

## EA-QUEST Uplands Workshop

### Knowledge Map

<p><b>Molly Anderson</b> Environment Agency</p>	<p><b>Projects:</b> see other EA people.</p> <p><b>Background:</b> Climate change science programme manager.</p>
<p><b>Sean Burke</b> Environment Agency</p>	<p><b>Projects:</b> Proactive Agricultural Runoff Management and Mitigation. Project valuing services - methodology could be used and framework built on. Macaulay and EA have erosion risk maps. Climate impacts and other drivers on upland changes (CEH/Macaulay/ECOSSE) experimental and monitoring work. EARWIG: Environment Agency Rainfall and Weather Impacts Generator – model developed by Newcastle University Cost benefit analysis of different projects on nitrate management and cost effectiveness.</p> <p><b>Background:</b> Surface and ground waters, diffuse surface and groundwater pollution, land use changes and their cost effectiveness.</p>
<p><b>Aletta Bonn</b> Moors for the Future Partnership</p>	<p><b>Projects:</b> Establishing moorland vegetation on bare peat damaged by fires. Here stock is excluded to encourage the sown grasses and heather to grow. Gully blocking Upland Path Repair</p> <p>We investigate upland patterns and processes by collation of existing data within a GIS (Geographic Information System) and the Moorland Centre library, initiation of extensive surveys &amp; mapping and data analyses. The sustainability baseline will inform efficient conservation, land use and recreation planning. We have established an active Moorland Research Forum with annual conferences, workshops and a grant scheme to facilitate and foster cross-disciplinary upland research in collaboration with universities and other organisations.</p> <p>Projects currently involved in:</p> <ul style="list-style-type: none"> <li>- Carbon flux from peatlands research project (wildfire, restoration and managed sites), with Martin Evans and Fred Worrall and their teams, funded by Natural England (100K)</li> <li>- Compilation of a Peat Compendium on peat projects and starting a national peatlands network in collaboration with Jo Holden, Martin Evans and Fred Worrall, funding by Defra. This could contribute to the knowledge maps.</li> <li>- RELU 'Sustainable Uplands' project, with e.g. Jo Holden and Fred Worrall, looking at carbon budgets across the Peak District as well as other case studies</li> <li>- Advice to Ecosystem Service Mapping project for Natural England (Fred and Jo are also involved)</li> </ul> <p><b>Background:</b> Works with national parks, the National Trust and water companies to help restore peat. Co-ordinates research on C balance within the UK, looking at C fluxes.</p> <p><b>Contact details/website:</b>  <a href="http://www.moorsforthefuture.org.uk/mftf/research/Carbon.htm">http://www.moorsforthefuture.org.uk/mftf/research/Carbon.htm</a>  <a href="http://www.moorsforthefuture.org.uk/mftf/restoration/firesite.htm">http://www.moorsforthefuture.org.uk/mftf/restoration/firesite.htm</a></p>

<p><b>Sal Burgess</b> Soils Policy Team, Defra</p>	<p><b>Projects:</b> Compendium of peat management and restoration project in the UK – big directory of case studies. Idea is find which mangement works where, and why did it work. Project code: SP0565 The way in which peat is managed/is a policy driver in other countries – how is it managed on the ground and how do they get funding for it/ how do civil servants organise it. Project code: SP0556</p> <p><b>Background:</b> Soil policy, gives advice on the evidence base for soil policy.</p>
<p><b>Steve Chapman</b> Soils Group The Macaulay Institute, Aberdeen</p>	<p><b>Projects:</b> RECIPE: Reconciling commercial exploration of peatlands with biodiversity in peatland ecosystems Risk based methods of assessing soil quality Management of soils to enhance function and value Validation of changes in soil C stocks in Scotland and use of data to develop the ECOSSE model Land capability scenarios under future climates Peat erosion and the management of peatland habitats Climate change, land management and erosion in the organic and organo-mineral soils in Scotland and Northern Ireland. Identification and evaluation of the extent and severity of erosion in upland organic soils in Scotland using remote sensing images Assessment of the INCA-DOC model as a tool to predict how interactions between climate, hydrology and soil solution affect catchment runoff DOC. Use of organic matter properties as natural tracers to determine critical soil areas and times for DOC transport to surface waters in small upland catchments. Reactive pools of soil organic carbon in organic and mineral soil horizons in relation to biotic and abiotic mechanisms of stability. Analysis of long term data on DOC and other geochemical solutes from UK upland sites including Scottish ECN sites and Lochnagar. Dissolved and particulate organic matter compositions in rivers as an indicator of ecological status and functioning.</p> <p><b>Background:</b> Dr Chapman has over 30 years of experience in research in soil science and microbiology, with over 20 years being at the Macaulay Institute. His particular expertise lies in determining the role of microbial processes in the cycling of elements (C, N, P and S) within the plant-soil-microbe ecosystem. He has contributed to investigations on soil organic matter turnover, quantifying and determining the influence of chemical structure and soil conditions on the decomposition processes. He has ongoing interest in the sulphur cycle in soil, the emission of volatile sulphur from soils and in sulphate reduction, particularly in peatlands. He has led a research program evaluating the effect of global warming on soil respiration, methanogenesis and methane oxidation, and was the Macaulay coordinator of a SEERAD-funded project involving Aberdeen University, NSRI and CEH concerned with carbon turnover in organic soils and modeling the influence of climate and land use change. Recently, he was European coordinator of the EU-funded project on peatland restoration and biodiversity in peatlands - RECIPE. He is involved in developing microbial diversity measurements for assessing soil quality and health using both phospholipid fatty acid analysis and physiological profiling methods, which have been patented in the UK (MicroResp). Current research is concerned with carbon in Scottish soils and the influences of both land use and climate change.</p>

<p><b>Sarah Cornell</b> Science manager of QUEST</p>	<p><b>Projects:</b></p> <p><b>Background:</b> Interdisciplinarity, background in marine geochemistry, active interest in risk in flood risk management</p>
<p><b>Caroline Culshaw</b> NERC – programme officer</p>	<p><b>Projects:</b> This initiative could help support delivery of challenges 3 (integrating soil-water life support systems) and 4 (valuing environmental services) in the SUNR theme.</p> <p><b>Background:</b> QUEST programme officer, programme officer for other NERC programmes including ecosystem services and biodiversity</p>
<p><b>James Davis</b> Environment Agency</p>	<p><b>Projects:</b> see other EA people.</p> <p><b>Background:</b> Mainly carbon loss mitigation in the uplands; options to mitigate carbon loss can be integrated into agri-environment schemes; looking at research (past, present and gaps) that can be used to drive positive change in policy.</p>
<p><b>Bridget Emmett</b> CEH Bangor</p>	<p><b>Projects:</b> Countryside Survey – GB-wide soil and vegetation data, repeats surveys from 1978-2007 Defra Terrestrial Umbrella – Impacts of atmospheric deposition on terrestrial ecosystems, N addition experiments (also grazing impacts), modelling, surveys etc Defra/EU funded field experiments (Climoor N Wales, Peaknaze Pennines) on organic soils examining effects of climate (warming, drought) and deposition change on C and N cycling, vegetation etc. FMRC (NERC, EPSRC etc) – Pont Bren study of hydrological effects of land-use change in upland farmland (tree planting, de-stocking)</p> <p>Peatlands: Laboratory manipulation experiments on drought simulations, warming (gradient-based). Field experiments on FACE CO<sub>2</sub> exposure, ozone (with CEH), acidification (with Nick Ostle/Chris Evans – CEH) Rivers: Biofilms; in-stream metabolism of aquatic DOC</p> <p>CEH Lancaster – changes in plant communities and the short term CO<sub>2</sub> dynamics. Burning effects on vegetation and CO<sub>2</sub>, plant manipulation.</p> <p><b>Background:</b> Countryside survey for soils, climate change experiments in upland environments in mid Wales and the Peak District</p>
<p><b>Chris Evans</b> CEH</p>	<p><b>Projects:</b> NERC project (Leeds, CEH) on effects of acidity on organic matter cycling and DOC (lab acid manipulation experiments, time series analysis) NERC (EHFI) project (CEH, Bangor U) - effects of deposition change on C and N cycling in peats and peaty podzols (field acidity manipulation, water and gaseous C and N fluxes) CEH Carbon catchments – DOC, POC, CO<sub>2</sub>, CH<sub>4</sub> measurements for 4 peatland catchments (Moor House, Auchencorch Moss, Conwy, Forsinard) Defra Acid Waters Monitoring Network – Long-term monitoring of DOC, acidity, N etc for 22 upland catchments, from 1988. Analysis of drivers of change etc Defra Critical Loads and Dynamic Modelling – Development of linked C-N-acidity models, national-scale 1km acidity and N modelling, critical loads, deposition maps etc ECOSSE (SEERAD/WAG). CEH Bangor component assessment of controls on DOC loss, intensive carbon stock measurements at Plynlimon and Glensaugh, development of land-management guidelines for stakeholders.</p>

C catchments, using fluxes to determine ecosystem C budgets.

**Background:**

Interested in biogeochemical process and modelling studies of carbon, nitrogen and acidity in terrestrial and aquatic systems, focusing on the interactions between them. My work addresses how both climate change and other environmental drivers, notably atmospheric sulphur and nitrogen deposition, influence the biogeochemical cycling and carbon balance of upland ecosystems. I have a long-standing interest in the analysis of long-term monitoring data, which led to the identification of rising DOC trends in surface waters and much subsequent work trying to explain them. I am currently PI on two NERC-funded projects relating to the linkages between decreasing sulphur deposition, rising DOC concentrations and the impacts these changes may be having on nitrogen cycling. I am project leader for the Defra Critical Loads and Dynamic Modelling contract, which provides Defra with predictions of the effects of atmospheric deposition on upland terrestrial and aquatic ecosystems, including biodiversity impacts. I am also responsible for the CEH core-funded 'carbon catchment' research programme, involving the intensive instrumentation of four UK peatland catchments to quantify gaseous and riverine carbon fluxes.

<p><b>Martin Evans</b> Upland Environments Research Unit, School of Environment and Development, University of Manchester</p>	<p><b>Projects:</b> <u>Research on the erosion of upland peatlands and peatland carbon balance</u> Work over the past 5 years has focussed on controls on erosion of upland peatlands and in particular on the effects of erosion, re-vegetation, and restoration on the peatland carbon balance. Peatland erosion has been addressed through compilation of detailed sediment budgets for small catchments and through using LiDAR mapping or erosion systems to extrapolate to landscape scale. The mapping data has also been used in combination with carbon sequestration data to quantify the impact of peatland erosion on the carbon balance considering the effects of drainage, reduced primary productivity and particulate carbon loss. In degrading peatlands the particulate flux is the dominant component of the carbon balance. Transformations of particulate carbon to the dissolved and gaseous phases during transport determine the relative importance of this flux in terms of climatic impact. Ongoing work suggests significant effects and this is an area requiring further work. Many eroded peatlands in the UK are re-vegetating, either naturally or through restoration projects. We have also been working on the controls on re-vegetation and effects on carbon balance. Re-vegetating gullies are wet and are appear to sequester carbon at much higher rates than surrounding peatland.</p> <p>An ongoing project on the eroded Bleaklow Plateau in the southern Pennines is addressing the complete carbon balance of artificially re-vegetated peatlands. This work is in collaboration with Fred Worrall at Durham University and is funded by Moors for the Future and Natural England</p> <p>Monitoring carbon flux from restoration and wildfire sites on blanket peat. Geomorphological controls on carbon flux from eroding peatlands. Mapping gully erosion in blanket peatlands. Modelling metal pollution, hydrological effects, effects of erosion on C flux and effects of restoration on all of the above Case study: comparison of runoff on 2 restored catchments and 2 unrestored catchments.</p> <p>We have three ongoing projects which are relevant, one on moorland restoration and carbon flux funded by Natural England, one on moorland restoration and peatland water tables funded by the environment agency and one on macroscale carbon flux in rivers funded by NERC</p> <p><b>Background:</b> Water/fluvial systems in upland environments and peatlands. Implications for carbon flux and natural and artificial respiration</p>
<p><b>Pru Foster</b> QUEST – HYMN</p>	<p><b>Projects:</b></p> <p><b>Background:</b> Co-ordinator for biosphere modelling activities in the EU-funded HYMN (Hydrogen, Methane and Nitrous Oxide) project. Background in cloud forests, recent changes in the hydrological cycle, attribution of changes, modeling of cloud formation, isotopic tracers of the hydrological cycle, regional climate models</p>
<p><b>Jim Freer</b> Env Science Lancaster University</p>	<p><b>Projects:</b> NERC-FREE project on cascading uncertainties from climate change scenarios through to rainfall-runoff models and the resultant uncertainties in flood inundation impacts. NERC long-term project on the uncertainty assessments of environmental models.</p> <p><b>Background:</b> Research fellow in Hydrology. Climate change and cascading</p>

	<p>modelling uncertainties to flooding. Risk based model for soil erosion at the catchment scale. Evaluation of better diagnostic tools for assessing model performance/risk assessment of models. Hillslope and catchment process understanding through modelling and field data collection.</p> <p><b>Contact details/website:</b> <a href="mailto:j.freer@lancaster.ac.uk">j.freer@lancaster.ac.uk</a>  <a href="http://www.lec.lancs.ac.uk/cswm/cswm_front.php">http://www.lec.lancs.ac.uk/cswm/cswm_front.php</a></p>
<p><b>Vincent Gauci</b> Open University</p>	<p><b>Projects:</b> The RICHES project investigates how pollution, in the form of acid rain (globally a growing problem), can influence the emission of the powerful greenhouse gas methane (CH<sub>4</sub>) from wetlands, the largest individual source of this gas. We will tackle this important question by performing a regional integration of the many CH<sub>4</sub> emission studies that have been published in the past 2 decades together with data on pollution in these areas.</p> <p>Recent experiments where acid rain sulphur pollution has been simulated in wetlands have shown that these interactions can have an important effect on the emission of CH<sub>4</sub> at the global scale and may be offsetting the growth of methane from the wetland CH<sub>4</sub> source that should otherwise be occurring through global warming. These assessments are based on the findings of a limited number of experimental studies. The draw back from such studies is that they may replicate conditions only at the beginning of a period of increased pollution rather than the long-term ecosystem response. There are also other pollutants, such as reactive nitrogen (nitrate and ammonia), that may have important effects but are difficult to quantify without long-term (e.g. decade long) experiments. Our approach will treat the numerous studies that have monitored CH<sub>4</sub> emission from a wide range of wetlands, spanning existing pollution gradients, as a regional/global experiment where the long-term impacts of pollution are more accurately represented.</p> <p><b>Background:</b> Wetland biogeochemistry methane emissions, how they respond to aerial pollution, rice methane emissions and tropics. Working with Zoe Wallage on a database of methane emissions and DOC emissions and the RICHES project.</p>
<p><b>Anna Maria Giacomello</b> Environment Agency</p>	<p><b>Projects:</b> see other EA people.</p> <p><b>Background:</b></p> <ul style="list-style-type: none"> <li>• To translate in monetary terms the sequestration service value provided by biophysical processes;</li> <li>• To estimate both the benefits and costs of mitigation options to ensure that the most cost beneficial options is selected by maximising social welfare;</li> <li>• To model how changes in the value of carbon sequestration service provided by biophysical processes might change the management of land activities (e.g. optimal tree rotation time); and the probability of change in land use;</li> <li>• To identify how best to spatially allocate mitigation options with the aim of not only maximising offsetting carbon emissions, but also minimising the negative externalities (such as impacts on biodiversity, water and soil degradation), which such options might cause;</li> <li>• To identify the most effective policy mechanism that will ensure the uptake of the most cost beneficial mitigation option.</li> <li>• To incorporate equity issues in the climate change debate.</li> </ul>
<p><b>Claire Hamilton</b></p>	<p><b>Projects:</b> see other EA people.</p>

Environment Agency	<b>Background:</b> Peat projects, project earth sciences
<p><b>Joe Holden</b> University of Leeds,</p>	<p><b>Projects:</b></p> <p>See <b>Appendix I</b></p> <p>The University of Leeds have a lot of data available - this includes runoff production from intensive monitoring in Upper Wharfedale and Moor House at a variety of scales (e.g. runoff plots, hillslopes, river flow etc) all running simultaneously. Probably the most intensively monitored catchment in the UK. There are many GBytes of data from the catchment collected at 5 minute and 15 minute intervals. Data also include POC and DOC from soil, drain, hillslope and streamwater. We have also instrumented an adjacent afforested peat catchment. We have lots of other datasets too.</p> <p>Here Leeds we have links with existing initiatives including SCAMP, SPROUT, Peatscapes, Moors for the Future, Upland Hydrology Group, CHASM and others. For example with SCAMP we were involved in the pilot study work and UU have invited us to apply to do work for SCAMP 2 in partnership with other universities. With SPROUT our RELU Sustainable Uplands project is working in the SPROUT area and is developing the work in Nidderdale AONB in partnership with the local agencies there. We also helped with some of the work for SPROUT (e.g. via Professor Adrian McDonald). I am on the Peatscapes advisory panel, have two projects funded by them, am a member of the Upland Hydrology Group and we are partners with MFF in a several projects. Leeds were also one of the CHASM partner organisations. I am also lead investigator on a number of upland peat projects at the moment and am funded by DEFRA to produce a compendium of peat restoration and management projects jointly with MFF, Manchester and Durham.</p> <p><b>Background:</b> Main interests involve the study of hillslope hydrology, wetland environments and catchment management. Current work focusses on upland management, peatland hydrology, water colour, land drainage, carbon processes, soil piping, climate change and flooding.</p> <p><b>Contact details/website:</b> <a href="http://www.geography.leeds.ac.uk/people/j.holden/">http://www.geography.leeds.ac.uk/people/j.holden/</a></p>
<p><b>Jo House</b> QUEST Science and Policy Officer</p>	<p><b>Projects:</b></p> <p><b>Background:</b> Terrestrial ecosystems as part of the global carbon cycle; bioenergy and climate mitigation; savanna ecology; science synthesis in the IPCC and Millennium Ecosystem Assessment Reports.</p>
<p><b>Guy Kirk</b> Cranfield University</p>	<p><b>Projects:</b> Carbon cycling in models – developing new modelling. Also done work on using the Centuri model (C model) using data from the national soil archive (held at Cranfield). Europeat – EU.</p> <p><b>Background:</b> Biogeochemist modeller. Carbon crossing in Wales in 1980s and 1990s attributable to climate change</p>
<p><b>Paul Leadbitter</b> Peatscapes</p>	<p><b>Projects:</b> We have a wealth of data on drainage and eroding peat, however we have little on remote sensing data in the North Pennines AONB, no lidar etc coverage.</p>

Project Manager	<b>Background:</b>
<b>Ed Maltby</b> Centre for Sustainable Water, Integrated Management and Ecosystem Research (SWIMMER)	<p><b>Projects:</b> Peatscape initiative. Peat and upland management, carbon sequestration, impacts of fire and human activities, ecosystem functioning, climate change. Quantifying C losses - ecosystem services and poverty alleviation programme in India has transferable methods, cascading from physical to socio-cultural impacts. Currently developing collaboration initiatives with United Utilities which will be very relevant.</p> <p><b>Background:</b> Upland peat background, microbiological processes and indicators of change of C loss and accumulation. Monitoring North Yorkshire moors C balance. Ecosystem services, including economics, with Defra.</p>
<b>Tom Nisbet</b> Forestry Commission	<p><b>Projects:</b></p> <p><b>Background:</b> Forest hydrology, impacts of CC on forest soils and water.</p>
<b>Harriet Orr</b> EA	<p><b>Projects:</b> see other EA people.</p> <p><b>Background:</b> EA climate change science representative; contemporary catchment scale processes and management; soil carbon and peat - peat project manager.</p>
<b>Mike Rebane</b> Natural England	<p><b>Projects:</b> Looking at accreditation scheme for carbon credits; quantifying carbon savings for different restoration programs. Limited to carbon currently. Peatland bio meta-analysis of carbon cycle, pollution impacts. Restoration manual: trying to compile costs for the benefits associated with per-unit-area restoration of peatland/moorland or grazed fell. It addresses costs of doing gully bloc but not what this cost achieves.</p> <p><b>Background:</b> Specialist on uplands environments: special advice to ecology and restoration of peatlands.</p>
<b>James Skates</b> Welsh Assembly Government	<p><b>Projects:</b> We have data on land use in Wales based on GIS analysis from farmer surveys etc. We have soil data although not particularly well organised. Data were also collected for the ECOSSE project</p>
<b>Pete Smith</b> University of Aberdeen	<p><b>Projects:</b> QUEST-QUERCC looking at ecosystem roles in the C cycle in uplands Validation of changes in soil C stocks in Scotland and use of data to develop the ECOSSE model. Calculating C savings from windfarms on Scottish peatlands revision of guidelines. JULES/Hadley Centre modelling developments Simple C budgets calculated for loss of C due to different land management.</p> <p><b>Background:</b> Climate change impacts and mitigation with respect to soil.</p>
<b>Ian Soane</b> University of Cumbria	<p><b>Projects:</b> University of Cambria new centre to look into ways of having more integrated approach to upland management, what knowledge will help communities in land planning/management?</p> <p>The Upland Centre, University of Cumbria</p> <p>The International Centre for the Uplands, University of Cumbria aims to enhance our ability to manage upland landscapes in a sustainable way</p>

	<p>through</p> <ul style="list-style-type: none"> <li>• Interdisciplinary and participatory research and knowledge sharing</li> <li>• Networking and connecting</li> <li>• Influencing</li> <li>• Teaching</li> </ul> <p>The Centre is interested in adaptation to climate change and how this might be planned for at a community level. We wish to explore whether the creation of different scenarios of land-use and climate change can help identify what experts, professionals and local communities need to know to take informed decisions. We are therefore interested in both the scientific questions and how the answers to those questions might be applied, since decisions about adaptation may essentially be about risk management concerning the implications of uncertain levels of change. We welcome the concern to relate the desired outcomes of the QUEST research questions to delivery mechanisms and are interested in how different sectoral views can best be integrated and the relationship of this to governance mechanisms. Our recent Workshop of 4 and 5 September can be found at <a href="http://www.theuplandcentre.org.uk/Reference/Climate/CC%20WS%20REPO%20Final.pdf">http://www.theuplandcentre.org.uk/Reference/Climate/CC%20WS%20REPO%20Final.pdf</a></p> <p>We are interested in networking at national and international level to gather information and comparisons on planning for adaptation to climate change. We have ambitions to promote an international project that would develop and disseminate good practice in climate change adaptation planning that offers sustainability assessment, community participation and risk management protocols that assess the value of differing ecosystem services to communities.</p> <p><b>Background:</b></p> <p><b>Contact details/website:</b> <a href="http://www.theuplandcentre.org.uk">http://www.theuplandcentre.org.uk</a>  <a href="http://www.theuplandcentre.org.uk/Reference/Climate/CC%20WS%20REPO%20Final.pdf">http://www.theuplandcentre.org.uk/Reference/Climate/CC%20WS%20REPO%20Final.pdf</a></p>
<p><b>Kate Snow</b> United Utilities</p>	<p><b>Projects:</b> United Utilities hold extensive WQ data which may be of use to the project. The water companies are also currently drawing up catchment studies as part of our PR09 process.</p> <p>I would be happy to talk to anyone about our SCaMP programme. We have also commissioned research estimating the current scale and state of our carbon land bank. As we own and manage 54,000 ha of mainly upland catchment land we are interested in any developments in how best to protect and restore them.</p> <p><b>Background:</b></p>
<p><b>Judith Stuart</b> Defra</p>	<p><b>Projects:</b> Constructing a list of all restoration projects for peatlands – PEAT project.</p> <p>Defra is just starting to look at pools and implications for different land management practices - gap analysis, data compilation to provide guidance for land management.</p> <p>Science synthesis of state and vulnerability of England/Wales soils, mapped and status assessed (but depth not known). Multiple drivers of change.</p> <p>Ecosystem services cost &amp; benefits across landscapes, perhaps uplands will be assessed (Sarah Moon, Natural Environment Strategic Unit)</p>

	<b>Background:</b>
<b>David Thompson</b> Natural England	<p><b>Projects:</b> Upland management handbook Interested in guidance on C storage, reducing C loss. Upland Futures.</p> <p><b>Background:</b> Part of the policy team, looking at mitigation, role of land managers as carbon managers, peat restoration, working with CLA and forestry commission.</p>
<b>Zoe Wallage</b> OU	<p><b>Projects:</b> The RICHES (Regional integration of CH<sub>4</sub> emission studies) project, see Vincent Gauci for details.</p> <p><b>Background:</b> Regional methane studies database of CH<sub>4</sub> emissions and modelling effects – DOC release and its dynamics.</p>
<b>Clive Walmsey</b>  CCW	<p><b>Projects:</b> Main initiatives relevant to EA/QUEST Workshop:</p> <p><b>Protect And Enhance Special Conservation Sites And Secure Lasting Biodiversity Gains Through Robust Management Plans That Integrate Carbon Conservation</b> There is an increasing recognition that the way we manage our protected sites will have to be altered in the light of climate change. CCW is currently undertaking a <i>major review of site management goals</i> with this in mind. Adaptation of our sites work in response to climate change will require flexibility in both the special features we recognise on sites, and in the Conservation Objectives we set. We will need to adapt our management rather than concentrate exclusively on the designated features. Designated sites are the best places for wildlife in Wales today, and will be in the future too, but their wildlife composition is likely to change dramatically in coming decades. In undertaking this work we aim to implement the BAP Guidelines on adapting biodiversity conservation to climate change.</p> <p><b>Tir Cloi</b> The inter-agency <i>Tir Cloi</i> initiative focuses on climate-friendly rural development. It will offer both grants for reducing emissions and for adaptive measures in the countryside, targeted at increasing the scale and number of projects which directly address Climate Change by supporting sustainable development activities that drive the shift to a low or zero-carbon economy at a local level. Monitoring and assessment will underpin the Tir Cloi partnership, facilitating effective project validation. CCW's input to this process is partly focused on the evaluation of potential carbon conservation or sequestration gains delivered by land use practices.</p> <p><b>A Practical Guide to Carbon Management in the Countryside</b> Following on from a workshop involving Welsh LBAPs at the WBP, it has been agreed that there is a need for a Practical Guide to Carbon Management for conservation managers. Conservation land use and management practices can have a significant effect on carbon storage and emissions. Carbon impacts of candidate procedures are often hidden, contradictory or counter-intuitive. Conservation practitioners are therefore faced with a growing awareness of the importance of carbon considerations and conflicting messages on how to best address those considerations in the field. This short pdf guide will provide a simple means of assessing likely carbon consequences of 'everyday' commonly used reserve management</p>

	<p>options, enabling the best option to be selected. A grading system will be devised that will simplify this process, without diminishing validity of conclusions. The guide will provide links to sources of detailed information for more complex appraisals.</p> <p><b>Background:</b> Environmental change issues in relation to climate change and carbon: set up the Tir Cloi initiative (see above), issues in land management, numerical modelling looking at greenhouse gases.</p>
<p><b>Olly Watts</b> RSPB</p>	<p><b>Projects:</b></p> <p><b>Background:</b> Climate change policy team – climate change and peatlands, stopping peat extraction, carbon balance of peatlands, and birds.</p>
<p><b>Howard Wheater</b> Imperial College London</p>	<p><b>Projects:</b> There is a small Defra funded experimental project at Newcastle, led by Enda O'Connell with Keith Beven and I as collaborators, which is linking with SCaMP on the Reibble to look at peat management and flooding. Modelling aspects of this are being investigated under a NERC FREE project on land management and flooding.</p>
<p><b>Sue White</b> Cranfield University</p>	<p><b>Projects:</b> Planning pilot trials of remediation. Yorkshire Water: land management and DOC - now focussed on burning. Work for Natural England on extent and trends of managed burning. Now doing work with BNSpace Centre producing an operational tool to repeatedly map burning nationally. Natural Capitals programme with Stanford and WWF; Leverhulme work at Cranfield - development of transferable framework/methodologies, field sites being sought.</p> <p><b>Background:</b> Hydrologist looking at catchment scale monitoring modelling. Works with Yorkshire Water looking at dissolved org C and effects of land management, especially impacts of burning.</p>
<p><b>Duncan Whyatt</b> University of Lancaster</p>	<p><b>Projects:</b> Lancaster run a model called HARM which provides estimates of S, N and NH deposition with enhancements for seeder feeder processes at higher altitudes. Recent activity includes extensive uncertainty analysis of our model such that we can supply range based estimates (e.g., 5-95 %le) for and given 10km square in the UK for wet or dry deposited species. We have also done some climate change work - generating deposition estimates for future emission scenarios under predicted future climates - may prove useful to some members of the consortium?</p> <p>Our second area of potential contribution is spatial and temporal analysis of rainfall in upland areas - something Harriet and I have worked on (with a PhD student, Malby) and is being progressed by a NERC funded student (Ferranti). Our work has focused on the English Lakes (looking at changes in rainfall intensity with altitude, changes in rain shadow over time) but also has been applied to Snowdonia by an undergraduate student.</p>
<p><b>Dylan Williams</b> Countryside Council for Wales</p>	<p><b>Projects:</b></p> <p><b>Background:</b> I lead CCW's science and policy work on protecting, managing and restoring soils, with an emphasis on soil function and ecosystem services. I'm currently in a land use and landscape policy team so I could bring some policy thinking to your project, in addition to some science and practical experience. Previously I was a soil ecologist with CEH, where, among other things I worked on the impacts of climate change on upland soils, including a TIGER project with Phil Ineson on Great Dunn Fell and a</p>

	CLIMOOR project with Bridget Emmett in Clocaennog forest, north Wales.
<b>Fred Worrall</b> U Durham	<p><b>Projects:</b> The whole range of management impacts upon carbon storage in peat soils with monitoring of complete carbon budgets for: managed burning, wildfire, drained, drain-blocked, "pristine", grazed and those undergoing a range of restoration techniques. Developing regional models of carbon fluxes from peatlands. DOC trends. Recent projects: C flux from managed peatlands South and North Pennines case studies. Complete year of C data will be available from Dec 07. Is grip-blocking effective at the catchment scale? Optimising C storage in managed land. C storage in peats and organic-rich soils The feasibility of C trading from managed upland peat</p> <p><b>Background:</b> For the last 8 years Fred has worked on all aspects of the carbon biogeochemistry and hydrology of peatlands. Works have included studies of long term records of carbon fluxes for the whole of the UK; mechanistic studies of carbon release from peat; developing methods for estimating the complete carbon budget of peat soils; and understanding the impacts of management upon carbon fluxes. Present projects are looking at: i) the whole range of management impacts upon carbon storage in peat soils with monitoring of complete carbon budgets for: managed burning, wildfire, drained, drain-blocked, "pristine", grazed and those undergoing a range of restoration techniques.ii) Developing regional models of carbon fluxes from peatlands including understanding the carbon storage potential of managed peats.</p>
<b>ECOSSE</b> (Estimating Carbon in Organic Soils – Sequestration & Emissions)	<p><b>Projects:</b> Soil carbon maps: Soil depth, density inventories – modelled for Scotland and Wales. Good practice guidance reports:</p> <ul style="list-style-type: none"> <li>- Good practice guidance for the agricultural management of organic soils</li> <li>- Suggestions for guidance on the likely effects of changing land use from grazing or semi-natural vegetation to forestry on soil C and N in organic soils.</li> </ul> <p>Modelling project – simulating ghg emissions in highly organic soils, changes in soil C stock.</p> <p><a href="http://www.scotland.gov.uk/Publications/2007/03/16170508/0">http://www.scotland.gov.uk/Publications/2007/03/16170508/0</a></p>
<b>RELU</b> (Rural Economy and Land Use Programme)	<p><b>Projects:</b> Sustainable Uplands: Learning to Manage Future Change</p> <p>A RELU project in Leeds is the sustainable uplands project. There's already been a lot of work done with stakeholders, and they are also in the process of putting together a book on upland management issues (Aletta Bonn running this?), although this work is pretty much focused on the peak district.</p> <p><a href="http://homepages.see.leeds.ac.uk/~lecmsr/sustainableuplands/">http://homepages.see.leeds.ac.uk/~lecmsr/sustainableuplands/</a></p>
<b>University of East London</b>	Richard Lindsay: currently reviewing which peats are where in the UK.

<b>The Environmenta I Change Network and the Acid Waters Monitoring Network</b>	Have a considerable amount to offer the project through access to excellent long term records of dissolved organic carbon and accompanying water chemistry and climate data, and are very keen to develop collaborative projects with other interested scientists.
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## Appendix I: Information from Joe Holden

Examples of recent and current upland projects that JH has been involved with:

Bonn, A Walker, J. (Moors for the Future), Holden, J. Worrall, F. Evans, M.G. (2008) DEFRA Peat compendium. DEFRA

Holden, J. (2007-2008) Monitoring hydrological recovery in drain blocked catchments. Yorkshire Water.

Holden, J. (2007) Carbon assessment and management in upland catchments. Yorkshire Water.

Brown, L. and Holden, J. (2006) Impacts of reservoir releases on river ecology. Yorkshire Water

Brown, L. and Holden, J. (2007-2009) Understanding moorland aquatic insect ecology to inform biodiversity conservation and sustainable land management. Peatscapes

Armstrong, A. and Holden, J. (2007-2008) What promotes vegetation growth in grips post blocking? Peatscapes

Holden, J., Chapman, P.J., Billett, M.F. and Baird, A.J. (2007-2010) The carbon catchment of peatland pipes. NERC (£407,495)

Holden, J., Wainwright, J., Hubacek, K., et al (2007-2010) White Rose studentship network - 3 PhD studentships plus research costs on Upland Ecosystem Services.

Holden, J and Armstrong, A. (2007-2008) Monitoring the hydrological consequences of ditch blocking and related restoration activities within blanket bog in the Berwyn and South Clwyd Mountains SAC, NE Wales. RSPB.

Holden, J and Armstrong, A (2007) Hydrological equipment design for bog restoration monitoring. RSPB.

ed, M. Hubacek, Dougill A., Holden, J. and Kirkby, M.J. and with other EU partners (2006-2010). Desertification, mitigation and remediation of land (DESIRE). EU. £2.04 million total.

Holden, J. (2005) Geltsdale peatland restoration monitoring programme. English Nature.

Holden, J. Chapman, P.J. Kay, P., Warburton, J., Evans, M.G., Haycock, N., Hubacek, K. (2006-2007) Vulnerability of peat organic soils in England and Wales. DEFRA

Holden, J., Kay, P., McDonald, A.T. and Chapman, P.J. Grip blocking cost-benefits. Yorkshire Water.

Holden, J. Impact of peatland management on coloured and non-coloured components of dissolved organic carbon in rivers. Royal Society

Hubacek, K., Holden, J., Reed, M., Burt, T.P., Chapman, P.J., Stagl, S., Kirkby, M.J. Worrall, F., Turner. A., Pitts, C., Fraser, E. and Dougill, A., Prell, C. (2004) Managing uncertainty in dynamic socio-environmental systems: an application to upland management. BBSRC/ESRC/NERC (£750,339).

Holden, J, Wallage, Z.E. and Jones, T. A study into the influence of management on enzyme decay processes in upland blanket peat. Nuffield Undergraduate Science Bursaries.

Worrall, F., Holden, J., McDonald, A.T., and Burt, T.P. Monitoring different grip blocking techniques. United Utilities (£35, 000). CI

Hubacek, K., Burt, T.P., Holden, J., Reed, M., Stagl, S., Kirkby, M.J. Worrall, F., Turner. A., Pitts, C., Fraser, E. and Dougill, A., Prell, C. (2004) Sustainable upland management for multiple benefits. BBSRC/ESRC/NERC (£50, 000) CI

Holden, J., Lane, S.N., Brookes, C.J. and McDonald, A.T. (2004) Strategic locations for gully blocking. Moors for the Future.

Holden, J. (2003-2006) Artificial drainage and wetland restoration in managed upland wetlands (University Endowed Scholarship, ~£50, 000)

Holden, J., McDonald, A.T., Lane, S.N. (2003-2006) Impact of stocking density on

revegetation and runoff production in eroded moorland. Environment Agency (£10,000).

Holden, J. (2002-2005) Hydrological, fine sediment and water colour response of managed upland wetlands. NERC. (£110,000) + 3 NERC studentships (+~£180,000)

Holden, J. (2002-2003) Use of ground-penetrating radar to identify soil pipe density, connectivity and runoff sources in blanket peat catchments, RGS-IBG (£2,100)

Holden, J. (2001) Survey of piping and pipeflow in upland Britain. Royal Society.

Holden, J. (2001) Assessment of natural recovery of moorland gripping in the Pennine blanket peats. BGRG.

Examples of other Leeds peat/upland projects that are currently running (and are by no means all inclusive):

Chapman, P.J. and Bottrell, S. NERC, 2006-2009. Influence of recovery from acidification on the mobility of dissolved organic carbon. £330,000

Application of catchment-scale data to the quantification of soluble organic and inorganic nitrogen fluxes within and from UK upland soils' (2000-2003) P.J Chapman, M. Cresser, T. Edwards, NERC.

Human waste and water management in National Parks (1999-2003) PhD research by Kyoko Fukasawa, co-supervised by Dr Pippa Chapman and Prof Adrian McDonald

Application of Catchment Scale Data to the Quantification of Soluble Organic-and Inorganic-N Fluxes within and from UK Upland Soils (2000-2003) NERC GANE Grant with Dr Pippa Chapman (Leeds), Prof Malcolm Cresser (York U.) and Dr A. Edwards (MLURI)

The significance of organic forms of nutrients and the influence of in-stream processes on total nitrogen and phosphorus losses from upland ecosystems (1996-1999) NERC postdoctoral fellowship held by Dr Pippa Chapman

Examples of recent upland papers JH has produced:

Holden, J. (in press, 2008) Upland hydrology. In Bonn, A., Hubacek, K., Stewart, A., Allott, T. Drivers of change in upland environments. Routledge.

Holden, J., Lane, S.N., Kirkby, M.J., Brookes, C.J., Milledge, D.J., Holden, V. and McDonald, A.T. (in press) Factors affecting overland flow velocity in peatlands. Water Resources Research.

Howard, A.J., Challis, K., Holden, J., Kincey, M. and Passmore, D.G. (in press) The impact of climate change on archaeological resources in Britain: a catchment scale assessment. Climatic Change.

Jin, N., Termansen, M., Hubacek, K., Holden, J. and Kirkby, M.J. (in press) Adaptive farming strategies for dynamic economic environments. Journal of the Institute of Electrical and Electronics Engineers.

Holden, J., Gascoign, M. and Bosanko, N.R. (2007) Erosion and natural revegetation associated with surface land drains in upland peatlands. Earth Surface Processes and Landforms, 32, 1547-1557

Holden, J. (2007) A plea for more careful presentation of near-surface temperature data in geomorphology. Earth Surface Processes and Landforms, 32, 1433-1436.

Prell, C., Hubacek, K., Reed, M., Quinn, C., Jin, N., Holden, J., Burt, T.P., Kirkby, M., Sendzimir, J. (2007) If you have a hammer everything looks like a nail: 'traditional' versus participatory model building. Interdisciplinary Science Reviews, 32, 263-282. DOI 10.1179/030801807X211720.

Worrall, F., Armstrong, A. and Holden, J. (2007) Short-term impact of peat drain-blocking on water colour, dissolved organic carbon concentration and water table depth. Journal of Hydrology, 337, 315-325

Holden, J., Shotbolt, L., Bonn, A., Burt, T.P., Chapman, P.J., Dougill, A.J., Fraser,

E.D.G., Hubacek, K., Irvine, B., Kirkby, M.J., Reed, M.S., Prell, C., Stagl, S., Stringer, L.C., Turner, A., Worrall, F. (2007) Environmental change in moorland landscapes. *Earth-Science Reviews*, 82, 75-100

Holden, J. (2006) Peat hydrology. In Martini, I.P., Cortizas, A.M. and Chesworth, W. (editors) *Peatlands: basin evolution and depository of records of global environmental and climatic changes*, Amsterdam, Elsevier, p319-346,

Holden, J., Chapman, P.J., Lane, S.N and Brookes, C.J. (2006) Impacts of artificial drainage of peatlands on runoff production and water quality. In Martini, I.P., Cortizas, A.M. and Chesworth, W. (editors) *Peatlands: basin evolution and depository of records of global environmental and climatic changes*, p501-528, Amsterdam, Elsevier

Reid, S., Lane, S.N., Berney, J.M., and Holden, J. (2006) The timing and magnitude of coarse sediment transport events within an upland, temperate gravel-bed river. *Geomorphology*, 83, 152-182. doi: 10.1016/j.geomorph.2006.06.030

Holden, J., West, J., Howard, A.J. Maxfield, E., Panter, I., Oxley, J. (2006) Hydrological controls of in situ preservation of waterlogged archaeological deposits. *Earth-Science Reviews* 78, 59-83

Holden, J., Burt, T.P., Evans, M.G. and Horton, M. (2006) Impact of land drainage on peatland hydrology. *Journal of Environmental Quality*, 35, 1764-1778, doi:10.2134/jeq2005.0477

Wallage, Z.E., Holden, J. and McDonald, A.T. (2006) Drain blocking is an effective treatment for reducing dissolved organic carbon loss and water colour in peatlands. *The Science of the Total Environment* 367, 811-821

Dougill, A., Fraser, E. Hubacek, K., Reed, M. Holden, J., Prell, C. Stringer, L. (2006) Learning from doing participatory rural research: Lessons from the Peak District National Park. *Journal of Agricultural Economics*, 57, 259-275

Holden, J. (2006) Sediment and particulate carbon removal by pipe erosion increase over time in blanket peatlands as a consequence of land drainage. *Journal of Geophysical Research*, 111, F02010, doi:10.1029/2005JF000386

Holden, J. (2005) Peatland hydrology and carbon cycling: why small-scale process matters. *Philosophical Transactions of the Royal Society A*, 363, 2891-2913 doi:10.1098/rsta.2005.1671

Holden, J. (2005) Piping and woody plants in peatlands: cause or effect? *Water Resources Research*, 41, W06009: DOI: 10.1029/2004WR003909.

Holden, J. (2005) Controls of soil pipe density in blanket peat uplands. *Journal of Geophysical Research*, 110, F010002, DOI: 10.1029/2004JF000143.

Warburton, J., Holden, J. and Mills, A.J. (2004) Hydrological controls of surficial mass movements in peat. *Earth-Science Reviews*, 67, 139-156.

Holden, J. and Wright, A. (2004) A UK tornado climatology and the development of simple prediction tools. *Quarterly Journal of the Royal Meteorological Society*, 130, 1009-1022.

Holden, J. (2004) Hydrological connectivity of soil pipes determined by ground penetrating radar tracer detection. *Earth Surface Processes and Landforms*, 29, 437-442.

Lane, S.N., Brookes, C.J., Kirkby, M.J. and Holden, J. (2004) A network-index-based version of TOPMODEL for use with high-resolution digital topographic data. *Hydrological Processes*, 18, 191-201.

Holden, J., Chapman, P.J. and Labadz, J.C. (2004) Artificial drainage of peatlands: Hydrological and hydrochemical process and wetland restoration. *Progress in Physical Geography*, 28, 95-123.

Holden, J. and Burt, T.P. (2003) Runoff production in blanket peat covered catchments. *Water Resources Research*, 39, 1191, DOI: 10.1029/2003WR002067.

Holden, J. and Burt, T.P. (2003) Hydraulic conductivity in upland blanket peat; measurement and variability. *Hydrological Processes*, 17, 1227-1237.

Holden, J. and Burt, T.P. (2003) Hydrological studies on blanket peat: The

significance of the acrotelm-catotelm model. *Journal of Ecology*, 91, 86-102  
Holden, J. and Adamson, J. (2002) The Moor House long-term upland temperature record - new evidence of recent warming. *Weather*, 57, 119-126.

Holden, J., Burt, T.P. and Vilas, M. (2002). Application of ground penetrating radar to the identification of subsurface piping in blanket peat. *Earth Surface Processes and Landforms*, 27, 235-249.

Holden, J and Burt, T.P. (2002) Laboratory experiments on drought and runoff in blanket peat. *European Journal of Soil Science*, 53, 675-689.

Holden, J. and Burt, T.P. (2002) Piping and pipeflow in a deep peat catchment. *Catena*, 48, 163-199.

Holden, J. and Burt, T.P. (2002) Infiltration, runoff and sediment production in blanket peat catchments: implications of field rainfall simulation experiments. *Hydrological Processes*, 16, 2537-2557

Holden, J., Burt, T.P. and Cox, N.J. (2001) Macroporosity and infiltration in blanket peat: the implications of tension disc infiltrometer measurements. *Hydrological Processes*, 15, 289-303.

Holden, J. (2001) Recent reduction in frost in the North Pennines. *Journal of Meteorology*, 26, 369-374

Holden, J. and Adamson, J. (2001) Gordon Manley and the north Pennines. *Journal of Meteorology*, 26, 329-333

Evans, M.G., Burt, T.P., Holden, J. and Adamson, J. (1999) Runoff generation and water table fluctuations in blanket peat: evidence from UK data spanning the dry summer of 1995. *Journal of Hydrology*, 221, 141-160.