JOINT NATURE CONSERVATION COMMITTEE

Looking to the Hills

Newsletter of the Uplands Lead Co-ordination Network

Issue 16 **July 2009**

Welcome

CONTENTS

We have a wide range of articles in this issue and we are especially pleased to see a mixture of conceptual field based and experimental work reported. There has been a fair amount of debate on the changing face of agriculture in the uplands, so we are especially pleased to have Ian Condliffe's editorial, and the lengthy article by Tony Waterhouse.

Do keep the articles coming, and please do not shy away from letting us have controversial articles.

We are very pleased to learn that Marcus Yeo, who has had a long association with the ULCN, has been selected for the JNCC Managing Director post to replace Deryck Steer when he retires later in the year.

A good summer to you all.

Sally Johnson and Des Thompson

Cyngor Cefn Gwlad Cymru
Countryside Council for Wales

NATURAL ENGLAND

NIEA Northern Ireland Environment Agency
www.ni-environment.gov.uk

Scottish Natural Heritage
All of nature for all of Scotland

*The Joint Nature Conservation Committee's **Upland Lead Co-ordination Network** was established to carry out the special functions with respect to GB nature conservation needs for upland habitats. It involves staff in the three country conservation agencies, the JNCC support unit and EHS in Northern Ireland.*

Guest Editorial - Maintaining the balance

The 2003 CAP reforms are leading to a fundamental shift in farming in the uplands. With the removal of financial incentives to keep livestock, many farmers are reassessing their farming options, although in the uplands, these have always been limited.

In the UK, the move away from production-led farm support started much earlier with the decoupling of the LFA schemes eight years ago. The UK also led the way on environmental cross compliance by introducing overgrazing penalties on LFA schemes in the early 1990s. These measures, coupled with the incentives from agri-environment schemes have contributed to the reduction of hill sheep flocks over the past 15 years and have helped slow the decline in upland habitat quality. CAP reform now seems to be accelerating this reduction in the numbers of both sheep and cattle.

The SAC's report, *Farming's Retreat from the Hills*, featured in this issue, highlights this trend in Scotland. It makes the important point that it is not geographically even and the picture is probably similar for the rest of the UK and between different Less Favoured Areas.

The reduction of livestock numbers from a farming system that was skewed and overloaded, producing goods of questionable quality is welcome. Cross-compliance and agri-environment schemes could only have limited impact whilst production subsidies remained. With these removed, the danger now, as I see it, is that we enter a period of environmental boom and bust, and there are few mechanisms in place to regulate this.

Reduction or total cessation of grazing can be both beneficial and detrimental to upland ecosystems services. More to the point, we do not have a clear understanding of where and when it can be most beneficial and for how long. Unfortunately, unlike set-aside, the grazing of mountains and moorlands is not something that can be switched on and off with relative ease. The reduction or removal of hefted sheep flocks is a difficult process to reverse. Also, once lost, the accompanying livestock husbandry skills can be difficult to replace. Whilst agri-environment measures rarely advocate total livestock removal, it can be more economic for the farmer to remove the whole flock rather than to manage reduced numbers. This can produce a 'domino effect' leading to the removal of other flocks as neighbouring farms rely on each other's labour. It seems to me that more research is needed on balanced, low level grazing systems. Conservationists and policy-makers need to have a strategy to address the potential total loss of moorland grazing livestock on significant areas of our uplands.

The most fundamental reason for the decline in upland grazing systems is that, for many, it just doesn't pay. Average livestock production costs on LFA farms in England are 50% greater than the income from the enterprises, leaving the farmers with a net loss of £17,000. Monies from Single Payment, LFA and agri-environment schemes account for around 40% of total farm income, so covering this loss and allowing a modest 'profit' to be made.

If upland livestock farming is to continue, for the benefit of wildlife, landscape, people and cultures then it seems that it must continue to rely on public support. Defra's policy (for England) that farmers must provide some tangible pubic benefit in return is exemplified in the recent announcement of the switch of LFA payments into an upland entry level agri-environment scheme in 2010. Payments for agri-environment schemes have to be based on income foregone. With upland farm production incomes generally being negative, the scope for these types of payments to provide the bulk of support to farmers must be limited.

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Farming's Retreat from the Scottish Hills

In August 2008, SAC's Rural Policy Centre published a short report *Farming's Retreat from the Hills*[1]. This created considerable interest, crystallising the views of many stakeholders in the uplands of Scotland. Shortly afterwards, the National Farmers Union of Scotland published its *Manifesto for the Hills*[2], further reviewing some of the evidence for dramatic changes in upland farming and suggesting some potential political and financial solutions. The Royal Society of Edinburgh produced its year-long *Committee of Inquiry into the Future of Scotland's Hills and Islands*[3] in September which also highlighted the widespread stock reductions and went in further depth into the role, problems, changes and some of the impacts of these changes on the wider economic, social and environmental issues of the Highlands and islands of Scotland.

Here we summarise the findings of SAC's report, drawing upon the experience and findings of a number of SAC research scientist and economists.

Is farming retreating from the hills?

An examination of the census data showed that sheep numbers have declined dramatically since 1999, most notably in the North West, with many areas seeing a reduction of between 35 and 60 percent (figure 1). The data on the number of sheep per unit carrying sheep and the number of holdings with sheep suggest that this reduction in sheep numbers is part of a process of down-sizing coupled with a number of farmers withdrawing from sheep production (although the number of sheep per unit has dropped much more significantly than the number of holdings with sheep).

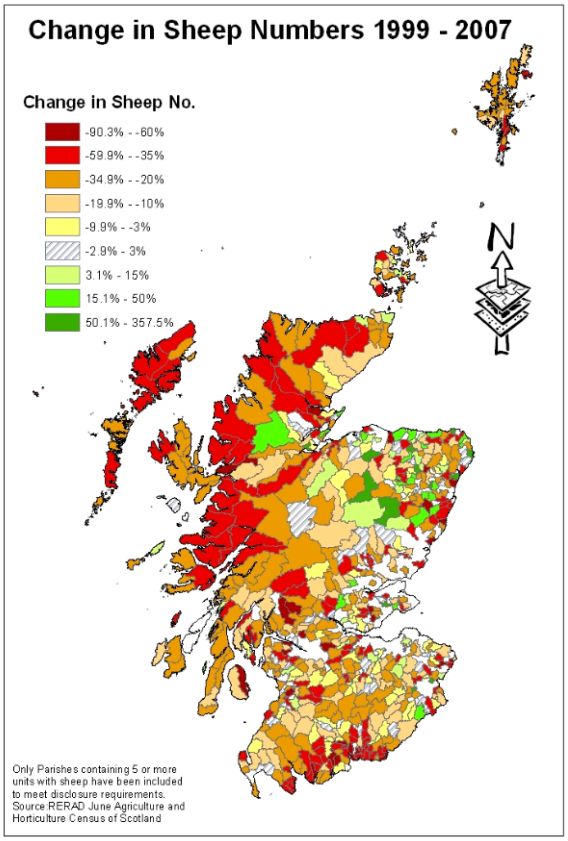

Figure 1: Change in sheep numbers between 1999 and 2007 at the parish level. Source: June Agricultural Census.

Cattle numbers have also declined, although not so dramatically and not in the same areas. The decline in cattle numbers in some areas is a combination of downsizing and farmers withdrawing from production. However, in many areas the changes are due to an increase in intensity as some farmers have expanded as others leave the industry. Crucially, declines in livestock numbers appear to have accelerated after the introduction of the Single Farm Payment and the decoupling of livestock numbers from payments. However, the analysis of the data highlights that the decline in livestock numbers is extremely complex with a great deal of spatial variation even within single geographical areas (such as Highland).

The economic reality of farming in the hills

A review of the economic situation found that hill farmers are under significant pressure at present because most hill production is financially uneconomic (table 1). The price that farmers receive for their livestock, for example, is often below the costs of production and much of the farming in hill areas only continues because of the support payments provided by government. These QMS figures for self selected flocks do not necessarily paint a true picture of variation in economic reality between the north west of Scotland and better areas, for example in the Scottish Borders. SAC's Farm Management Handbook for 2008-9 shows predicted margins of £(-)7.56 and £6.02 for hill flocks for north-west Highlands and the Grampian & Southern Uplands respectively. These latter

[1] The full report *Farming's retreat from the hills* can be found at www.sac.ac.uk/ruralpolicycentre/publs/researchreports/
[2] www.nfus.org.uk/uploadedfiles/Manifesto_for_the_hills.pdf
[3] http://www.ruralgateway.org.uk/en/node/236

figures are not real ones but a consensus view from industry commentators, many seeing individual farm accounts. They do demonstrate the nub of the economic problems, negative gross margins can but only drive numbers down and that the issues are not equally distributed geographically.

Table 1: Gross and net margins per ewe for, low ground, LFA upland and LFA Hill breeding flocks (Source: QMS 2007)

	Lowground Breeding Flocks Average holding £ per ewe	LFA Upland Breeding Flocks Average holding £ per ewe	LFA Hill Breeding Flocks Average holding £ per ewe
Gross Output	78.98	67.38	38.99
Less Replacement costs	(-) 6.42	(-) 10.21	(-) 7.50
Net Output	72.56	57.17	31.49
Variable Costs (incl. concentrates and forage)	(-) 28.96	(-) 22.08	(-) 15.25
Gross Margin	**43.60**	**35.09**	**16.24**
Fixed Costs	(-) 44.54	(-) 44.97	(-) 42.09
Net Margin per ewe	**(-) 0.94**	**(-) 9.88**	**(-) 25.85**

The prices received for finished lambs and cattle have risen recently and represent a welcome increase in the income per animal. Nevertheless, for store lamb producers these prices are rather academic and even if factored in, still leave many hill farmers with negative gross margins before labour and other fixed costs are included. In practice, the degree to which a farmer will benefit from rising prices will depend on the detail of their operation.

Consequences for biodiversity

Although grazing levels were considered to be too high in large parts of the British uplands throughout much of the late twentieth century (leading to heather loss and damage to vegetation and soils), the situation in many parts of Scotland has been of limited increases in breeding ewe numbers in the 80's and 90's and the recent livestock reductions are well below any changes upwards. Based on the census data, research interviews with individual farmers and the experiences of SAC's local consultants, it is evident that the pattern of change varies considerably between different localities between farms, and even within farms. Stock removals are influencing neighbouring farms. Gathering is reported to becoming ever more difficult, as neighbours remove stock and sheep flow across the unfenced boundaries. Without fences on the high hills, reductions and removals on one farm is affecting grazing intensities across others. Some farms are removing stock from selected areas.

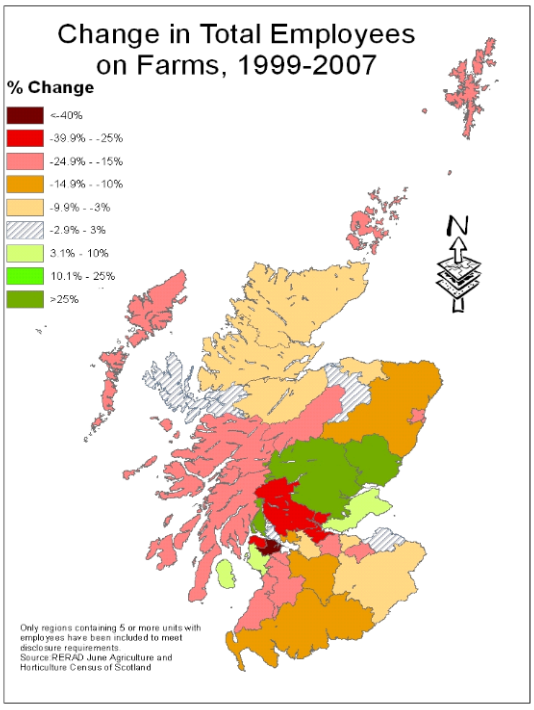

Figure 2: Change in total employees on farms between 1999 and 2007 (excluding occupiers and spouses).

Under-grazing is now commonly seen as an issue. In general, though, a reduction of grazing on hill land will benefit some species but be detrimental to others. Perversely, on some sites where grazing was seen as a problem through pressures on some species and habitats, there may be bigger issues from a reduction or removal of domestic herbivores. Having a range of different management systems, including some which have little or no grazing livestock, and valuing this diversity in management is perhaps the key to coming to terms with the biodiversity impacts in the uplands. Deer are likely to increase as a result of decreased livestock grazing and reduced disturbance. Their grazing patterns, especially seasonally, do not match that of sheep so changes are likely at the landscape scale.

Consequences for communities

Agriculture plays an important role in many rural economies and communities either directly, through employment, or indirectly, through the way that farm

businesses are linked to other businesses in an area. Change in agricultural production, especially in remote rural areas – where agriculture plays a more prominent role in the economy – can have significant implications for the local economy and for local communities. An examination of the census data suggests that the Highlands and Islands have seen the greatest decline in the number of full-time occupiers and spouses at the same time as witnessing the slowest growth in part-time occupiers working 50 percent of their time or less. There has also been a rise in the number of spouses working less than 50 percent of their time on farm, suggesting that spouses in particular are shifting to find employment off-farm. The availability of labour is also an issue with the number of employees having declined across large parts of Scotland (figure 2).

Managing the retreat from the hills – where next?

The trends in livestock numbers, the number of people working in the hills and the high input prices suggest that, in the short-term at least, the decline will continue. Other factors, such as the relative interest of alternative land uses such as forestry, may also come into play. If the profitability of hill farming remains low and funding is available for forestry, it could make economic sense over the long-term for many landowners to move further away from hill sheep farming. Such a shift is not without its own economic, social and environmental consequences and requires further examination.

In general terms, the current decline in livestock numbers in the Scottish hills could have several negative implications: the farming sector appears to be contracting in hill areas; there are knock on consequences for local economies and communities; and some moorland species, maintained (even if in less than favourable condition) by grazing, are likely to be detrimentally affected.

Is this retreat a Scottish phenomenon? Recent press coverage highlights concerns in some of the English upland National Parks[4]. Areas with low livestock productivity, such as the North York Moors, appear particularly sensitive to changes in moorland grazing practices.

The reduction in livestock numbers throughout the UK therefore begs the question of whether new policies are required. Any response will be difficult, however, because, as a society, we want to retain a thriving farming sector, we want to see vibrant rural communities and we want a healthy natural environment. It will be difficult to achieve all these in the difficult and more remote parts of the UK without significant public funding. Finding solutions that help to deliver all these objectives will be complex. At a general level, there are three broad responses:

- accept that farming is changing – simply allow the changes to happen and deal with the consequences;
- attempt to halt the decline through changes to the rules surrounding direct payments – reinforcing cross compliance or providing some form of support payment (perhaps through Article 69/68);
- attempt to halt the decline through enhanced rural development measures – move further towards paying farmers for the provision of 'public goods'.

Whatever the overarching policy support, a series of lower level issues emerge:

- How can meaningful forms of land-use, and sustainable food production, survive in the areas of retreat and what is needed to build a changed future?
- Or more pragmatically, how can livestock farming in these areas be made profitable through innovation, technology or just different ways of doing things?
- What are the implications for the people, the sheep (their genes and their welfare) and habitats and species under threat, or under a period of change?
- And how do we manage the change?

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[4]Morris, S. (2008) the Guardian http://www.guardian.co.uk/environment/2008/nov/07/conservation-endangered-habitats

Quantifying grazer activity in remote upland areas using digital cameras and automated image analysis

Introduction

One of the major barriers to understanding the effects on biodiversity of extensive grazing in complex semi-natural habitats is the standardization of data collection between observers and data processing limitations. The advent of cheaper and more sophisticated digital camera technology has lead to an increase in the number of habitat monitoring images and information that is being collected and stored. We report the use of automated trail cameras (designed for the game hunting market) to continuously capture images of grazer activity in a variety of habitats. These techniques are being used in conjunction with GPS collars and more well established survey methods (dung counting and vegetation surveys). We are now developing Artificial Intelligence based methods to assist in the analysis of the large number of images collected. Here we describe the data collection techniques, outlines the quantitative and qualitative data collected and propose systems that can reduce the time required to interpret the data.

Study site

Moor House National Nature Reserve[5] is situated in the North Pennines, in the North of England at an average altitude of over 600m. Rainfall is high, and in most areas the soil consists of deep peat (1m to 3m), populated by a mix of heather (predominantly *Calluna vulgaris*), mosses (*Sphagnum* spp.) and sedges (*Eriophorum* spp.). In a few areas glacial drift is thin or absent and the underlying calcareous bedrock influences the soil formation. Also, near the rivers and in eroding gullies, the soils are peaty loams of alluvial origin. These soils support grass dominated turf that is intensively used by grazers. Some small areas of the peat have been planted with conifers. The site is one of the Environmental Change Network (ECN) sites[6] and has been intensively monitored for physical, chemical and biological environmental variables for many years. The dominant grazers are sheep, whose numbers are controlled by common grazing rights owned by local farmers in agreement with Natural England (NE) and rabbits which are controlled by natural processes such as severe winter weather, predation and disease (myxomatosis). In recent years rabbit numbers have grown significantly and sheep grazing has reduced. Our initial aim was to capture images that indicated the range and frequency of grazer movement, in order to enable an informed assessment of the impact of changing grazing patterns. In the future we hope to generalize the methodology to address other questions (relating to birds, bats, butterflies and the other animals captured in our images).

Techniques

We deployed 10 motion triggered (PIR) day/night cameras (Stealth Prowler STC-DVIR5). The cameras can store 2000 images and with moderate sized batteries and sufficient solar power scavenging to increase battery longevity routine maintenance is reduced. Daylight images are in full colour and night images (IR flash) are black and white. The cameras take (and timestamp) two pictures at a 2 second interval when motion is detected (fig 1). The camera then sleeps for just over a minute in order to avoid capturing a large number of images of the same visit by an individual animal. By processing the pairs of images a composite image highlighting the features of interest can be generated automatically (fig 2).

Three cameras were deployed in a meadow (sheep excluded) near a large system of rabbit burrows (fig 3). These cameras were positioned in each others line of sight, around four 2 metre quadrats used for dung (pellet counts) and vegetation surveying. This setup enables quantification of the likelihood of undercatch by the cameras.

[5] Holden, J., Adamson, J.K. (2002) The Moor House long-term upland temperature record: new evidence of recent warming. *Weather*, 57, 119-127.
[6] http://www.ecn.ac.uk/

Figure 1. A pair of Images, illustrating the motion

Figure 2. Composite Image incorporating movement and highlighting only the rabbit

Figure 3. Meadow Cameras (3, 4 and 6). Also shown is an annotated view (camera 6) that shows the survey quadrats and an approximate boundary used in categorization

Two cameras were placed on an access trail to a re-vegetating peat gully, one was placed in a glade in one of the small plantations and two were placed on a small river terrace. Two further cameras were placed at altitude (840m) on the nearby peak of Great Dun Fell.

Using these cameras it has proved possible to continuously capture ~200 images of faunal activity per day for a period of 6 months (and counting). The technique is revealing new data about faunal activity (the grazers, rabbits and sheep but also other mammals and birds), together with new information about the environment (river state, plant growth and weather conditions such as visibility and snow lie). However, it is necessary to automate the processing of the large number of image files retrieved (currently around 40,000 images). Other methods for assessing habitat usage

and biodiversity have been carried out alongside the photographic monitoring, including tracking sheep using four Bluesky AgTrax[7] GPS collars (fig 4) and counting rabbit droppings in defined quadrats (shown in fig. 3).

In the North Pennines approximately 95% of the sheep that graze on the moorland are Swaledales which is a medium sized hardy breed. On upland farms sheep are traditionally over wintered at lower altitudes and lambed in early spring. In early May ewes with lambs and first year ewes that will form the future breeding stock are turned out on to open moorland. They remain on the moorland until early November with the exception of two short periods (a matter of a few days) when they are 'gathered' and brought back to the farms. The first of these occasions is for shearing in July and the second in September when lambs are removed for market. This system of animal husbandry provides the opportunity to monitor an individual sheep's movements for three approximately equal sessions of 8 weeks duration.

Figure 4. A Swaledale modelling the Bluesky GPS collar for us (IR camera)

Because the sheep are free to range over an area much greater that the size of the Nature Reserve it was decided to allow the animals to spend

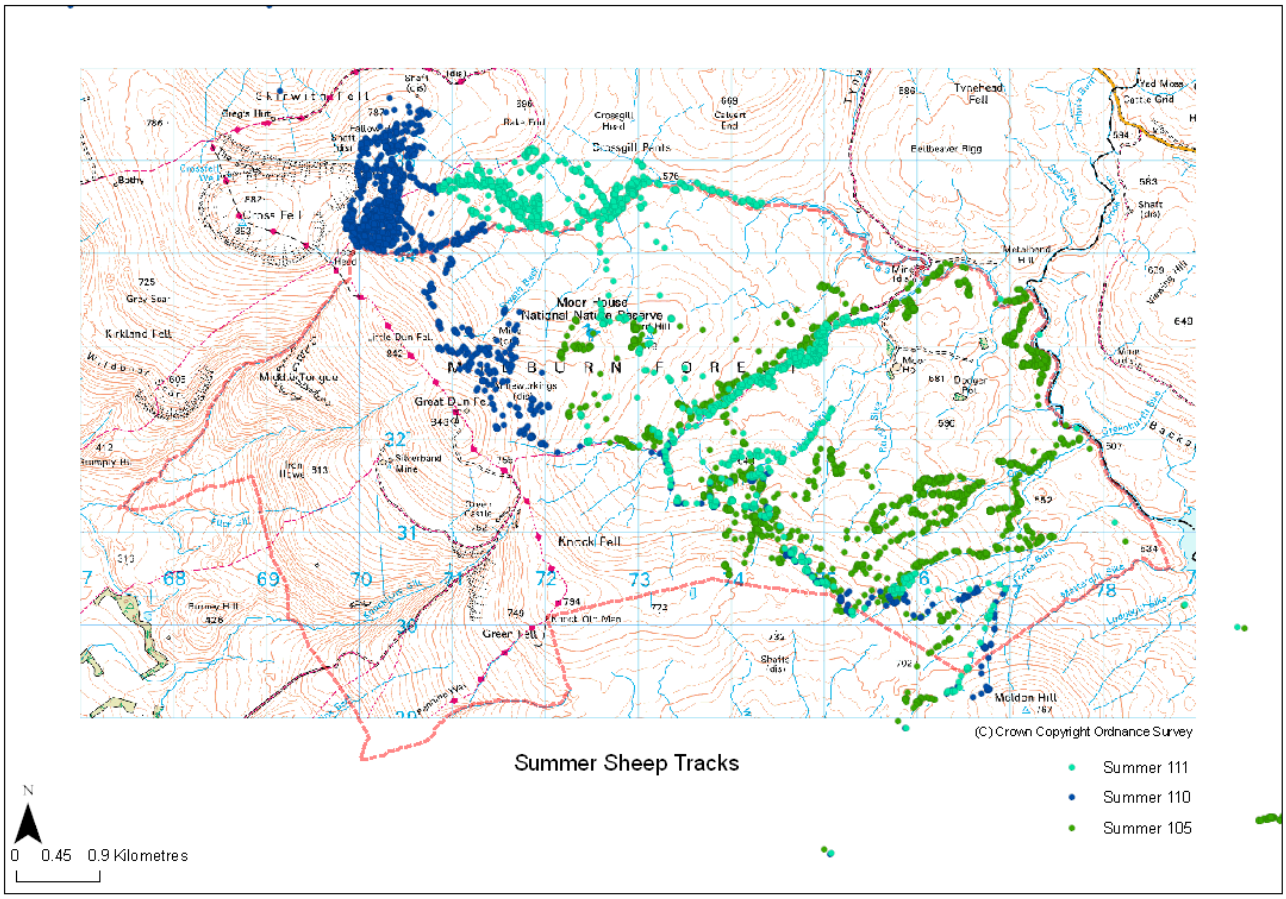

Figure 5. GPS positions showing the extensive grazing ranges of the sheep.

two weeks on the moorland before collars were attached. Three sheep were selected from a

[7] http://www.blueskytelemetry.com/agtrax.asp

central area of the Reserve, two were ewes with lambs (numbers 105 and 111) and the other a ewe of pre-breeding age (number 110). The collars were fitted around the necks of the sheep using an adjustable belt. The collars weigh 600g which is <1% of body weight of this breed of sheep and at each session an inspection of the general health and in particular the area around the collar was made.

The collars were programmed to record the position of the sheep at 30 minute intervals day and night throughout the entire grazing period. In addition to location information two dimensional tilt and temperature data has also been collected at the same frequency. This information will provide complementary data to that collected by the static cameras on the individual ranging patterns of animals throughout the grazing period (fig.5).

Coupling all this rich and varied dataset into a coherent, informative process provides a major challenge. We have chosen to focus initially on automating the most time consuming aspect – the image analysis. Many image processing techniques exist[8] but they are usually problem specific, computationally intensive and still require manual interrogation. The aim is to provide a much more lightweight, reusable system that provides categorization and alert generation with the option for real time retraining *in situ*.

Results

The images captured during the first six months have been manually analyzed according to the category scheme which focuses on rabbit behaviour, and disease evidence. The rabbit activity category "other" includes basking, and interaction between individuals (grooming, fighting, etc.). Disease (Myxomatosis) is more evident in the later season images, but awaits full statistical analysis. An interesting array of animals have been observed. By far the most frequent observations are of rabbits and sheep (where they are not excluded) but other mammals recorded include badger, deer, fox, mice and stoat. Rabbit, sheep and deer activity is continuous (24 hr), but the other mammals have only been observed in early morning, late afternoon and in darkness. .A wide variety of birds have also been captured. To date 17 species have been recorded (Blackbird, Starling, Red Grouse, Mistle Thrush, Meadow Pipit, Tawny Owl, Kestrel, Pied Wagtail, Wheater, Ring Ouzel, Chaffinch, Robin, Fieldfare, Redwing, Woodcock, Oystercatcher and Wren) without specifically targeting a range of avian habitats. Information on bird species abundance and the times of arrival and departure of migrating species will be obtained from these camera records. Additionally, species such as Starlings often flock to moorland areas to feed during the short periods of Tipulid (Crane Fly) emergence. This technology will enable us to accurately monitor such short-term events. The manual analysis is a painstaking task given that each image requires entries for over 30 columns of information and this motivates our focus on automation of the analysis.

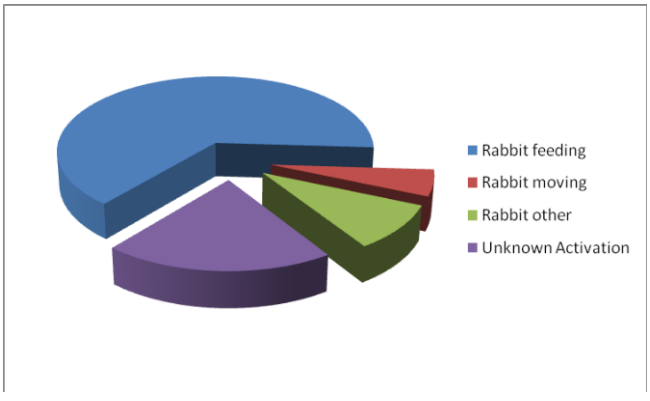

Figure 6. Distribution of classifications for meadow images

A summary of the activity statistics for the meadow cameras is given in fig. 6, which illustrates that around 20% of the images have no observable animal present. These cases can result from the animal leaving the field of view (there is a shutter lag of ~1 sec), the animal hiding in vegetation, or due to solar effects (rapidly moving clouds, etc.). There are approx twice as many false triggering events in daylight as there are in darkness. This is due to elimination of solar effects and because animal eyes are obvious (strongly reflect the infra-red flash). There are also cases where animals in the dark can trigger the PIR, but are out of flash range when their back is to the camera. The undercatch (camera failed to trigger due to sleep period or lag in the PIR) is difficult to estimate, but initial results from the meadow suggest it is under 10%

[8] Pratt, W.K., Adams, J.E. (2007). Digital Image Processing, 4th Edition. J. Electron. Imaging, Vol. 16

We are currently experimenting with a neural network based approach to image analysis. A set of statistics derived from the original and composite images are categorized into groups, rabbit present, other animal present, no animal present (figure 6). Accurate (80~95%) categorization of faunal content can be obtained, requiring human intervention for only those images containing rare animals or unusual (undecidable) conditions, and enabling automatic deletion of images generated by erroneous triggering (e.g. cloud movements). Our next target is to automate the estimation of rabbit activity type in each image (we have enough rabbit images to do this). Unusual, unknown or anomalous images can be used for system retraining after they have been manually interpreted, so performance of the automated tool will improve as more images are captured. By focusing the attention of the scientist analyzing the images onto the more unusual cases, a much more efficient use of time is made available.

Conclusions

Understanding both the effects of seasonality on grazing preferences and the impact of current weather conditions on daily grazer activity forms a key part of mitigation strategies relating to the biodiversity implications of overgrazing of certain habitats. Current observer based techniques are subject to unknown biases, low sampling rates and issues with representativeness. In particular observations outside daylight hours are extremely sparse. Improvements and cost reductions in digital cameras, potentially provide an affordable means to overcome these limitations. This research proposes methods to address the rapid increase of available data that is being collected both manually and automatically. The volume of visual data in particular is increasing exponentially. By converting digital image data into statistical composite data it can be handled in a similar way to other biodiversity statistics thus improving the scalability of monitoring experiments. Unsupervised feature detection methods and supervised neural methods offer solutions to simplifying the process.

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Understanding an exceptional heather die-back event in the Scottish Highlands

Conservation management sometimes involves radical changes over large areas, and these can throw up surprises, especially when interacting with climate change.

When RSPB acquired large areas of moorland adjacent to the ancient Caledonian pine forest of Abernethy (now within the Cairngorms National Park), in the late 1980s, there were large-scale reductions in burning and grazing, to foster forest expansion. This policy has been very successful in allowing new areas of woodland to develop, but may also have contributed to a recent unexpected case of exceptional heather die-back.

In early spring 2003, following a period of exceptionally low humidity, extensive heather die-back was observed over large areas of the Scottish Highlands, particularly around the Cairngorms. At Abernethy, data collected as part of a series of management trials showed that about a third of the heather was killed, in monitored areas of both forest and moorland. Moreover, there was negligible

Photo 1. An example of partial heather die-back at Abernethy in spring 2003, showing the typical observed mosaic of surviving and dead shoots. Photo by M. Hancock.

heather recovery over the subsequent three growing seasons. Die-back was more severe where the topography was flatter and more north-facing, and where heather stems were longer.

Ironically, this die-back event was generally seen as favourable to objectives at this particular site, where the thrust of much recent management has been to reduce heather dominance. Indeed, heather die-back has probably led to increased bilberry abundance in some areas, which is likely to benefit Capercaillie, a key species at the site.

Analysing the pattern of die-back, in relation to a range of other data available for the site, suggested that die-back followed severe 'winter desiccation', caused by extreme low humidity conditions, combined with low temperatures, lack of snow cover, and heather vulnerability due to age. Perhaps appropriately in an era of climate change, parallels can be seen between these changes in a northern, upland site, and those observed in some southern, lowland heathlands in the past.

The climate of the Cairngorms (and many other areas of upland Britain) is predicted to change towards warmer, wetter winters - which might be expected to favour heather - but also to become more variable. Since the early 1980s, winter humidity minima in the area have become eight times more variable. This example shows how such increased climatic variability could contribute to major, unexpected, vegetation changes in our heather-dominated uplands.

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For further information, please see a related article in *Plant Ecology and Diversity* Vol 1(1): 89-103, available free online at http://www.informaworld.com/smpp/content~db=all~content=a795056081.

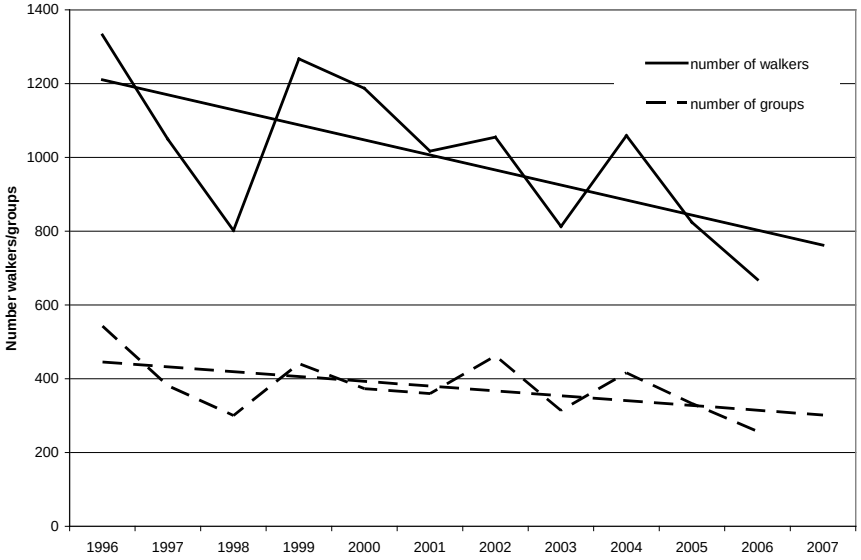
Route card analysis and footpath management on Rum

The purpose of this initial research was to investigate the potential of route cards to aid in the development of a footpath management plan for the Rum NNR. Particular focus has been placed on the identification of the level of use of routes in order to assist in the prioritization of path management. This builds on the Amber/Red footpath study conducted in 2001 (Ball, 2002). Indeed the executive summary of the study says:

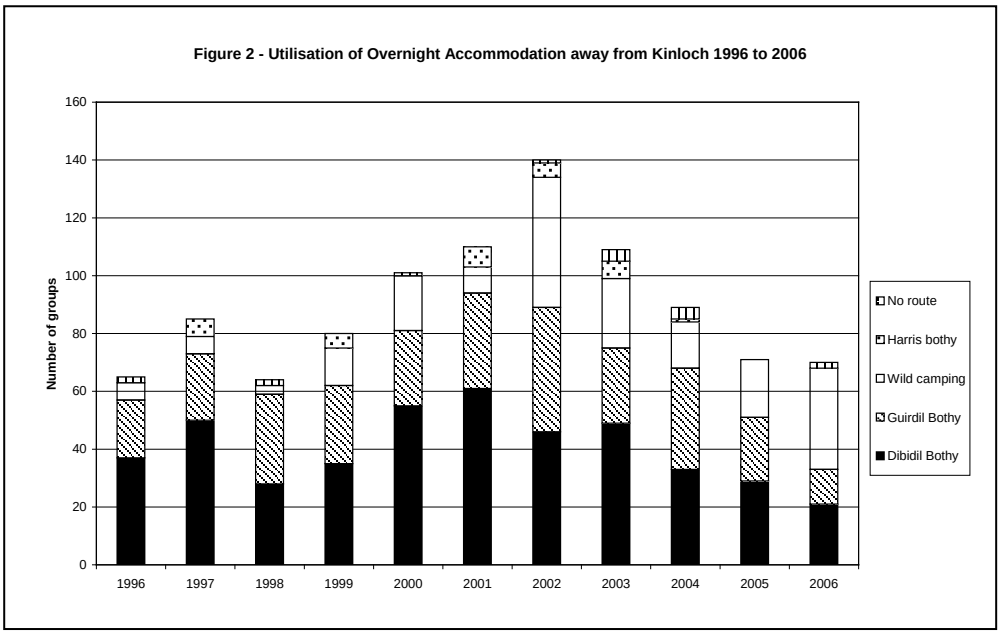
> 'Management decisions on repair priorities should take account of a wide range of other related criteria such as landscape impact, natural heritage sensitivity of use, recreational value and accessibility.'

Eleven years of data (1996 to 2006) derived from 4180 route cards were analysed representing 11074 walking days on the NNR. The data show that there is a general downwards trend in the number of people using the path network over the period (Figure 1).

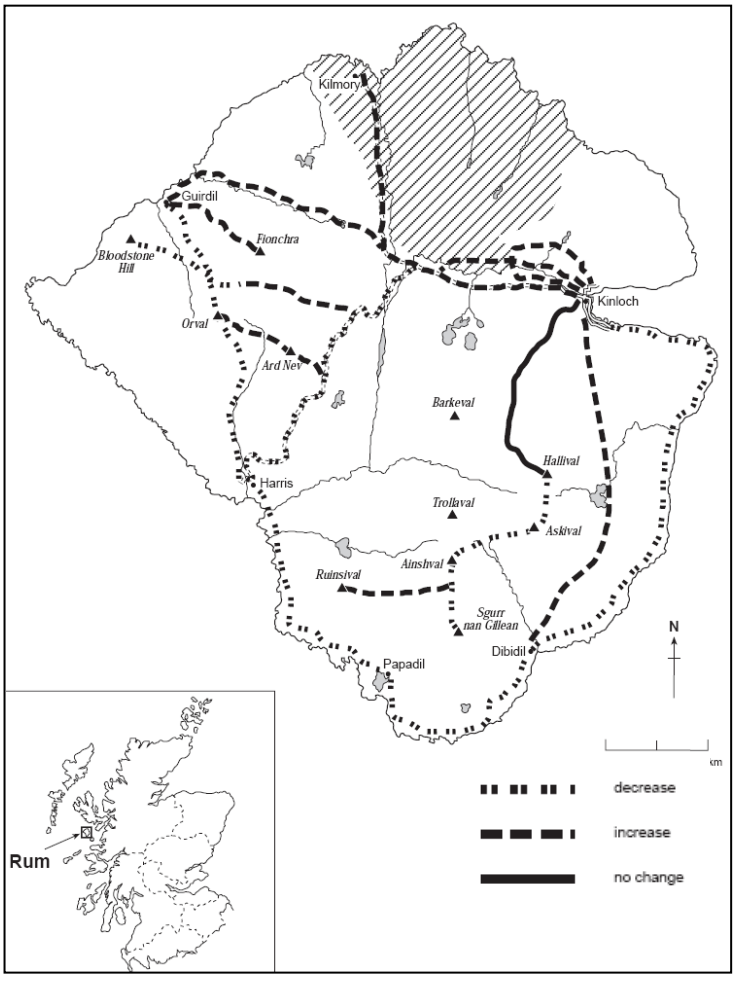
Figure 1 - Walker and Group Numbers 1996 to 2006



The most popular walking months are April and May with a secondary spike in October. Walking groups are made up of 1 or 2 people with large groups (of 10 or more) accounting for only 4% of walking parties. The number of hours walked per individual has increased over the last eleven years but most trips are under 24 hours. Dibidil Bothy is the most popular overnight accommodation away from Kinloch, but nights away from have reduced since 2000 (Figure 2).



Linear walking routes are by far the most popular activity. There has been a slight shift from linear to circular patterns, with part-circular route remaining static between 1996 and 2006. Detailed analysis of the actual routes walked identified 22 discrete path sections. Of these, three stood out as the most popular volumetrically: Coire Dubh, the Harris track to the Kilmory Junction and the Rum Cuillin traverse. The lowest volumes were those routes amongst the Western Fells. Location Quotients (a form of Gini Co-efficient) demonstrate that there has been an increase in the share of the route sections on the northern side of the island, to Guirdil, the Dibidil track and from Sgurr an Guillean/ Ainsval to Ruinsival (Figure 3). There has been a decline in popularity of the Cuillins traverse, but volumetrically it is still the most popular route on the island. The Coire Dubh track has remained static with respect to its popularity.



A Utilisation Index was developed by combining path popularity (volumetric use) and path share (location quotients). This allowed a management prioritisation of routes to be established as follows:

- **Group 1 Short Term Priority** – Harris Track to Kilmory Fork, Coire Dubh, the Kilmory Track, Pony track to Loch Coire nan Grunnd, Ruinsival spur on Cuillins traverse
- **Group 2 Medium term Priority** – Pony track from nan Grunnd to Dibidil, Glen Shelesder to Guirdil, Cuillins traverse, Malcolms Bridge to the Fionchra-Orval col, Malcolm bridge to Harris.
- **Group 3 Long term Priority** – Harris track from Kilmory fork to Malcolms Bridge, Ard Nev to Orval, Northern Side of Kinloch Glen, Dibidil to Papadil
- **Group 4 No maintenance** – Fionchra and Orval to Guirdil, Loch Scresort Trail, Fionchra –Orval col to Bloodstone Hill, the Kinloch Glen Nature trail, Dibidil via the coastal path, Harris via Glen Duian and Papadil to Harris.

Whilst this offers some form of path management prioritisation there are many factors that are not taken into account by the Utilisation Index, these include: the new 2008-2018 Management Plan Objectives, Reserve staff expertise, vehicular or stalking access needs, funding, emergency washouts and Limits of Acceptable Change (LAC).

LAC management is designed to identify acceptable thresholds or standards which if exceeded trigger management activity. It is suggested here that the development of environmental (ELAC) and social (SLAC) standards should form the next phase of this path investigation. The ELAC will draw on aspects of the terrain analysis research related to Cairngorm paths by Morrocco & Ballantyne (2008) focusing on NVC communities and varying lithologies. The SLAC will use a visitor perception approach based on VERP (Visitor Experience and Resource Protection) advocated by the US National Park Service (National Park Service, 1997).

Initial recommendations are:

- Maintain the rationing system of access through passive advertisement of the Rum experience.
- Experiment with subsoil inversion as a method of path management where soil type permits
- Channel funds into top tranche of popular walking routes
- Develop 'honeypot' routes underpinned by innovative visitor interpretation
- Continue to monitor use via route cards and path status regularly
- Develop a 'Limits of Acceptable Change' model for path management

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Morrocco SM & Ballantyne CK (2008) 'Footpath Morphology and terrain sensitivity on high plateaux: the Mamore Mountains, Western Highlands of Scotland.' *Earth Surface Processes and Landforms* Vol 33 p40 to 54

National Park Service (1997) '*VERP – The Visitor Experience and Resource Protection (VERP) Framework. A Handbook for Planners and Managers*.' US Dept of Interior: Denver Service Center

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Linking to other upland articles…

Below are links to a few recent relevant articles that are available via the internet.

A vision for the uplands?

Helen Armstrong and Mike Smith suggest that, to improve the productivity of the uplands, we should be planting more broad- leaved woodland. But, once established, how should we then make best use of these woodlands?

See the rest of the article in issue 43 of the Forest Research Ecotype *newsletter at*:
http://www.forestresearch.gov.uk/pdf/Ecotype43.pdf/$FILE/Ecotype43.pdf

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Protecting peat in the UK's uplands

More carbon is stored in Britain's soils than in the forests of France and Germany combined. Mark Reed discusses a new way to protect this valuable carbon reservoir.

Britain's wild and rugged moors, mountains and valleys - the uplands - are some of the country's poorest and most remote areas. But they could be a key to helping us meet carbon reduction targets. And the work needed to make it happen may even pay for itself.
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See the rest of the article in the Spring 2009 issue of the NERC Planet Earth *magazine at*:
http://www.nerc.ac.uk/publications/planetearth/2009/spring/

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Economic determinants of biodiversity change over a 400-year period in the Scottish uplands

Nick Hanley *et al* investigate whether economic factors are important in determining biodiversity change over the 'long run' – 400 years – for 11 upland sites in Scotland. Using a combination of palaeoecological, historical and economic methods to construct and then analyse a database of factors contributing to changes in plant diversity over time.

Using an instrumental variables panel model they find livestock prices, their proxy for grazing pressure, to be a statistically significant determinant of diversity change, with higher grazing pressures resulting in lower diversity values on average, although site abandonment is also found to result in a fall in plant diversity. Technological change, such as the introduction of new animal breeds, was not found to be a statistically significant determinant.

Using later period data (post 1860) on livestock numbers at the parish (local) level, they were able to confirm the main result noted above in terms of the effects of higher grazing pressures on plant diversity.

This study shows how data from very different disciplines can be combined to address questions relevant to contemporary conservation and understanding. This novel, interdisciplinary approach provides new insights into the role of economic factors as a driver of biodiversity loss in the uplands. Biodiversity levels have varied considerably over 400 years, partly as a function of land management, suggesting that establishing baselines or 'natural' target levels for biodiversity is likely to be problematic. Changes in livestock grazing pressures brought about by changes in prices had statistically significant effects on estimated plant diversity, as did land abandonment. This suggests that long-term management of upland areas for the conservation of diversity should focus on grazing pressures as a key policy attribute. Another policy implication is that drastic cuts in grazing pressures – such as might occur under current reforms of the Common Agricultural Policy – can have adverse biodiversity consequences.

See the rest of the article in the Journal of Applied Ecology *2008 45 15557-1565 at*:
http://www3.interscience.wiley.com/journal/121474303/issue

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Projects & Research

Nitrogen- friend or foe of Sphagnum mosses?

This Ph.D. study is one of three funded by SNH in 2006. My research is looking at the effects of increased nitrogen (N) deposition on *Sphagnum* mosses. Changes in the amount and/or condition of *Sphagnum* mosses in peatlands can lead to wholescale changes in peatland ecosystems and the functions they perform with respect to ecosystem services. Because Scotland has a relatively large proportion of the world's peatlands, especially blanket bogs, it is essential to know what possible effects enhanced N deposition could cause in Scotland. Based on my results I hope to provide advice on conservation and management of bogs in Scotland regarding N deposition and *Sphagnum*.

The role of *Sphagnum* mosses in bogs
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Sphagnum mosses grow indefinitely from the capitulum, while decomposing from the lower parts at the same time. This growth habit together with the decomposition resistant nature of *Sphagnum* material and the characteristically high water tables associated with bogs leads to the formation of peat. Consequently, in total, *Sphagnum* mosses perhaps contain more carbon (C) than any other plant genus. *Sphagnum* mosses form a large portion of the vegetation in peatlands, especially in bogs, and thus play an extremely important role in the C balance of these ecosystems. Besides contributing to peat accumulation, *Sphagnum* mosses can influence their environment in many other ways. They have properties which they use to create nutrient poor, acidic conditions that favour themselves at the expense of other vegetation (Table 1.Van Breemen 1995).

Property	Short-term benefit	Long-term benefit
Organochemical composition	Anti-herbivory action	Peat formation
Microstructural (hyaline cells)	Water conservation	Finely porous, impermeable peat
Macrostructural (pendent branches)	Capillary water supply	Collapses easily to dense peat
High nutrient retention	Efficient nutrient use	Low nutrient supply to vascular plants

Table 1. Specific properties of *Sphagnum* that increase its fitness in the short term and in the long term (through promoting peat formation) (according to Van Breemen 1995).

Peatlands are very nutrient poor environments; this is true especially in bogs because they receive nutrients only from rain water. A large proportion of the nutrients are 'locked up' in the peat and not available for plant use. In general, bog species, and especially *Sphagnum* mosses, are well adapted to these conditions and they have low physiological tolerance for higher N conditions. In the nutrient poor conditions *Sphagnum* mosses are able to take up most of the N that is deposited in rain, making it unavailable for vascular plants. Therefore, bogs often have a low cover of vascular plants with *Sphagnum* species forming the bulk of living and dead biomass.

N deposition and its effects on *Sphagnum*

Photo 1. Whim

In recent years N deposition from anthropogenic sources, e.g. vehicles, agriculture and industry, has become an increasing problem for semi-natural ecosystems which have evolved to succeed under N limited conditions and may be contributing to the degradation of bogs. This is because with increasing amount of N available more N becomes available to vascular plants which can outgrow and suppress *Sphagnum*. Too much N can even be toxic to *Sphagnum* mosses and cause changes in their functioning. For bogs in the UK the Critical Load, above which significant effects start occurring, has been estimated to be 5-10kg ha^{-1} y^{-1}. The average annual N deposition in Britain has been estimated at 17 kg ha^{-1} y^{-1} being highest in the central England and lowest in northern Scotland. The average N deposition is not equally divided and high rainfall areas receive more N than drier areas. Almost by definition, most blanket bogs in the UK are situated in these rainy areas so many receive higher N deposition than the estimated critical load. The questions that follow from this are what is this extra N doing to bogs and how can we detect it?

The results from previous studies on the effects of N on *Sphagnum* are not very clear. In the short term and with low N doses, growth and productivity seems to increase but in the longer term, probably in response to the cumulative N load, and with high doses growth and productivity possibly decrease. The effect also depends on the background deposition of the area where the study has been done; i.e. in areas with very low N deposition there is usually an initial increase in the productivity but in high N deposition areas this is not usually the case. It is generally presumed that N increases decomposition as usually N is the limiting nutrient in these ecosystems. However,

this is not necessarily so as N might also affect the different species in a different way and also change the vegetation composition of peatlands. In some studies contradicting data, i.e. decreasing decomposition with increasing N, has been found lately. In general, most N deposition studies have been done on a short time-scale and N has been added by hand only few times during the experiment. There is a lack of long-term data that will be more realistic in terms of what might happen in the real world.

Experiments

My study is being carried out mainly at Whim bog in the Scottish Borders, where N deposition has been manipulated since 2002. Here the effects of different forms of N are being studied. Ammonium and nitrate are added with doses of 8, 24 and 56 kg ha^{-1} y^{-1}on top of the background deposition (8 kg ha^{-1} y^{-1}). There are also plots with N load of 8 kg ha^{-1} $y^{-1}$and 56 kg ha^{-1} y^{-1} where P and K are added with N. In total there are 44 study plots. The advantage in this experiment is that N is added with rainwater during real rain events. This mimics the natural wet N deposition better than previous studies. I chose *S. capillifolium* as my study species because it is abundant both at Whim and in Scotland in general and I could find it at all the study plots. During the last two years I have been measuring many attributes of *Sphagnum* which N might affect: growth and productivity, the decomposition rates, CO2 fluxes, nutrients in the moss material etc. I shall also be doing some microbial work on the decomposing litter to see if there are changes in the microbial community between treatments.

Photo 3. Whim

Preliminary results

To date, I have found that increasing the load of N decreases growth; ammonium seems to have a larger impact than nitrate. This means less C being captured in the moss and less peat being formed. Because the reduction can be found already in the smallest dose, this is an indication that *Sphagnum* mosses are probably affected also in Scotland although the deposition is low. Adding P and K with N seems to alleviate the effects of N. However, the fertilising effect of P and K also increases the growth of competitive species, so it does not mitigate the problem, but rather changes the stress. Although adding P and K can not be used as a management tool in large scale it might offer a tool in very small scale management, for example preserving a threatened *Sphagnum* species.

Decomposition, i.e. loss of mass, is also reduced by N, which could lead to an overall increase in peat accumulation although the opposite would have been expected based on most previous experiments. We hope that the microbial analysis of the litter will give some answers to this dilemma. In general, this means that the slowed down decomposition could compensate the decreased growth and thus the C balance may not be affected. However, preliminary results on my CO^2 measurements show loss of C from the *Sphagnum* stands and based on this, it seems that the decreased decomposition does not compensate for all the other problems caused by increased N.

At the moment I am very much in the middle of analysing the results and the time will tell what the overall effects are. My thesis should be ready this autumn (2009) when the final words of wisdom can be said.

References: Van Breemen, N. 1995. How *sphagnum* bogs down other plants. TREE 10:270-275

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Reintroduction of Woolly Willow and the Species Action Framework

Background

Woolly Willow *Salix lanata* is a UK BAP species with Steering Group members drawn from the National Trust for Scotland, Scottish Natural Heritage, Royal Botanic Garden Edinburgh and independent individuals. This Vulnerable willow is one of SNH's Species Action Framework (SAF) species. Twenty-two species were selected to receive additional funding which would provide targeted action to increase range or population size. Woolly Willow has already been included in investigations by the Scottish Montane Willow Research group, a collaboration between the RBGE, the Macaulay Institute, the Scottish Agriculture College, the Scottish Crop Research Institute, the University of Aberdeen and the University of Edinburgh looking at ecology of montane willows, clone size, fungal associates, genetic variation and hybridization. This provided a wide-ranging amount of background research to inform the five-year SAF project and gave further impetus to the Steering Group plans to supplement and extend several sites of Woolly Willow in the Scottish Highlands. Woolly Willow is now restricted to only thirteen montane sites in Scotland. Seven of these sites have fewer than 100 plants, some have considerably fewer. They are vulnerable to grazing and other factors and there is a danger of losing these smaller remnants. In some sub-populations there are insufficient numbers of male and female plants to ensure pollination and seed production. Some augmentation and re-introductions of several montane willows has already been carried out and a good example of this is the work by the National Trust for Scotland on Ben Lawers where substantial progress with several species can be seen after twenty years of sustained effort.

The project which will receive the first planting in 2009 is in Corrie Sharroch at the head of Glen Clova, north of Dundee. This is part of the Corrie Fee NNR has been protected by a deer fence for some years although there have been problems with fence maintenance, roe deer, resident mountain hares and a healthy vole population. The existing willows are mostly growing on the less accessible cliffs and the well-vegetated slopes of the Corrie do not appear to offer many sites for seed establishment. The intention is to extend montane willow scrub down into the corrie where the associated vegetation is already growing.

Reintroductions

No plants should be introduced without careful planning. A re-introduction or supplementation should be conducted with reference to the guidelines provided by the IUCN so that responsible decisions are made. One of the first considerations is where the plants are to be sourced. It is generally accepted that they should come from the nearest population which will be best adapted for that area. For purposes of ensuring sufficient genetic variation it was decided that a minimum of 30 parent plants should be used. Ideally the progeny should be grown from seed which would provide more variation, but some cuttings could supplement the numbers. In Corrie Sharroch there were many parent plants so there was no difficulty in finding sufficient sources. By the end of 2008 collections from 50 separate plants had been made and successfully grown, although the numbers varied from one or two cuttings to hundreds of seedlings from separate parent plants. Seed was collected in 2007 but there was poor seed-set in 2008 so cuttings were collected to add to the numbers. Willow seed is not the easiest to collect as it is green and therefore only viable for a short period. In montane locations, visits are necessarily made at intervals and the seed might be immature on one visit but completely shed two weeks later. The seed is equipped with a fluffy 'parachute' consisting of an inner ring of hairs that clasp the seed and an outer ring of hairs that catch the wind. These hairs have to be removed before sowing to minimize mould, maximize contact with the growing medium and prevent problems of seed clumping. The inner ring responds to moisture but it was found that the seeds could be released by rapid stirring with a pen.

A further complication at this site was the decision to plant a community rather than single species and although priority in collection was given to the Woolly Willow, seed and cuttings were also collected from Downy Willow *Salix lapponum* and Dark-leaved Willow *S. myrsinifolia*, with more yet to be gathered. As a guide number at this site it is planned to plant at least 250 of each species which will allow for some mortalities and still make a significant contribution to the total numbers present. Sites will be carefully chosen and marked for the planters. None will be planted within existing areas of willow and the locations of other 'special' flowering plants will be avoided. The

local Botanical Society of the British Isles Recorder will give advice and be involved in site selection. The aim is to plant intermixed clumps of the three species, each in genetically mixed groups. This will extend the scrub off the crags onto the upper slopes of the corrie. It is interesting that in traversing the corrie occasional Downy Willow have been found right down on the floor, indicating that the higher altitude might not be essential for survival, merely as a refuge from grazing. The populations on the crags are nevertheless at the lowest altitude of all the Scottish Woolly Willow sites with the exception of one other very small site, and this is the second largest site.

The planting will be done by collaboration between horticultural staff from the RBGE and teams of volunteers. This will be part of the SNH/RBGE partnership in the Plants and People Project which aims to engage people in plant-related projects. Opportunities are given through courses at the RBGE and in other locations to learn about plant identification and plant communities, and then to use this knowledge in practical conservation. Students at the RBGE have learnt about conservation issues for montane willows and have helped in the propagation of the many plants that are required. This project will involve planting over several years and monitoring for a longer period. There is scope for continued participation as this project develops.

The project might extend to further planting of appropriate species down the slope. At lower levels there could be more Dark-leaved Willow following the line of the stream, with the commoner Eared Willow *S. aurita* and patches of birch, all sourced from the surrounding neighbourhood. Once the shrubs become established their canopy would thin the dense ground vegetation and allow a greater variety of species to grow. The local seed sources are not abundant but by germinating the seed in cultivation, the local species are given the opportunity to grow. Once returned to the site as strong young plants they should establish new scrub woodland faster than if left to regenerate ‘naturally’ in an area which human management has already highly modified so that there are few seed germination sites.

Causes of decline

There are probably several reasons why Woolly Willow has declined. Extensive grazing will have progressively restricted the plants to less-accessible areas which are probably not the preferred habitat but a last refuge. Once populations become fragmented this brings problems with pollination and increased vulnerability to events such as rock-falls. A very small sub-population might not have the resources to recolonise. Of the thousands of seeds produced only a few have the chance to grow and there is probably a threshold for effective seed production which these small populations have fallen below. An extreme example of a plant with nowhere to go is seen in a single female plant at Glas Tulaichean, west of Glen Shee. The same situation occurred on Ben Lawers and Meall nan Tarmachan. All of these plants have been supplemented by additional male and female plants from the nearest local sites. The unfenced Glas Tulaichean site, e.g. received 28 young plants in 1999, of which seven had survived in 2007. The surviving plants were very short, growing flat along the ground, and help to illustrate several points. Their prostrate growth might be due to grazing from large animals eating the shoot tips, or could be caused by voles nibbling the bark. Voles tend not to eat the underside of a twig so if that side is undamaged, new growth will come from below, but always be directed sideways. Another possibility is that prostrate growth is encouraged by a reduced depth of snow cover as prostrate shoots would be protected for a longer period and taller shoots become more vulnerable.

The importance of snow

Climate change might be the biggest single factor affecting decline. While cultivated plants of Woolly Willow grow well at lower altitudes, at higher levels there is benefit in the protection of a covering of snow persisting into the spring. The snow provides an even temperature, around zero, and also protects from grazing and from abrasion by wind-blown ice-crystals. The original large female plant as Glas Tulaichean is now smaller and grows in a more prostrate manner and is probably demonstrating the effects of climate change as it grows on a relatively inaccessible ledge. There is clearly a balance to be struck as snow beds that persist too late into the summer would inhibit growth. In the large population at Corrie Sharroch it might be expected that new young plants could colonize into areas that previously had an excessive depth of snow, but natural regeneration still appears to be very slow, and that is why this project is designed to make up for

the lack of sufficient seed production to colonize the few sites suitable for seed germination. The new planting is designed to experiment with a range of sites, some lower in less exposed areas, others higher where there is still some snow cover. This should give a greater chance of suitable sites being chosen before it is too late to respond. If nothing is done it is likely we will continue to observe a slow decline into extinction.

Other sites for re-planting are also being planned but with the intention of concentrating on Woolly Willow. In areas where there are fewer than 30 plants in fragmented populations it has been decided to augment the population with additional plants from other sites. This will promote outcrossing, rather than propagating from the limited number of local plants where several may be inaccessible for seed collection. Efforts are to be concentrated on areas where the deer population has been substantially reduced. It would not be practicable and also very expensive, to fence these difficult areas. In other sites the planting might be restricted to inaccessible ledges, using ropes for access, to close gaps across the population. This will provide populations better able to reproduce, to colonize into the most appropriate areas and be self-sustaining.

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Biodiversity change in the Irish Uplands (BioUp)

The BioUp Project in Southern Ireland

The semi-natural landscape of the uplands has been managed through low intensity grazing and rotational burning for centuries. This gave way to the headage payment era which maintained stock numbers at higher than normal market levels and thus encouraged over-grazing. Now however the introduction of the Single Farm Payment (SFP) has resulted in under-grazing and in some cases even abandonment. By decoupling subsidies from production, hill sheep numbers have fallen so far that it is scrub encroachment which now threatens upland systems.

The BioUp project is an interdisciplinary initiative set up by the departments of Geography and Zoology, Ecology and Plant Science (ZEPS) in University College Cork and is funded by Science Foundation Ireland (SFI). Working on this project are two PhD students and four co-investigators. By integrating both ecological and socio-economic data and by applying empirical and theoretical approaches we hope to provide a comprehensive view of management in the uplands of Ireland. By involving farmers, agricultural advisory groups, land owners, conservation groups, forestry, and local authorities we hope to develop a framework for the monitoring, evaluation and modelling of the biodiversity status of the Irish uplands under different land management scenarios.

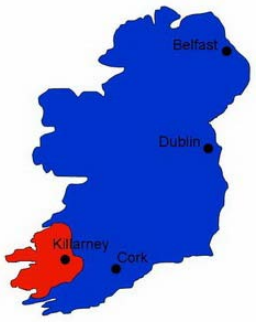

Figure 1. Map of Ireland showing Co. Kerry in red

Figure 2. Showing Inveragh Peninsula showing four main study sites, each containing three farms of varying grazing intensity

Methodology

The research is being conducted over a period of three years (2006 - 2009) on the Iveragh Peninsula, County Kerry (see Figs. 1 & 2), where four main study regions have been selected based on their potential for continuation in extensive hill farming. Within each of these regions, three hill farms have been chosen that are currently subject to grazing management regimes of varying intensity. From a further nine farms, sub-sets of data have also been collected. Almost all
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twenty-one farms reach altitudes of between 400 and 800m, although total farm areas are generally less than 250ha.

Allocating a level of grazing intensity or 'state' to each farm was innately difficult as most farms generally consist of some areas which are over-grazed, some which are under-grazed and others which may be in a sustainable condition. However after an initial farm visit, all habitats were mapped using Fossitt's (2000) 'A Guide to Habitats in Ireland.' The four largest were selected and, using habitat-specific criteria, based on MacDonald et al's (1998) 'A guide to upland habitats: surveying land management impacts,' a grazing impact level (high, moderate or low) was attributed to each habitat and an overall state (over-grazed, under-grazed or sustainably grazed) assigned to each farm. Using quadrat sampling, general grazing impact factors such as percentage of litter or dunging and habitat-specific impact factors such as extent of *Calluna* versus *Erica spp*. in blanket bog, for example, were examined. Frequency plots of grazing impact factors were created for each farm and if, for example, over fifty percent were classified as 'high' the farm in question would be assigned as 'over-grazed,' and likewise for low impact factors (under-grazed) and moderate impact factors (sustainably grazed).

Photo 1. Bridia Vallev. Photo bv Roz

The gathering of bird, invertebrate and plant species data provided an overview of some of the biodiversity elements present within each grazing intensity 'state'. Plant species composition and vegetation structure were recorded and a biomass sample collected and sorted to provide a measure of primary productivity. Secondary production was measured using pitfall traps to collect all ground dwelling invertebrates, specifically carabids which are sensitive to vegetation management. Birds were surveyed during the breeding seasons of 2007 and 2008. Commencing an hour after dawn, all bird species observed and/or heard and their estimated distance to the observer were recorded. Five 200m transects in the uplands and five in the lowlands were covered per farm. Each farm was surveyed twice, the first to record resident birds and the second to incorporate migrant species later in the year.

Alongside the ecological data, 45 interviews were conducted with farmers, farm advisors, conservationists, and representatives of the tourism industry as well as a detailed farm management survey to assess 80 farm households, two stakeholder meetings and a farm walk.

Photo 2. The Kells, looking to Macgillycuddy's Reeks. Photo by Roz Anderson

Ecological Data – findings so far

The environmental implications of over-grazing and under-grazing are serious and well documented and it is widely accepted that low-intensity grazing can act as a viable conservation tool for upland areas by maintaining biodiversity, nutrient cycling and productivity. Heterogeneity in vegetation structure and composition provides a diverse mosaic of habitats suitable to support a great variety of species, many of which play a vital role in upland food webs.

Preliminary data analysis from the BioUp study has shown that altitude, as expected, has a significant effect upon bird species richness, density and diversity. Significant differences in bird species richness and diversity were found between over-grazed and under-grazed sites for the 2007 and 2008 data, whilst density was also affected in 2008. Significant differences were also found in bird species richness and diversity between over-grazed and sustainably grazed sites in 2008. One question that springs to mind, however, is why do we not see the same effect on

evenness? Do habitats absorb effects of new species entering a system? Are many species using the same resources and no one species is dominating – perhaps functional trait analysis will hold the key? Could landscape features such as hedges and ditches be having more of an effect than grazing management *per se*?

A preliminary examination of the individual bird species data shows meadow pipit and skylark densities to be higher on sustainably grazed than over-grazed farms when altitude was taken into account. Wren density, however, was only found to be higher on under-grazed than over-grazed farms when altitude was excluded as an interaction factor, suggesting perhaps that wrens are equally abundant in the uplands and lowlands. The number of grazing ewes showed a significant effect with sustainable farms exhibiting higher bird diversity than overgrazed, stocking rate itself, however, had no effect.

Dwarf shrubs showed a decrease in biomass from under-grazed to sustainably grazed to over-grazed farms. Gorse was generally only detected on under-grazed farms and it also appears that on over-grazed farms upland and lowland blanket bogs provided the greatest biomass, suggesting sheep were avoiding grazing the bogs.

Socio-Economic Data – findings so far

Farming in the uplands is often synonymous with low income. Land managers are forced to employ unsustainable management practices that degrade natural resources and decrease livestock productivity, leading to even further loss in income. Traditional farming is seen as key to the economic stability, social cohesion and ecological integrity of upland landscapes, it is therefore vital that a balance is struck between these issues. Herein lies the challenges to policy design. The Kerry uplands are increasingly recognised as an important High Nature Value farming landscape with a rich plant and animal life. Farmers play a pivotal role in both quality food production and countryside management, but must also adapt to changing times. Formulating the transition from 'less favoured' agricultural regions to 'highly valued' environmental landscapes is central to this process. This study found that seventy-six percent of the farmers surveyed had significantly reduced their stocking levels since the implementation of the SFP in 2005 and more than half of the participating households had actually noticed a sharp increase in the presence of scrub and unpalatable grasses on their hills since then.

Multifunctionality refers to the different outputs a farmer's activities may have, such as quality food production or environmental conservation. Potential activities for farmers in disadvantaged areas may be agri-tourism, the development of niche markets for high value food products or the provision of environmental services. Given the area's spectacular scenery and well developed tourist industry, it would appear that the Iveragh peninsula is well placed to tap into multifunctionality. However the vast majority of farmers and their spouses in this study have opted for off-farm work as opposed to diversifying their income. On average, farming contributes 60 % to household incomes, indicating both the importance of the farm income, as well as the necessity for off-farm work. Only 17% had diversified into tourism-related services and less than 3% actually saw diversification as a viable option. In general farmers were reluctant to leave farming, however the survey results were equally balanced between those who were confident that the farm would stay in the family (most often passing to the son) and those who were unclear as to what the future would hold.

Summary

By applying both empirical and theoretical approaches, whilst analysing the socio-economic driving forces behind land-use change, BioUp will provide a comprehensive view of management in the uplands of Ireland. By sampling vegetation, invertebrates and birds as well as modelling the links between upland biodiversity, farming practices and socio-economic policy, a highly relevant management tool will be produced that will quantify the impact of land-use change, enhance biodiversity value and provide recommendations for future policies. Having characterised these linkages, we hope to be in a better position to define policy options which both enhance biological diversity and respond to the needs and aspirations of the people living and working in the uplands.

Further work will involve the use of classification and ordination methods to investigate how habitat structure and plant species composition as well as carabid diversity affect bird measures of

diversity, species richness, density and evenness. This will be incorporated into a GIS database and mixed effects models used to integrate the ecological and socio-economic data.

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UK Population Biology Network (UKPopNet) Pilot biodiversity research platform - Lake Vyrnwy

What is UKPopNet?

UKPopNet is a network of institutions founded by some of Britain's leading research Universities and funded by the Natural Environment Research Council and Natural England. UKPopNet's work focuses on two questions of pressing importance to science and society:

(i) How will biodiversity change affect the sustainability of ecosystems, landscapes, and livelihoods?
(ii) How can we mitigate those effects?

Background

In order to answer the above questions in an upland environment, UKPopNet established a pilot biodiversity research platform at RSPB's Lake Vyrnwy Reserve in Wales.

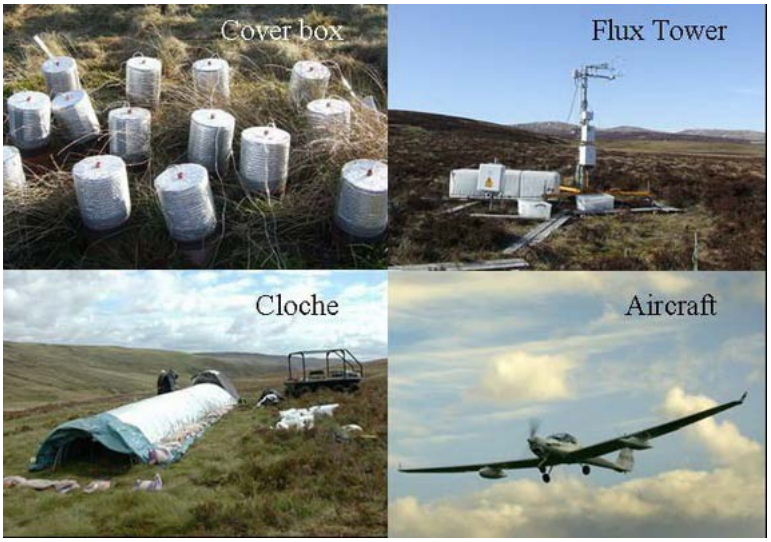

Photo 1. Gas flux measurement techniques used at various scales being employed at the Vyrnwy site. Photos by Andreas Heinemeyer, Matt Walker, Andy Lloyd & Tim Hill.

Upland areas are of vital importance for the delivery of many ecosystem services such as carbon storage, provision of potable water, flood risk mitigation and recreation. Changes in land management and climate will affect these services. There are several restoration schemes in the UK Uplands currently aiming to restore peat bogs to favourable condition using techniques such as the blocking of drainage ditches, tree and rhododendron removal and heather reseeding. However it can not be taken as a given that present restoration techniques will restore and secure the provision of all ecosystem services. Consequently there is a need for more rigorous scientific monitoring or assessment of restoration techniques and potentially unintended side-effects.

Current research

In 2006, the LIFE Active Blanket Bog Project in Wales Project was awarded five years of funding to restore significant areas of blanket bog in the Berwyn and Migneint Special Areas of Conservation from the EU LIFE-Nature programme (Wilson, 2007). This includes the blocking of more than 90 km of drains on the Lake Vyrnwy Reserve. We have been fortunate enough to be able to work closely with RSPB and the LIFE Project and its partners since 2007 conducting research at the site which to date has received approximately £1M in funding. The RSPB and Countryside Council for Wales agreed to the establishment of five pairs of experimental subcatchments across the site, each pair consisting of one catchment with all drains blocked and the other catchment with all drains left unblocked, allowing us to compare the impact of active restoration vs. no restoration. This set up is now one of the largest replicated terrestrial scientific experiments in Europe and is of great importance and relevance not only to the research community but to policy makers also.

Some of the projects being carried out include:

- Linking microbial biodiversity and trace gas fluxes at the landscape scale.
- Measuring microbial methane oxidation in peat soils in relation to vegetation cover.
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- Determining biophysical drivers of methane ebulltion (bubbling from seasonally flooded or waterlogged areas)
- Examining whether small-scale controlled experiments predict the impacts of landscape scale management changes.
- Modelling the relative importance of microclimate and land use to the biodiversity of spiders and ground beetles.
- Monitoring and modelling vegetation responses under catchment-scale treatment regimes using Earth Observation data
- Trialling airborne data gathering approaches at Lake Vyrnwy
- Scaling-up measurements from plots to catchments to regions

Carbon balance

A great deal of the work has been focussed on the carbon balance of the site because of the great importance of upland soils as a carbon store. Methane research is a particular interest because of its relatively high potency as a greenhouse gas and short lifespan in the atmosphere compared to carbon dioxide, making it a good target to reduce carbon emissions. Furthermore, raising the water table through drain blocking has the potential to increase methane emissions from the peat. Research is therefore being conducted to try and determine the controls on greenhouse gas emissions using state-of-the-art equipment to simultaneously measure gas fluxes at several different spatial scales, ranging from dinner plate- to landscape-scales. The eventual aim being to develop models that are able to predict impacts of upland restoration practices and climate change on carbon storage and green house gas emissions.

References: Wilson, J. (2007) *Breathing Life into Welsh Blanket Bog*. Looking to the Hills JNCC Newsletter 15: 19-20. http://www.jncc.gov.uk/page-1844

Contact: **Debbie Coldwell** UKPopNet Platforms Co-ordinator, Environment Department, University of York, Heslington, YO10 5DD
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For further information please see UKPopNet's website http://www.ukpopnet.org and LIFE Active Blanket Bog Project in Wales Project website http://www.blanketbogswales.org

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Tees Water Colour Project

In the March 2004 edition of *Looking to the Hills* (Issue 12), the article 'Holistic catchment management for the River Tees' described studies that Northumbrian Water Ltd (NWL) was doing to better understand the opportunities for managing the observed rising trend of dissolved organic carbon (colour) in the river Tees in a way that maximised the benefits to a broad range of stakeholders. Now, five years later, it's time to provide an update on how the Tees Water Colour Project has evolved.

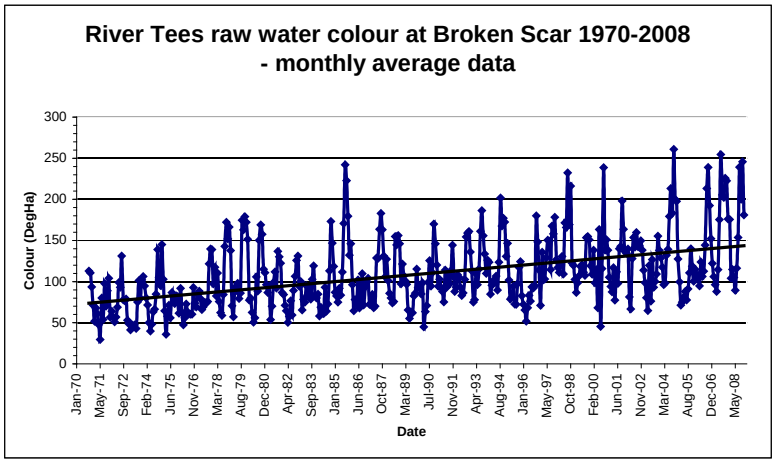

Figure 1. Monthly average water colour in the River Tees 1970 – 2008

The current project owes its origins to the recognition, in about 2000, of growing evidence of a long-term increase in colour in Tees river water. This trend continues to be apparent, as shown in data collected at NWL's Broken Scar water treatment works near Darlington (Figure 1).

Water colour is a natural phenomenon in streams and rivers originating in upland peat habitats, and research suggests it is affected by many factors, including changes in environmental pH, temperature,
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drought frequency and how the surrounding land is managed, for example by moorland drainage, grazing and burning. Removal of colour is a vital step in the treatment of potable water and represents one of the major operational costs of any water treatment plant.

NWL takes a source-to-tap approach to managing risks to drinking water quality. However, the company owns very little, if any, land around its upland reservoirs, so the management of these 'source' areas is in the control of others. NWL received approval from Ofwat to undertake a small pilot-scale project during 2005-2010 with two main aims: firstly, to investigate and demonstrate what it is realistic to achieve, in terms of water quality improvements, via working with and influencing land managers in upland catchments, without being the land-owner of the land in question; and secondly, to investigate and demonstrate the all-round benefits, in addition to water quality, that can be gained from taking a catchment-approach.

Since 2005, through the Tees Water Colour Project, we have:

- Worked directly with a landowner in Lunedale to fund and block 70kms of open moorland drains (grips), restoring over 100ha of SSSI blanket bog habitat (see Photo 1).
- Supported further grip blocking in the North Pennines through working in partnership with Natural England and the North Pennines AONB Partnership's Peatscapes Project.
- Funded a PhD research project to investigate the catchment scale hydrological impacts of the grip blocking in Lunedale and at the Natural England site.
- Undertaken botanical surveys at grip blocking and control sites to investigate any ecological response to grip blocking.
- Undertaken an investigation into the relationships between water colour and water treatment costs via a modelling exercise and extended this to consider the impacts of different future colour scenarios.
- Supported two MSc placements exploring various aspects of stakeholder engagement.
- Undertaken a survey of nearly 150 upland land managers in the North Pennines area, to better understand their perceptions of the costs, benefits, drivers and constraints relating to changing land management practice in the uplands.
- Supported the production of the Peatscapes Project's 'Land management and water colour' leaflet and their 'Peatlands Matters' Conference in September 2007. You can download the leaflet from: http://www.northpennines.org.uk/index.cfm?articleid=9416
- Started work on the development of a stakeholder engagement framework, to assess and critically evaluate the multiple costs and benefits associated with different possible models of stakeholder engagement on water quality and other 'catchment' issues.

As more of the current work streams come to a close over the coming months we will be producing reports, leaflets and updating our website with information - http://www.nwl.co.uk/Teeswatercolourproject.aspx

Subject to a favourable response from our regulators, we intend to continue this area of work through to 2015: extending the hydrological and ecological monitoring of the grip blocking sites, to create a valuable post-blocking, catchment scale dataset; continuing our support of the Peatscapes Project; increasing our engagement with catchment land managers and other stakeholders through the employment of a catchment officer; and participating in new landscape scale multi-objective partnerships that will benefit water quality, biodiversity, public access and build resilience to climate change.

Photo 1. Newly blocked grips at the site in Lunedale in March 200

Contact: **Claire Lorenc**, Northumbrian Water,
Email: claire.lorenc@nwl.co.uk Tel: 01245 212165

Managing upland heath to sequester carbon

The question

It is increasingly recognised that conservation management should promote not only biodiversity, but also other ecosystem services, including carbon sequestration. However, we do not have the knowledge base needed for the development of habitat management plans to increase carbon sink potential. I am beginning an SNH-funded PhD (with Dr Sarah Woodin, Dr Rebekka Artz, Dr Andrew Coupar and Dr Sarah Crowe as my supervisors) investigating the effects of upland heath management on carbon dynamics, comparing intact, degraded and restored heaths, to inform future developments in upland land management policy and practice.

Background

Highly organic soils are abundant across the UK particularly in Wales and Scotland. These soils contain huge quantities of stored carbon, and when they become degraded through bad management-practice and/or land-use changes they can lose their carbon sink capacity and act as a source of greenhouse gases (GHGs) to the atmosphere, enhancing climate change. Quite understandably research on the restoration of land to enhance carbon sequestration or to stop GHG emissions has primarily focused on deep-peat organic soils. However, the potential of other soils to sequester carbon needs to be considered. In Scotland, there are large areas of organo-mineral soils, (i.e. with an organic layer of less than 0.5m depth). Upland heath, dominated by dwarf shrubs particularly *Calluna vulgaris,* occurs on such organo-mineral soil. Upland heath is a cultural landscape which many rely on for a wealth of ecosystem services. It is primarily managed for red-grouse shooting and sheep/cattle grazing and thus held in a mid-successional phase.

Upland heath has undergone rapid declines due to afforestation, over-grazing and over-burning. These practices have led to increased cover of faster growing grass species in areas once dominated by dwarf shrubs. The current UK Biodiversity Action Plan (BAP) includes upland heath as a priority habitat and aims to maintain the current distribution in favourable condition and to restore the degraded resource to favourable condition.

Previous published work on restoration and management of heathland have quantified the success of restoration in terms of the vegetation or invertebrate communities, with these focusing on the percentage cover of *C.vulgaris*. To our knowledge the effect of restoring upland heath on its carbon sequestration potential has not been investigated. In fact, we do not even have basic understanding of how an intact, shrub dominated heathland compares to a ‘degraded’, grass dominated heath in terms of carbon storage and sink/source status.

An interesting potential approach to managing land to sequester carbon is to promote groups of plant species which are particularly efficient at assimilating CO_2 and converting it to stable (“recalcitrant”) forms of carbon within the soil. An obvious candidate for this is mosses, which are abundant throughout the understory of upland heath and form recalcitrant litter. Work on the role of mosses in restoring carbon sequestration has focused mainly on *Sphagnum* mosses in cutover peat; there has only been limited work on true mosses on upland heaths.

The PhD

I intend to compare CO_2 fluxes and carbon stores between degraded and intact upland heath in Scotland. I will also investigate how the carbon status of heathland which has been restored, by grazing exclusion or mechanical intervention, compares with ‘degraded’ and ‘intact’ heathlands, with the aim of determining whether heathland restoration is beneficial for carbon sequestration. I will investigate which functional group(s) of plants are most important for sequestering carbon, and specifically focus on the role of bryophytes in heathland carbon dynamics. An understanding of which species group(s) are desirable for enhancing carbon sequestration will be of practical relevance to management planning.

Do you know a suitable site?

I am on the lookout for suitable sites to use for my PhD. In particular, to study the effects of restoration I need upland heath sites in Scotland that include degraded, grassy areas, intact, shrub dominated areas and areas which have been or are being restored, all in close proximity of each

other. If you own or know of a site like this that might be suitable for me to take measurements on, please get in touch. Thank you.

Contact: **Sam Quin**, Plant & Soil Science, University of Aberdeen
Email: squin@abdn.ac.uk

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McVean & Ratcliffe re-visited: an update

The previous issue of Looking to the Hills (Issue 15) featured a re-visitation project based on the original 1950s vegetation data from the volume "*Plant Communities of the Scottish Highlands*" by Donald McVean and Derek Ratcliffe. Through re-sampling plots recorded fifty years ago, we can characterise and quantify changes in the vegetation and explore the links between environmental drivers and observed changes.

Following an intensive field season re-sampling key communities of the North-West Highlands in 2007, fieldwork in 2008 focussed on similar communities in the East Highlands and additional communities in the North-West. Comparing and contrasting the degree and direction of change in these two areas should give interesting insights into vegetation change under different climatic conditions and land management regimes. A methodology validation exercise has also been undertaken to investigate the spatial variation in the plant communities studied and critically evaluate the implications of this variation for our ability to detect historical changes with confidence.

One of the key communities re-sampled in the North-West Highlands was dwarf-shrub heath. Multivariate analysis indicated a pattern of homogenisation, where previously distinct heath communities have become more similar to each other in species composition. There have been significant declines in dwarf-shrub and lichen cover, and a very highly significant increase in graminoid cover. Increases in *Molinia caerulea*, *Nardus stricta*, *Trichophorum cespitosum* and *Luzula* species were particularly marked. This has led to the inception of a pot experiment aiming to assess the relative contributions of nitrogen, warming and grazing to the expansion of *Trichophorum*.

The majority of the field data have now been collected, and the next task is to collate data on variables including grazing pressure, burning history, temperature, rainfall, exposure and nitrogen deposition. This may be difficult as such data are often not available for exactly the time period in question or the location of the plots. However we hope to use such data, in parallel with the known ecology of the species which have changed in abundance, to infer the drivers of change in these upland communities. Ultimately, this could enable prediction of vegetation response to future drivers of change, informing both land management and policy development.

Acknowledgements: Thanks to many estates across the Highlands for site access, field assistants for their help and SNH staff especially Sally Johnson for discussions and providing contact details. Funding for Louise Ross's PhD project at the University of Aberdeen is provided by NERC and SNH.

Louise Ross[1], Sarah Woodin[1], Des Thompson[2], Alison Hester[3] and John Birks[4]
1.University of Aberdeen, 2.Scottish Natural Heritage, 3.Macaulay Institute,
4. University of Bergen and University College London

Contact: **Louise Ross**, Institute of Biological and Environmental Sciences, Cruickshank Building, University of Aberdeen, Aberdeen AB24 3UU.
Email louise.ross@abdn.ac.uk

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Accessing information on key upland projects from the web

There are so many interesting and valuable projects underway in the UK uplands that it can be difficult to remember which is which and who is doing what!

So in order to make access to information on key upland projects easier I am preparing a list with brief outlines and links to web pages. The aim is to bring together links to the various ongoing and recent projects together, and to make sure that projects that have been completed are not forgotten.

A prototype, which is still under development, is available on the JNCC Uplands web page at http://www.jncc.gov.uk/page-1436 (scroll down to ***Weblinks to some key UK upland projects*** to find the spreadsheet). Please let me know about any projects that I should add. The only requirement for a project to be added is that it has an upland interest and that there should be a web page that holds information on the project. I will update the list when I hear of new projects to add. Please email me with the web page URL of the project.

Contact: **Sally Johnson**
Email: sally.johnson@snh.gov.uk

Books and other resources

Drivers of Environmental Change in the uplands

Editored by Aletta Bonn, Tim Allott, Klaus Hubacek, Jon Stewart
List Price: £90.00 (20% discount £72.00 when using order form sent with this newsletter)
ISBN: 978-0-415-44779-9
Hardback 544 Pages
Published by: Routledge
Publication Date: 23/12/2008

This volume brings together a wealth of knowledge of the British uplands from diverse but interrelated fields of study, clearly demonstrating their importance in 21st Century Britain, and indicating how we may through interdisciplinary approaches meet the challenges provided by past and future drivers of environmental change.

The upland environments are subject to change. They face imminent threats as well as opportunities from pressures such as climate change, changes in land management and related changes in fire risk, increases in erosion and water colour, degradation of habitats, altered wildlife and recreational value, as well as significant changes in the economy of these marginal areas. This book presents up-to-date scientific background information, addresses policy related issues and lays out pressing land management questions. A number of world-class experts provide a review of cutting-edge natural and social science and an assessment of past, current and potential future management strategies, policies and other drivers of change. After appraisal of key concepts and principles, chapters provide specific examples and applications by focussing on UK upland areas and specifically the Peak District National Park as a key example for other highly valuable upland regions.

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Saxicolous Lichen and Bryophyte Communities in Upland Britain - JNCC Report 404

Alan Orange
Price £20: Paper copies 324 pages - available from NHBS http://www.nhbs.com/
Free PDF available from the JNCC website http://www.jncc.gov.uk/default.aspx?page=4759
Published by JNCC
Publication date: January 2009

Phytosociological data were collected to describe the terrestrial lichen and bryophyte vegetation of rock or saxicolous habitats within 14 Special Areas of Conservation (SAC) within upland Britain, with special reference to four saxicolous habitats listed in Annex I of the EU Habitats Directive. Additional data were available from other surveys within upland Britain, giving a total of 1539 relevés available for analysis. Data were analysed using TWINSPAN, combined with manual sorting. A total of 83 communities were distinguished, including 56 on siliceous rock and 27 on limestone. A description and floristic table is provided for each community, along with a key for the placement of individual relevés is provided. As is commonly experienced in phytosociological work, delimitation of communities was not straightforward; this was attributed to the existence of variation in composition of vegetation in response to many independent environmental variables, precluding a simple system of classification. Despite these problems, the classification proposed is a major advance on earlier phytosociological knowledge of the lower plant communities of the British uplands.
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The British uplands have two groups of lichen species of outstanding conservation interest: 1) species of western oceanic areas and 2) species of calcareous rock at high altitudes. The most characteristically oceanic of the communities delimited in the present study are SS E1 on siliceous rock and SL 15 on limestone. Samples from high altitude calcareous rocks were few in the present survey, but Community SS X1 from Eryri, the Ben Nevis range and Beinn Heasgarnich includes some examples. Most of the samples recorded were from treeless, grazed upland sites. A cessation of grazing in these areas would be a potential concern, likely to result in shading or engulfment of rocks by vascular plant vegetation or robust bryophytes. Recreational pressures are also known to be a potential threat in some upland habitats.

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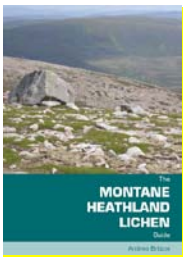
The Montane Heathland Lichen Guide



Andrea Britton

Price: £10.99 (P&P included) Order from http://www.macaulay.ac.uk/lichen/
Published by the Macaulay Institute
(Special reduced price for British Lichen Society and British Ecological Society Members: £8.99)

The Montane Heathland Lichen Guide' is a new field guide aimed at hill walkers, naturalists, field ecologists or anyone interested in learning more about the lichens to be found in mountain environments. The book covers everything you need to know to start looking at lichens in easy, non-technical language and covers all of the species that you are most likely to see in montane heath habitats.

Twenty seven of the most common or conspicuous species are fully illustrated with high quality photographs and another twenty four species are covered in the text with notes on how to identify them in the field and how to separate similar-looking species. The 50-page A5 size book is designed with outdoor use in mind and is printed in full colour throughout on tough waterproof paper.

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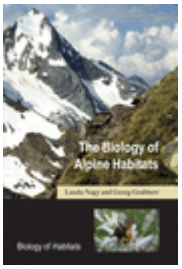
The Biology of Alpine Habitats

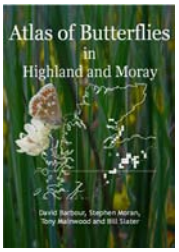


Laszlo Nagy and Georg Grabherr

Price: £27.50 (paper) (20% discount £22.00 when using order form sent with this newsletter)
Order from http://www.ljmu.ac.uk/NSP/NSP_Docs/Biology_of_Alpine_Habitats.pdf
ISBN: 978-0-19-856704-2
Published by: Oxford University Press
Publication date: 19 March 2009

This book is unique in providing a global overview of alpine (high mountain) habitats that occur above the natural (cold-limited) tree line, describing the factors that have shaped them over both ecological and evolutionary timescales. The broad geographic coverage helps synthesise common features whilst revealing differences in the world's major alpine systems from the Arctic to the Tropics. The words "barren" and "wasteland" have often been applied to describe landscapes beyond the treeline. However, a closer look reveals a large diversity of habitats, assemblages and individual taxa, largely connected to topographic diversity within individual alpine regions.
The book considers habitat-forming factors (landforms, energy and climate, hydrology, soils, and vegetation) individually, as well as their composite impacts on habitat characteristics. Evolution and population processes are examined in the context of the responsiveness / resilience of alpine habitats to global change. Finally, a critical assessment of the potential impacts of climate change, atmospheric pollutants and land use is made and related to the management and conservation options available for these unique habitats.

Atlas of Butterflies in Highland and Moray



Butterfly Conservation Highland Branch
A5, 76pp, £4 + £1 p&p.
(£3 + £1 p&p to Butterfly Conservation members)

Tony Mainwood, 13 Ben Bhraggie Drive, Golspie, Sutherland, KW10 6SX, Tel 01408 633247, email tony.mainwood@btinternet.com
Please enclose a cheque made payable to 'Butterfly Conservation Highland Branch' with your order.

This atlas, published in October 2008, documents the distribution of 30 species of butterflies in the period 1980 - 2007 in the area covered by Highland Branch of Butterfly Conservation. It presents a snapshot of our current knowledge and a baseline for studying changes and trends in the future.

Individual species accounts give notes on general status and distribution together with population trends, habitat, flight period, larval foodplants, appearance and behaviour. A chapter describes and maps the range-expansion of four species during the recent period.

A collection of photographs shows the attractiveness of many of our resident butterflies as well as giving an indication of the differences between some of the species that can be tricky to tell apart at first sight.

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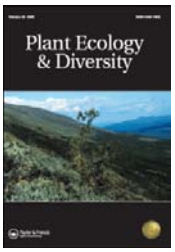

New journal - Plant Ecology & Diversity

Previously published as Botanical Journal of Scotland
Increasing to 3 issues per year from 2009
Subscription form online at
http://www.informaworld.com/smpp/title~content=t793409773~tab=subscribe~db=all

Plant Ecology and Diversity is an international journal and the new forum of the Botanical Society of Scotland for communicating results and ideas in plant science. All areas of plant biology relating to ecology, evolution and diversity are of interest, including those which explicitly deal with today's highly topical themes, such as biodiversity, conservation and global change. Submissions concerning cold environments world-wide are particularly welcome. Plant Ecology and Diversity considers for publication original research articles, short communications, reviews, and scientific correspondence that explore thought provoking ideas. Unique to Plant Ecology and Diversity is its Scottish section, publishing contributions on aspects of botany and plant ecology particular to Scotland. The journal is open to reporting 'negative results' and 'repeat experiments' that test ecological theories experimentally, in theoretically flawless and methodologically sound papers.

Call for Papers - The Editor welcomes original research papers on all aspects of plant biological science. Manuscripts should be submitted to the Editor at laszlonagy@btinternet.com

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Natural Economy Northwest - The Economic Value of Green Infrastructure

Natural Economy Northwest (NENW) is a regional partnership programme led by Natural England on behalf of a wide cross-sectoral partnership to deliver priority action 113 in the Regional Economic Strategy.

At the heart of the NENW's ethos is the vision for a prosperous economic future with a thriving natural environment for the Northwest. The focus of the programme is to maximise the economic benefit from existing and new investment in the natural environment.

Investment in the environmental economy, of which the natural environment is a significant component, contributes to economic prosperity through 109,000 jobs and £2.6 billion Gross Value Added to the region's economy.

The NENW website provides a range of resources, information and reports on the Economic Value of Green Infrastructure www.naturaleconomynorthwest.co.uk.

Contact: **Will Williams** Natural England, Natural Economy Northwest Programme Director
Email: Will.Williams@naturalengland.org.uk

Conferences and other events

The sixth Moors for the Future conference 'Living Upland Landscapes'

Held during the 24 and 25th November 2008 at Losehill Hall. This years conference reported on the wide range of research Moors for the Future are involved and also covered a wide range of upland ecosystem service challenges facing both the Peak District the wider UK moorlands.

Moors for the Future set a great example in use of multi media. The talks from this conference are available as both Powerpoint PDFs and MP3 files and so can be listen to while viewing the slides on their webpage at www.moorsforthefuture.org.uk.

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Learn about recording birds in the uplands

The Bird Atlas 2007-11 is an ambitious project being undertaken at the moment, and for the next three years, to try and map all bird species across the UK and Ireland. The project is being run by The British Trust for Ornithology, The Scottish Ornithologists Club and BirdWatch Ireland and depends on thousands of people taking part, by telling us what birds they have seen and where. The response so far has been fantastic but there is still a long way to go.

We especially need records from the uplands. We need to fill in the gaps in our coverage, so that we can get the full picture of where our birds are, as this is the basis for their conservation. At this early stage it looks like some upland species such as whinchat and ring ouzel have seen their ranges contract since the last Atlas 20 years ago, but with only limited coverage of upland areas so far this might not be the full story.

If you are a walker, a climber, an estate-worker, a land-owner, a farmer or anyone else that is regularly in the uplands, please consider giving us your bird records. You don't have to be an experienced birdwatcher to take part. Just give us records of the birds you do know. For example you may know red grouse, ptarmigan, golden plover or raven. All records of all kinds of birds are important.

If you would like to take part but have little or no experience of bird surveys, you may want to come along to a "bird survey taster day". We have a programme of events running in 2009. (See www.bto.org/regional/bto_scotland/bbms for details).

If you would like further details about this, or any other course, please contact Robin Anderson at BTO Scotland: 01786 466560 or robin.anderson@bto.org. Courses are being run as part of the *Building Bird Monitoring in Scotland* project funded by SNH, The Gillman Trusts, BTO and SOC. For further details about the Atlas, and how to submit your records either online or on paper go to www.birdatlas.net

STOP PRESS Job vacancy:

Uplands Knowledge Exchange Officer Ref no 215026 - University of Leeds

University Grade 7 (£29,704 - £35,469 p.a.) Full time fixed term for 12 months.

Researcher with an interest in knowledge exchange and science-policy dialogue to work with a dynamic interdisciplinary team disseminating research findings to upland stakeholders. This ESRC funded post is to commence 1 August 2009. Closing date for applications 13th July 2009.

Further details: http://hr.leeds.ac.uk/jobs/. Informal enquiries may be made to Professor Joseph Holden, email j.holden@leeds.ac.uk, tel +44 (0)113 3433317 or Dr Mark Reed, email m.reed@abdn.ac.uk, tel +44 (0)753 8082343
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Uplands Staff across the Country Conservation Agencies

JOINT NATURE CONSERVATION COMMITTEE

Des Thompson – Chair of JNCC ULCN, Policy and Advice Manager responsible for the SNH Research and Development Programme, UK upland conservation issues (Principal Uplands Adviser), alpine and raptor management issues. Edinburgh.
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Cyngor Cefn Gwlad Cymru Countryside Council for Wales

Barbara Jones - Upland Ecologist. Lead officer for all generic upland conservation science issues for CCW including agricultural and overgrazing management issues. Upland grassland; rock habitats; tall herb ledge; montane. Bangor.
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Peter Jones - Peatland ecologist for all upland and lowland habitats, blanket bog, fens and lowland raised bogs. Conservation evaluation, ecology, management, hydrological and monitoring advice. Bangor.
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Jan Sherry – Heathland ecologist for upland and lowland heath. Conservation evaluation, ecology, management and monitoring advice. Bangor.
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NATURAL ENGLAND

Mick Rebane - Head of Uplands Unit; Manager of Uplands Unit, responsible for the specialist service provided by the unit and national overview of all upland matters. Lead within Natural England on overgrazing policy issues. Chair of Natural England's Upland Focus Group. Peterborough.
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Alistair Crowle – Upland Specialist, Biodiversity Team, Provides advice in relation to land management, site protection, biodiversity and condition assessment in the English uplands and commissions research and projects to support these areas of work. Peterborough.
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David Glaves - Senior Specialist - Upland Ecology. Lead on agri-environment, including scheme development and implementation, research and monitoring, and input to overgrazing cross compliance. Exeter.
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☏ 0300 060 0164

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NIEA Northern Ireland Environment Agency
www.ni-environment.gov.uk

Paul Corbett - Habitat Survey Team Leader; responsible for co-ordinating the survey and assessment of terrestrial habitats in NI, with the main aim of completing the declaration of Areas of Special Scientific Interest. (the NI equivalents of SSSIs; the NI programme of site designation lags well behind the rest of the UK); representing NIEA on the Uplands Lead Co-ordination Network. Belfast.
E-mail: paul.corbett@doeni.gov.uk
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Bobbie Hamill - Responsible for survey and condition assessment of blanket bogs. Belfast.
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Richard Weyl - Biodiversity Unit. Head of a team responsible for the preparation, co-ordination and delivery of selected Northern Ireland biodiversity habitat and species action plans. Currently co-ordinating a review of the list of priority species for Northern Ireland. Belfast.
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Martin Bradley - Biodiversity Unit. Leads on the preparation, co-ordination and delivery of selected Northern Ireland biodiversity habitat and species action plans, particularly relating to peatlands & uplands. Co-ordinates BAP Reporting in NI and represents NIEA on the UK BARS Advisory Group. Belfast.
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Scottish Natural Heritage
All of nature for all of Scotland

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ULCN visiting the Langholm Moor Demonstration Project to advise on habitat management. Above: Discussing burning management with the project staff (Photo Sally Johnson). Right above: Andew Coupar and Sally Johnson. Right below: Martyn Howat and Richard Saunders (Photos by Des Thompson).

A big thank you to all of you who have contributed to this issue.
We welcome any comments or views on this issue, or contributions for future issues.

Please contact our editor:
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Further information on upland and other habitats, as well as cross-cutting issues such as air pollution, climate change and soils, and the Lead Co-ordination Networks can be found on the JNCC website at: http://www.jncc.gov.uk/page-2. Follow the links in the left-hand list. A wide range of publications and other resources can be found under the various links. Newsletters (including the pdf version of this with coloured photos) are available at http://www.jncc.gov.uk/page-1844.
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