution to farm income, often making the difference between profit and loss. They therefore contribute towards enabling people to continue farming and in often to employ more labour than would otherwise be the case.

The Farm Business Survey 2017/18[86] concludes: **"**Basic Payment and Agri-environmental payments together account for over 35% of [hill farm] revenue. Although there is substantial variation amongst the farms in terms of their commercial performance, most of these farms could not survive in their present form as commercial businesses without the public payments."

Information shared by farmers during the hill farming training sessions and farm economics information supplied to Natural England by Andersons also tell the same story.

As does a report by RSPB on the finances of their reserve at Haweswater.[87]

Farm Profitability

The profit or loss that a farming enterprise makes is the difference between the income and the expenditure required to produce this income. Greater profitability can only be achieved by increasing income or decreasing costs. An increase in production (eg an increase in the size of the fell flock) will only result in increased profits if it can be achieved without incurring costs greater than can be recouped through sheep sales.

The method for feeding stock is key. Natural vegetation growth only requires sunlight and rain, so is cost free. The moment a farm wants to produce more animals than can be supported by this natural vegetation growth, fertilizers or feed need to be brought in and costs go up. When considered alongside other variable costs – such as labour and veterinary costs which also increase with larger numbers of animals– these additional costs can easily exceed the extra income from increased production. Conversely, reducing the size of the flock may actually increase profitability (obviously depending on the size of the flock to start with).

When a flock reduction then allows a farmer to sign up to an agri-environment scheme, then additional payments are also received. Although these payments are theoretically based on 'profit foregone', the calculations are done at national level and contain a large number of assumptions about average profitability. This is then translated into a fixed area

payment that is used throughout England. Depending on the individual characteristics of the farm, this can create a win-win situation where not only does a flock reduction make the core business more profitable but it also adds an agri-environment payment on top. It is therefore well worth each farm carefully analysing the effects of flock size and agri-environment agreement entry on its profitability.

Each farm will have an optimum number of animals that can be produced that will maximise profits (or minimise losses). Whilst there is no absolute guarantee that this will exactly match the number of animals that would also result in optimum environmental outcomes, it is much more likely to do so than a higher level boosted by additional fertilizer and feed.

Many Lake District Farms consist of several enterprises, with the fell flock only being one of them. Many of these are able to subsidise the fell flock through their other activities, and many choose to do this for cultural reasons. However, when the fell flock is looked at in isolation, the above principles hold true.

Further detailed economic analysis of economically optimal flock sizes on different Lake District farms, how well this matches with the achievement of different environmental objectives, and the accompanying impacts on farmer's lifestyles and wellbeing, would be extremely valuable. Indeed, as the Basic Payments Scheme is phased out (see section 14 below) this type of analysis is likely to become essential for the survival of many farm businesses.

Further detail is given in the report by the farm business advisor, Chris Clark and others: "Less is more: Improving profitability and the natural environment in hill and other marginal farming systems"[88]

9.4 Changing farming practices

One personal view of, and much useful information about, the changes happening to sheep farming in the Lake District is given in Edwards (2017).[89]

Natural England's local team's views on many of the points raised in the report are given in section 10 below.

Above: Gathering near Blencathra

Rehefting is possible (though labour intensive) as shown by Caldbeck and Uldale Commons which were restocked after foot and mouth disease from 2003, with specific support for shepherding under the Wildlife Enhancement Scheme agreements that were then in place on the commons. Hefts on these 2 commons now function quite well, the major issue reported by commoners is that there is one larger flock on Caldbeck (which did not reduce as much as the others) and this flock spreads across the top of the fells and encroaches onto Uldale Common.

A flock has also been replaced on the Derwent Fells Commons. This was onto an area previously occupied by a flock but abandoned before being taken on by a new tenant. This took considerable time and energy but did succeed in re-establishing the heft.

Breed conservation

In the past, there were some cases of Natural England's predecessors coming to an agreement with farmers over reduced sheep numbers, only to find that the traditional herdwicks or swaledales were replaced by a larger breed such as cheviots or lleyns. As well as the erosion of local sheep farming culture, these eat more and therefore negate much of the beneficial results of the stock reduction. We are now careful to specify which breed is involved.

Above: Swaledale, below: Herdwick. Both are traditional hill breeds in the Lake District

10. Farmers' views on agri-environment agreements

Farmers are a varied and individualistic group of people so there is a wide range of views and opinions amongst them. We have not done a structured survey but our advisors regularly speak to individual farmers, agents, commoners associations and representatives such as the Federation of Cumbria Commoners.

The table below summarises many of the comments and concerns we have received.

Views on the issues below can differ greatly between individuals, sometimes even between commoners on the same common. Many issues are inherent issues/problems in hill farming (regardless of whether any agri-environment schemes are in place) whilst others are affected to varying degrees by agri-environment (ie low stocking density) management regimes. Some are practical management issues and others are more related to the individual's attitudes, values, self-image and sense of purpose.

Issue	Farmer Comments	Natural England comments
Late agri-environment payments	Payments should be made on the dates they are expected and late payments cause serious cash-flow problems	We regret that there have been problems in recent years with late payments from both NE and RPA. All payments are now made by RPA
Agri-environment payments are important for farm survival	Agri-environment payments often make the difference between profit and loss…and provide a reliable source of income for the term of the agreement	Agreed
Pride in environmental improvements	Many farmers are proud of the environmental improvements they have brought about and want to leave the farm in good condition for their successors	We very much welcome this and would like to see more celebration of environmental achievements
Environmental management is not 'proper farming'	"We don't want to be park keepers!"	Farming has changed over time and will continue to do so. We would encourage people to look at all forms of land management that deliver public goods
Food production	Farmers want to produce food	Food production is one benefit that can come from the Lake District but it needs to be balanced with non-market public goods (water, carbon, biodiversity etc)

Concerns about 'undergrazing' and loss of agricultural value of fell land	Lower stocking rates result in under-utilisation of some areas of vegetation and can result in replacement of good grazing by less palatable, coarser vegetation	This is very complex. There can be both losses and gains from the agricultural perspective. This needs to be considered on a site by site basis. From an ecological perspective, we do not think 'undergrazing' is usually a concern in the fells; we would regard it as ecological succession (see section 4). We do recognise that some vegetation types can cause agricultural problems and work with farmers to try to find solutions, such as introduction of cattle to tackle coarse grasses and trample bracken. Low stocking rates can also result in improvement in the agricultural value of the fells – for example heath rush is very tough and wiry and is poor grazing and low stocking rates can result in it being shaded out by more diverse and palatable vegetation. Low stocking rates can also reduce soil loss and improve fertility.
Lower stocking rates are easier to manage	Fewer sheep mean less labour is required for husbandry. This can improve quality of life	We recognise this can be an advantage
Lower stocking rates make more profit	If stocking rates are matched to the 'natural' production of grass then seed, fertiliser and vet costs are reduced	We see this as an extremely important benefit. See section 9.3 on Farm Economics
Higher stocking rates make more profit	Sheep sales are an important part of farm income	Although sheep sales contribute to income, this does not equate to profit if costs are high. See section 9.3 on Farm Economics
Agri-environment agreements only pay profits foregone	Because agri-environment payments are based upon profits foregone calculations, farms are no better off if they come into an agreement	Agri-environment payments are based on national calculations and do not reflect local variation. They are area payments (rather than, for example being related to the number of animals kept). Each individual farm needs to look at the payments available and make their own decisions on whether they help their own circumstances. The

		economic benefits can be very substantial. (see also section 9.3)
Relationship of low stocking rates to traditional farming	"Agri-environment agreements are destroying traditional farming"	1. Farming has altered a great deal over the centuries, but never at a greater rate than in the latter part of the 20th Century, when intensified production caused significant damage to habitats. Although we don't entirely want to 'turn back the clock' (eg better human and animal health) we need to look further back in time to decide what we mean by, and what we value about 'traditional farming', for example, at how farming systems worked before it was possible to buy in fertilizer and feed. 2. Agri-environment agreements assist farm profitability. Lack of profitability of hill sheep, social changes, lack of succession and changes to subsidy regimes also impact upon farming systems.
'Sense of self' and purpose linked to flock size	Many farmers and their families have spent many years building up the scale of their enterprise and are proud of having done so	We understand this and recognise that the continuation of fell farming is essential in the Lake District. We want to work together with farmers and communities to think about different ways of doing things to maximise provision of public goods. We emphasise the value of reducing costs and nutrient inputs
Minimum viable flock size	Some farmers say that if their flock is reduced below a certain size it is not worth their while retaining it	The size considered as viable varies greatly between farmers and farming systems. This is not necessarily about financial viability and may be very much linked to the sense of purpose above. On commons there are often flocks of very different sizes on the same common. The WHS nomination does not identify flock size as critical to WHS value, though number of fell flocks is an attribute of WHS. We would like to work together with partners to understand how to

		increase the perception of relatively small flocks as worthwhile
Amalgamation of hill flocks and viability of shepherding	Many farmers are concerned that low stocking rates lead to people ceasing to farm the fell. This then leads to a shortage of people (and trained dogs) to gather sheep from what are often large and inaccessible areas	Lack of farm labour is a serious concern. However, unprofitability of hill sheep, changes to subsidies, social change and lack of succession on some farms are probably more significant than agri-environment agreements. Agri-environment payments are often key to enabling people to stay on the land.
Share of agreement payments on commons linked to flock size	On some commons, the way the money is divided up creates an incentive to try to keep a large flock	We leave decisions about how to divide up money on commons to each Commons Association. We do not wish to micro-manage commoners' business. However, we would caution Associations against setting up incentives that can cause conflict with scheme objectives.
Desire for independence	Many farmers would like the freedom to farm as they see fit without having to comply with numerous rules and regulations	Entering into agri-environment agreements is not mandatory for farmers. We wish to see agreements that are simple and easy to understand but the provision of public funds has to be linked to the provision of public goods
Off-wintering: benefits	Off wintering makes stock management easier and results in better quality stock	There are also significant environmental benefits
Off wintering: availability	The availability of off-wintering payments have resulted in a shortage of suitable grazing for off-wintering (this is often on dairy farms where cattle are kept indoors in winter)	We recognise this issue but it may be reducing as flocks become generally smaller. The alternative is to have flocks small enough to stay on the fell for longer and/or which can be kept on the inbye in winter.
Off-wintering: workload	If stock go some distance away for winter, then there is considerable work involved in transporting and checking them and there may be biosecurity issues	We recognise that this is a concern for some. Off-wintering payments through agri-environment agreements help with this.

Off-wintering: hardiness	If all sheep are off-wintered, then the weaker ones survive and hardiness is lost from the flock/breed	This is a greater concern to some farmers than others. Under HLS we have agreed a variety of different off-wintering regimes (ie different proportion off wintered) with different farmers. However, under CS scheme rules, the off-wintering supplement can only be paid if all stock are removed for the winter.
Off-wintering: twins	If breeding ewes are off-wintered then they tend to be in better condition and they produce more twin lambs. This means they have to be kept on better quality pasture for longer and are returned to the fell later	This is an impact of increased off-wintering but with careful planning, the farm system can be adapted to cope with this. It is less of an issue if stocking rates are low on the farm as a whole.
Herdwicks	It has been claimed that lower stocking rates threaten the continued existence of the Herdwick breed	Herdwicks are not on the Rare Breeds Survival Trust watchlist, but nevertheless exist in limited numbers. Retention of number of flocks and shepherds is more important than retention of number of sheep in each flock. Investigation into the genetic diversity of the Herdwick has been identified as part of the Lake District Partnership research programme.
Breakdown of hefts	Some farmers have said that when stocking densities are reduced, hefts break down and farmers have to spend longer gathering their sheep.	This is complex. Hefting has never been perfect and sheep have always wandered (hence 'shepherds' meets' where graziers met up to exchange strays). Particular problems occur when there are imbalances in sheep densities (eg where most flocks have been reduced in size but one or more remains much larger). Farmers vary in the amount of effort they are able to put into shepherding. Agri-environment payments can offset any additional costs of increased gathering effort. Some commons do seem to be able to manage hefts at lower stocking densities. Where dense heath or scrub vegetation is able to develop of the extremities of

		hefts, this can sometimes play a role in strengthening the heft. This whole subject would merit further study.
Stock encroachment	When stocking densities are greatly different between adjacent areas of unfenced land, stock are more likely to stray	We try to negotiate similar stocking densities on adjacent areas of land to minimise this problem – and indeed have helped resolve many such problems
Sout/Saut [the Cumbrian name for extreme light sensitivity in livestock]	Farmers are concerned that lower stocking rates and/or increased off-wintering increases the amount (or incidence of flowering) of bog asphodel (Narthecium ossifragum). When eaten, this plant may cause a light-sensitive reaction in sheep and sometimes cattle. This can cause severe sunburn-like symptoms – it can lead to loss of skin, blindness and even death.	This is complex. The causal link with bog asphodel is not certain and may not be simple. Bog asphodel is an extremely common plant in Cumbria (in both lightly and heavily grazed areas) but problems with sout are much more localised (it has been reported as a big problem in a few flocks and a lesser problem in many more). Sheep genetics may play a role; some flocks appear to have better degrees of immunity. More research is required.[90]
Red deer	Where sheep numbers are reduced, red deer numbers tend to increase.	This is a concern. We support better deer management eg through the work of the North Lakes Red Deer Group and through deer management plans that are part of individual agreements.
Bracken	Some farmers are concerned that low stocking rates are leading to the fells becoming covered with bracken.	Low stocking rates can result in denser bracken beds. However climate also has a big influence. Bracken growth is limited by soil depth and temperature – in shallower soils the roots are killed by frost. This means that on the one hand climate change is likely to be resulting in an expanding area suitable for bracken. On the other hand, there are still climatic constraints to bracken cover. Grazing is not the only management factor; in the past bracken was cut in large quantities for animal bedding and it was also removed

		and then burnt to make potash (for fertiliser and other uses). Bracken does have some environmental value, eg for birds such as Whinchat and its rooting system can reduce soil erosion. Low density bracken can also help conserve grazing in times of drought by providing some shade. However, we do understand the problems dense bracken poses, especially for gathering stock. Agri-environment agreements can help to pay for appropriate bracken cutting and the introduction of cattle which is an extremely good way of reducing bracken by trampling. Another valid response to bracken is to stop grazing it and to convert it to woodland or scrub. Indeed it is a marker of the deeper soils where trees and scrub could have grown in the past and are likely to be able to grow successfully in the future.
Molinia (purple moor-grass)	It is sometimes said that low grazing levels will lead to *Molinia* 'taking over'	There can be circumstances where thick tussocks of *Molinia* become dominant, however, this is fairly rare in the Lake District high fells. Here, *Molinia* is most often found on blanket bog (peat >40cm) where the vegetation has been altered by past heavy grazing and/or burning. If hydrology is intact, the peat is wet and bog mosses (*Sphagnum)* are present, then a period of very light grazing will usually allow bog mosses to take over again
Ticks	Some farmers are concerned that longer vegetation leads to more ticks which can have a severe impact on sheep health	The spread of ticks may also be linked to climate change, with more surviving in milder winters.
Fire risk	Some people are concerned that more vegetation on the fells will result in increased fuel load and fire risk	Fire risk will need to be considered, especially if climate change brings longer dry periods. However, native broadleaved woodlands do not burn. Wet heaths and mossy

		blanket bogs do not burn well. Gorse scrub and dry heath can burn but so far, there have not been many wild fires in the extensive areas that already exist of these habitats in the Lake District. True 'wild' fires are extremely rare; fires are usually started by people. Management of the sources of fire is crucial.

11. Other issues arising from agri-environment agreements

A range of concerns are also raised by other partner organisations. Those that do not overlap with farmers' concerns above include:

Issue	Comments received	NE Comments
Key mechanism for achieving environmental improvements	Many partner organisations see agri-environment agreements as a key mechanism to achieve their objectives in the environment	We are very keen to work with partners to get the best out of agri-environment. Our own staff resource is increasingly limited so where partners can assist, this is most welcome
Compliance	Non-compliance with agreements compromises outcomes	We will report any evidence of non-compliance to RPA
Insufficiently stringent prescriptions	Prescriptions in some areas have not delivered good results	We acknowledge that some agri-environment prescriptions have not been stringent enough to achieve the desired environmental results. This has been the case particularly where land was in Tier 1 of the ESA and then entered HLS without a significant enough change to stocking rates. We are trying to remedy this as we move into new agreements.
Landscape impact of fences	Some partners are concerned about landscape and access impact of fences in the fells	We work hard to ensure that landscape and access impacts of proposed fences are minimised. We will only proceed with proposals where we are convinced that the likely benefits outweigh the disadvantages
Impacts on World Heritage Status	There could be conflict between agri-environment agreements and the Outstanding Universal Values of WHS	Agri-environment agreements safeguard and enhance many of the attributes of WHS. We consider WHS when setting up all new agreements.

12. Recommendations for further studies

- Case studies of successful agreements in the high fells; what management has been done, what have the results been, why has it worked for the environment, why has it worked for the farmer? What stocking rates have delivered the most all-round benefits? (requires consultation with farmers and advisors involved)
- Detailed economic analysis of economically optimal flock sizes on different Lake District farms, how well this matches with the achievement of different environmental objectives, and the accompanying impacts on farmer's lifestyles and wellbeing
- Studies on how hefts can operate successfully at low stocking densities
- Further studies on sout/saut, bog asphodel and sheep genetics
- Lessons learnt about the establishment of woodland, trees and scrub in the harsh fell environment; design of schemes, practical land management advice and organisation of aftercare (in consultation with those involved in these schemes). Note that these are very different from 'forestry' schemes designed to produce timber, so much standard forestry advice does not apply.
- Conclusions of current soil and water research once these have reached reporting stage
- Ways that fell farming can contribute to climate change mitigation
- Place name studies; what can place names tell us about habitats and species that have been lost from the landscape? (Eg Wythburn, Eagle Crag, Lingy Hill, the Hollins)

Above: Keswick and Derwentwater from Skiddaw

13. The Future

It is not our purpose here to give a complete blue-print for the future of the fells. Detailed solutions need to be worked out in partnership with all those with an interest in how the land is managed. However, we would highlight the following themes:

The Government proposes phasing out the Basic Payment Scheme between 2021 and 2027, see the Defra leaflet "Farming is changing - here's what you need to know".

This will have a major impact on hill farmers and ensuring profitability will be challenging for many. In order for many fell farms to survive (which underpin the agro-pastoral system celebrated by the World Heritage Site) we expect that farmers will need to examine their farm businesses and finances very carefully (including an examination of their costs as described by Chris Clark - see section 9.3).

Most farmers will need to look to the new 'Environmental Land Management Scheme' (ELMS) as it is proposed that this will be the only source of government support. ELMS will provide public funds for public goods. These are defined as 'non-market goods' and include:

- Clean air
- Reductions in environmental hazards and pollution
- Thriving plants and wildlife
- Clean water
- Mitigation and adaptation measures to minimise the impact of climate change
- Enhanced landscapes

ELMS will also make key contributions to the Government's 25 Year Environment Plan. This commits to the development of Nature Recovery Areas and a Nature Recovery Network to deliver Sir John Lawton's 'Making Space for Nature' recommendations. Linking nature recovery and future farming has been identified as one of the strategic aims of the next Lake District National Park Partnership Plan. The Climate Change Committee has also recommended that there is 30,000ha of tree planting in the UK per year.

We hope that the lesson learnt from the last 25 years of agri-environment schemes as described in this report will be applied to the next 25 years in order to achieve successful recovery of valued habitats and species – and all of the public benefits that come with them.

If farms reduce their costs by having low stocking rates and low inputs of fertilisers and feed, then this benefits farm profitability at the same time as having significant benefits to the environment. This could be seen to be a return to a more 'traditional' form of farming that was in place before it was possible to buy in fertilisers and feed. However there have been huge changes to society since people farmed in this way, so such a transition may not be straightforward on all farms. People may choose to leave farming instead, leading to land abandonment or amalgamation of holdings and a reduction in skilled labour.

We need to be clear about the characteristics of traditional farming that are valued, for example quality of stock, cooperative fell gathering, more extensive cattle and pony grazing and management of species-rich grasslands (including hay meadows). A few Lake District farmers still carry out pollarding of trees and most care for their hedgerows but it would be good to see further breakdown of the boundaries between farming and forestry – for example more wood pasture systems, more active management of areas of new trees and scrub and more coordinated deer management.

14. Conclusions

1. Healthy habitats in the Lake District's high fells deliver a range of public benefits including biodiversity, filtration of water, moderation of water flows, helping to reduce landslips, carbon storage and capture, contributing to health and wellbeing and are part of the area's landscape, history and culture.

2. Livestock grazing is not the only activity affecting the composition and health of upland vegetation. However, intensive sheep grazing was encouraged by past subsidy regimes and is identified as the biggest man-made impact on the biodiversity value of the Lake District High Fells SAC. Good grazing management is therefore key to delivering all of the above benefits.

3. Habitats on the fells have recovered best under low grazing pressure. Recovery of existing SSSI habitats has been universally good below a year-round average of 0.4 ewes/ha. Good recovery has sometimes been seen up to an annual average of about 0.5 ewes/ha. No sites stocked above an annual average of 0.6 ewes/ha are achieving all of their objectives for existing habitats.

4. Some habitats, including tall herb vegetation, arctic alpine plants and trees and scrub benefit greatly from the complete removal of sheep grazing.

5. When habitats such as heaths have been lost altogether, recreating them is often more difficult. In such conditions, the planting of native trees or scrub may be one of the best options.

6. Native trees, scrub and wood pasture have become particularly scarce and fragmented in the fells. There are huge opportunities to expand these habitats and enormous environmental benefits from doing so. If designed well, such projects can also enhance the landscape and fit well with the cultural heritage.

7. There are often many benefits to habitats from combining cattle with sheep grazing and even greater benefits from grazing some areas only with cattle (or possibly ponies).

8. Good deer management is already important in much of the Lake District and the need for this is likely to increase.

9. Farms with numbers of livestock that can be comfortably supported within their capacity to produce natural vegetation are more likely to have room for a wide range of valuable conservation measures such as species-rich meadows, well-vegetated (ungrazed) riverbanks, naturally functioning floodplains (storage of floodwater), wide hedgerows and sensitively manged wetlands. They also use less fertilizer, which has huge benefits for habitats in general and especially freshwaters and wetlands.

10. There are numerous examples of good environmental practice in the Lake District Fells that are supported by agri-environment schemes. These should be celebrated.

11. 25 years of agri-environment agreements have helped shape the recent management of the high fells but there have also been a lot of other social and economic changes over that period that are not related to agri-environment schemes. Although there are many views on the way farming has

been changing, agri-environment schemes have provided vital farm income and have brought about significant environmental benefits.

12. It is difficult to make a living from farming in the uplands and further change to farm payments is on the way. Many farmers will need to re-examine how their businesses work and in many cases, reducing costs will be key. Changes to farming systems that will cut costs can also have significant environmental benefits, for example, smaller flock sizes require less imported feed and less fertilizer use.

13. More clarity is required on the specific impacts of upland livestock farming on climate change – but the same low input systems that have economic and environmental benefits are also likely to be good for the climate.

14. We need grazing regimes in the fells that result in nature recovery, and these should be based on experience of what has (and has not) worked over the last 25 years.

15. It is imperative that we encourage, celebrate and fund good environmental practice to help farmers to continue with agro-pastoral traditions - and to feel valued for doing so - at the same time as reviving the web of life on which we all depend.

Above: Patterdale, with Glenamara Park, an old wood pasture, on the slopes at centre right. A large number of species appear to have evolved to live the mosaics of mixed habitat found in wood pastures – and there is room for a lot more of it in the Lake District

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Links are only given where these have not already been provided in the main text

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