MAY 2014

GLASTIR MONITORING & EVALUATION PROGRAMME

FIRST YEAR ANNUAL REPORT

APPENDICES

Prepared by CEH on behalf of the Glastir Monitoring & Evaluation Programme Team

Canolfan Ecoleg a Hydroleg
CYNGOR YMCHWIL YR AMGYLCHEDD NATURIOL

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

NERC SCIENCE OF THE ENVIRONMENT

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Further copies of this report are available from: GMEP Office, Centre for Ecology & Hydrology, Environment Centre Wales, Deiniol Road, Bangor, Gwynedd, LL57 2UW.

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Appendix 1.1 External Communication Log

Stakeholder Organisation	Stakeholder individual name	Stakeholder individual surname	Type of external communication i.e. conference, talk, workshop	Title i.e. conference name, meeting name, presentation title	Date
CCW	Rhian	Thomas	Briefing	AXIS II MEP briefing	09/11/2012
Gwynedd Archaeological Trust	Emily	Bateman	Project stakeholder meeting	Project stakeholder meeting	05/12/2012
PLANED, Mentor Mon and Cadwyn Clwyd.	Steven	Bradley	Project stakeholder meeting	Project stakeholder meeting	05/12/2012
Dairy Co	Delyth	Davies	Project stakeholder meeting	Project stakeholder meeting	05/12/2012
WAO	Emma	Giles	Project stakeholder meeting	Project stakeholder meeting	05/12/2012
Gwent Wildlife Trust	Tim	Green	Project stakeholder meeting	Project stakeholder meeting	05/12/2012
FUW	Andrew	Gurney	Project stakeholder meeting	Project stakeholder meeting	05/12/2012
Gwent Wildlife Trust	Alaw	Hughes	Project stakeholder meeting	Project stakeholder meeting	05/12/2012
NFU Cymru	Dafydd	Jarrett	Project stakeholder meeting	Project stakeholder meeting	05/12/2012
Snowdonia National Parks	Rhys	Owen	Project stakeholder meeting	Project stakeholder meeting	05/12/2012
Butterfly Conservation	George	Tordoff	Project stakeholder meeting	Project stakeholder meeting	05/12/2012
Wildlife Trusts	Lizzie	Wilberforce	Project stakeholder meeting	Project stakeholder meeting	05/12/2012
RSPB	Arfon	Williams	Project stakeholder meeting	Project stakeholder meeting	05/12/2012
Canal & River Trust / Glandwr Cymru	Simon	Bamford	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Dwr Cymru	Ian	Brown	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Aberystwyth University	Mike	Christie	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
	Peter	Davies	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013

Stakeholder Organisation	Stakeholder individual name	Stakeholder individual surname	Type of external communication i.e. conference, talk, workshop	Title i.e. conference name, meeting name, presentation title	Date
Dwr Cymru	Tony	Harrington	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
NFU Cymru	Dafydd	Jarrett	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Afonydd Cymru	Frank	Jones	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
WEL	Frank	Jones	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Marine Conservation Society	Robert	Keirle	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
RSPB Cymru	Katie-Jo	Luxton	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Wye & Usk Foundation	Stephen	Marsh-Smith	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Dwr Cymru	Fergus	O'Brien	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Cardiff University	Steve	Ormerod	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Natural England	Roger	Owen	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
National Parks Wales	Aneurin	Phillips	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Dwr Cymru	Anna	Riddick	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Countryside Council for Wales	Kerry	Rogers	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013

Stakeholder Organisation	Stakeholder individual name	Stakeholder individual surname	Type of external communication i.e. conference, talk, workshop	Title i.e. conference name, meeting name, presentation title	Date
Wales Environmental Research Hub	Shaun	Russell	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Wildlife Trusts Wales	Rachel	Sharp	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Dwr Cymru	Maria	Sikovell	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Keep Wales Tidy	Louise	Tambini	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Carmarthenshire Rivers Trust	Gethyn	Thomas	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Consumer Council for Water Wales	Mansel	Thomas	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
WAG	Nicola	Thomas	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Elan Valley Trust/EA Wales	Bob	Vaughan	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Dwr Cymru	Lynda	Warren	Advisory Panel	Independent Environmental Advisory Panel to Welsh Water	24/01/2013
Countryside Council for Wales	David	Allen	Project stakeholder meeting	Project stakeholder meeting	14/02/2013
Environment Agency Wales	Sarah	Coe	Project stakeholder meeting	Project stakeholder meeting	14/02/2013
Forestry Commission Wales	Patience	Eastwood	Project stakeholder meeting	Project stakeholder meeting	14/02/2013
CADW	Ian	Halfpenney	Project stakeholder meeting	Project stakeholder meeting	14/02/2013
Countryside Council for Wales	Hilary	Miller	Project stakeholder meeting	Project stakeholder meeting	14/02/2013
Environment Agency Wales	Simon	Neale	Project stakeholder meeting	Project stakeholder meeting	14/02/2013
Forestry Commission Wales	Anne	Roberts	Project stakeholder meeting	Project stakeholder meeting	14/02/2013
Environment Agency Wales	Kyle	Young	Project stakeholder meeting	Project stakeholder meeting	14/02/2013

Stakeholder Organisation	Stakeholder individual name	Stakeholder individual surname	Type of external communication i.e. conference, talk, workshop	Title i.e. conference name, meeting name, presentation title	Date
Hybu Cig Cymru	Sion	Aron Jones	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
DairyCo	Delyth	Davies	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
Chair of the Climate Change Commission fro Wales	Peter	Davies	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
CLA	Sue	Evans	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
Pembrokeshire Coast National Park Authority	Jane	Gibson	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
Hybu Cig Cymru/Senrgy, Bangor University	John	Hyland	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
Bangor University	Anna Kaye	Jones	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
NFU	Bernard	Llewellyn	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
EA	Simon	Neale	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
FC	Trefor	Owen	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
	Havard	Prosser	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
Cynnal Cymru	Natalie	Rees	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
Aberystwyth University	Nigel	Scollan	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013

Stakeholder Organisation	Stakeholder individual name	Stakeholder individual surname	Type of external communication i.e. conference, talk, workshop	Title i.e. conference name, meeting name, presentation title	Date
WG	Ken	Stebbings	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
CCW	Clive	Walmsley	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
Menter a Busnes	Eirwen	Williams	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
Honorary Fellow CAZS, Bangor University	Gareth	Wyn Jones	Meeting	Climate Change Commission for Wales - Land Use sub group	15/02/2013
Countryside Council for Wales	Catherine	Duigan	Steering Board	Wales Environment Research Hub Steering Board	26/02/2013
Forestry Commission Wales	Sue	Ginley	Steering Board	Wales Environment Research Hub Steering Board	26/02/2013
Environment Agency Wales	Kathryn	Monk	Steering Board	Wales Environment Research Hub Steering Board	26/02/2013
Wales Environment Research Hub	Tim	Pagella	Steering Board	Wales Environment Research Hub Steering Board	26/02/2013
Bangor University	Andrew	Pullin	Steering Board	Wales Environment Research Hub Steering Board	26/02/2013
WAG	Katherine	Raymond	Steering Board	Wales Environment Research Hub Steering Board	26/02/2013
Wales Environment Research Hub	Shaun	Russell	Steering Board	Wales Environment Research Hub Steering Board	26/02/2013
Wales Environmental Research Hub	Jane	Smith	Steering Board	Wales Environment Research Hub Steering Board	26/02/2013
WAG	Karen	Stothard	Steering Board	Wales Environment Research Hub Steering Board	26/02/2013

Stakeholder Organisation	Stakeholder individual name	Stakeholder individual surname	Type of external communication i.e. conference, talk, workshop	Title i.e. conference name, meeting name, presentation title	Date
NRW	Hilary	Miller	Workshop	HNV workshop	10/04/2013
WG	Steve	Spode	Workshop	HNV workshop	10/04/2013
RSPB	Arfon	Williams	Workshop	HNV workshop	10/04/2013
NRW	Sarah	Coe	Workshop	EA data workshop	11/04/2013
NRW	Martyn	Evans	Workshop	EA data workshop	11/04/2013
NRW	Michael	Hodge	Workshop	EA data workshop	11/04/2013
NRW	Simon	Neale	Workshop	EA data workshop	11/04/2013
Association of Applied Biologists	N/A	N/A	Conference	Environmental Management on Farmland	23/04/2013
Cambrian Mountains Society	Peter	Foulkes	Workshop	HNV Workshop	29/05/2013
Chair of the Aberystwyth Ramblers Group, a Trustee of the Cambrian Mountains Society and Chair of the Ceredigion Local Access Forum	John	Morgan	Workshop	HNV Workshop	29/05/2013
Snowdonia National Park Authority	Carwyn	ap Myrddin	Workshop	HNV Workshop	29/05/2013
Wales Environment Link	Raoul	Bhambral	Workshop	HNV Workshop	29/05/2013
RSPB Cymru	Jon	Cryer	Workshop	HNV Workshop	29/05/2013
RSPB Cymru	Siôn Llŷr	Dafis	Workshop	HNV Workshop	29/05/2013
RSPB	Deborah	Deveney	Workshop	HNV Workshop	29/05/2013
WG	Frances	Dixon	Workshop	HNV Workshop	29/05/2013
PONT	Emma	Douglas	Workshop	HNV Workshop	29/05/2013
National Trust Wales	Rhys	Evans	Workshop	HNV Workshop	29/05/2013
IBERS	Mariecia	Fraser	Workshop	HNV Workshop	29/05/2013
Head of RDP Reform, CAP Planning Division, Welsh Government	Nia	Griffiths	Workshop	HNV Workshop	29/05/2013

Stakeholder Organisation	Stakeholder individual name	Stakeholder individual surname	Type of external communication i.e. conference, talk, workshop	Title i.e. conference name, meeting name, presentation title	Date
Butterfly Conservation Wales	Russel	Hobson	Workshop	HNV Workshop	29/05/2013
National Trust	Jo	Horsley	Workshop	HNV Workshop	29/05/2013
National Trust Wales	Emily	Keenan	Workshop	HNV Workshop	29/05/2013
Bats Conservation Trust	Steve	Lucas	Workshop	HNV Workshop	29/05/2013
BfE Conservation Officer (Wales), Bumblebee Conservation Trust	Sinead	Lynch	Workshop	HNV Workshop	29/05/2013
NRW	Hilary	Miller	Workshop	HNV Workshop	29/05/2013
RSPB	Charles	Morgan	Workshop	HNV Workshop	29/05/2013
National Trust Wales	Andrew	Roberts	Workshop	HNV Workshop	29/05/2013
Plantlife	Cath	Shellswell	Workshop	HNV Workshop	29/05/2013
Glastir Woodland Creation Officer/Ecologist, based in Carmarthenshire (Hugh Wheeldon & Co), also Woodland Trust	Alison	Wheeler	Workshop	HNV Workshop	29/05/2013
RSPB	Arfon	Williams	Workshop	HNV Workshop	29/05/2013
NRW	Julian	Woodman	Workshop	HNV Workshop	29/05/2013
Industry, advisors and regulators			UK stakeholder group	Capturing uptake of GHG mitigation measures within industry: what is being done to monitor progress within each country.	19/06/2013
WG	Kevin	Austin	Meeting	GMEP Steering Group	20/06/2013
NRW	David	Allen	Meeting	GMEP Steering Group	20/06/2013
CADW	Ian	Halfpenny	Meeting	GMEP Steering Group	20/06/2013
NFU	Dafydd	Jarrett	Meeting	GMEP Steering Group	20/06/2013
WG	Kevin	Jones	Meeting	GMEP Steering Group	20/06/2013

Stakeholder Organisation	Stakeholder individual name	Stakeholder individual surname	Type of external communication i.e. conference, talk, workshop	Title i.e. conference name, meeting name, presentation title	Date
NFU	Bernard	Llewellyn	Meeting	GMEP Steering Group	20/06/2013
RSPB	Arfon	Williams	Meeting	GMEP Steering Group	20/06/2013
NRW	Hilary	Miller	Meeting	HNV topic group meeting	16/07/2013
NRW	Jane	Stevens	Meeting	HNV topic group meeting	16/07/2013
NRW	Julian	Woodman	Meeting	HNV topic group meeting	16/07/2013
NRW	Rob	Stonehewer	Meeting	Wales Environment Data Meeting	18/06/2013
Dwr Cymru	Graham	White	Meeting	Wales Environment Data Meeting	18/06/2013
Defra	Alex	Coley	Meeting	Wales Environment Data Meeting	18/06/2013
NRW	Bob	Vaughan	Meeting	Wales Environment Data Meeting	18/06/2013

Appendix 1.2 Draft Communications Plan

1. Aim of external communication

The overall objective of the communication activities is to secure that the project's key messages reaches all relevant stakeholders and target group organisations and foster their commitment to the project.

2. **Key objectives of communication**

2.1. Raise the profile of the GMEP project

2.2. Communicate the projects outputs to relevant stakeholders

2.3. Ensure the general public are given accurate messages about the work programme

2.4. Perform the communication-related outputs which were specified in the tender:

2.4.1. Quarterly update reports.

2.4.2. Annual reports, with bilingual executive summary;

2.4.3. Initial stakeholder workshop and annual thereafter

2.4.4. Bi annual steering group meetings

2.4.5. Final policy and stakeholder workshops.

3. Key messages to communicate

3.1. The impacts of Glastir need to be closely monitored and evaluated in order to comply with the European Commission Common Monitoring and Evaluation Framework.

3.2. A partnership has been formed to deliver this for Welsh Government led by the Natural Environment Research Council's Centre for Ecology & Hydrology, an independent public research organisation.

3.3. The Glastir Monitoring and Evaluation Programme will deliver a scientifically-rigorous approach to the monitoring and evaluation of Glastir.

3.4. It adopts an ecosystem approach recognising the potential co-benefits and trade-offs individual intervention measures may have on our Natural Capital and the Ecosystem Services that it delivers therefore contributing to the Welsh Government 'Living Wales' framework.

3.5. The evidence-gathering components of the Glastir Monitoring and Evaluation Programme are split into the following three elements:

3.5.1. A national monitoring surveillance element to quantify ongoing change in the countryside and impacts of Glastir Entry.

3.5.2. A targeted element to identify impacts of specific measures within the advanced element of the scheme.

3.5.3. Models to estimate possible outcomes to enable fast feedback to Welsh Government on likely success of specific measures, and integrate results to explore co-benefits and trade-offs between measures.

3.6. All data, trend analysis and reports will be made available through a dedicated Glastir Monitoring and Evaluation Programme web portal to be launched autumn 2014.

4. Target audiences and mechanism for delivery

	Tool										
Audience	Website	Workshop	Meeting	Peer review press	Conference	Survey	Direct Communication	Articles	Reports	Agricultural show	Information brochure
General public											
Farming community											
Welsh and UK Government agencies											
Research community											
Industry											
NGOs/Pressure Groups											
Welsh and UK Government											

5. Action planning (further detail in annex 1)

5.1. Website – to be launched summer 2013. Will include monthly news updates. Data portal will be launched in autumn 2014.
5.2. Workshops – topic group workshops to be held when required
5.3. Meetings – annual stakeholder meetings, and bi-annual steering group meetings
5.4. Peer review press – project team will publish when appropriate.
5.5. Conferences – Project team to present at relevant conferences
5.6. Surveys – Wales farmer practise survey, Common land survey
5.7. Direct communication – Access permissions letters to landowners
5.8. Articles – When opportunities arise
5.9. Reports – quarterly highlight reports and annual reports
5.10. Agricultural shows – presence at the Royal Welsh Agricultural Show
5.11. Information brochures – Project flyer at the beginning of the project, to be updated when required.

6. Review and success criteria (further detail in annex 1)

6.1. Feedback from meetings with stakeholders and steering group
6.2. Website traffic – i.e. number of page hits and downloads
6.3. E-mail enquiries via the gmep@ceh.ac.uk
6.4. Collaborations and data sharing with external organisations
6.5. Citations within peer reviewed press
6.6. Invitations to speak at meetings, conferences, workshops etc
6.7. Footfall at agricultural shows

7. **Risks**

Risk	Control measures
Inappropriate/unauthorised publicity. Terms and Conditions of the contract state: **PUBLICITY, MEDIA AND OFFICIAL ENQUIRIES** 25.1 Except with the written consent of the Client (WG), the Researcher shall not make any press announcements or publicise the Contract or any part thereof in any way. Such consent from the Client shall not be unreasonably withheld. 25.2 The Researcher shall take all reasonable steps to ensure the observance of Condition 25.1 by its Staff. 25.3 The provisions of this Condition 25 shall apply during the continuance of this Contract and indefinitely after its expiry or termination.	CEH will ensure all project staff and project sub-contractors comply with these conditions. All project team members have been made aware all media enquiries etc have to be directed through the project management office. Conditions of the sub-contracts state : All publicity activities are to be agreed with CEH Project Manager who will seek approval of WG.
Unauthorised release of data covered by the Data Protection Act 1998.	All data, trend analysis and reports will be made available through the GMEP web portal to be launched in autumn 2014. CEH will ensure project staff and project sub-contractors are compliant with the Data Protection Act 1998. This especially relates to the resolution of the 1 Km^2 data (e.g. 10km^2 TBA). Conditions of the sub-contracts state : Data collected under this project may not be shared with landowners or 3rd parties. Location of survey squares must remain confidential within the project.
Glastir MEP is not seen as independent to Welsh Government and the Glastir scheme.	CEH will build an independent project website with a project domain name and unique branding. CEH will ensure all project staff and sub-contractors deliver clear messages in all communication.

Annex 1 – GMEP Activity Plan

			2012				2013												2014								
Tool	**Specification**	**Audience**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**Review criteria**
Website	Monthly news updates. Data portal launch yr 2	General public, Welsh and UK Government agencies, research community, industry, NGO's, Farming community, Welsh and UK Government																										Monitor web traffic, data downloads and number of e-mail enquiries
Workshop	Topic group workshops when required	Welsh and UK Government agencies, research community, industry, NGO's, farming community, Welsh and UK Government																										Commitment to and participation in project events, data sharing , invitation to shared topic groups, collaborations
Meeting	Annual stakeholder meeting and bi-annual steering group meetings	Welsh and UK Government agencies, research community, NGO's, farming community, Welsh and UK Government																										Feedback from stakeholder and steeering group. Commitment to and participation in project events, data sharing , collaborations
Peer review press	Consortium will jointly publicise papers when opportunities present	Research community																										Monitor number of citations
Conference	Present at relevant conferences	Welsh and UK Government agencies, research community, industry, NGO's, Welsh and UK Government																										Monitor number of invitations to speak/present
Survey	Farmer Practice Survey, Common Land Survey	Farming Community																										Monitor level of acceptable (TBA) responses
Direct Communication	Landowner access permission letters and personal visits	Farming Community																										Monitor acceptable level of access agreements
Articles	As required when opportunities arise	General public, Welsh and UK Government agencies, research community, industry, NGO's, Farming community, Welsh and UK Government																										Monitor number of invitations. Increase in range of audience types.
Reports	Quarterly highlight reports and annual report	Welsh and UK Government agencies, Welsh and UK Government																										Direct feedback
Agricultural show	RWAS - project flyers in year 1 only.	General public, Welsh and UK Government agencies, research community, industry, NGO's, Farming community, Welsh and UK Government																										Monitor footfall at display, monitor number of information brochures taken
Info brochure	Project flyer at the beginning of the project. Update in yr 2.	General public, Welsh and UK Government agencies, research community, industry, NGO's, Farming community, Welsh and UK Government																										Monitor number of flyers sent

Appendix 1.3 Farming Wales Article

News

What Will Glastir Deliver?

By **Bridget Emmett** (Head of CEH Bangor and GMEP Project leader) and the Glastir Monitoring and Evaluation Project Team

What will Glastir deliver in terms of the five ambitious outcomes desired by Welsh Government and the EU? This is the question being asked by Welsh Government (WG) to provide an evidence base for the EU reporting required for all initiatives funded under the Rural Development Plan. The EU place such priority on answering this question that they recommend between 2-3% of each national budget be allocated for this purpose. The Welsh Government, in taking this recommendation seriously is taking a lead role in the EU community.

As reported by Bernard Llewellyn in the May issue of Farming Wales, they have commissioned an independent scientific study to provide the evidence base to evaluate the success, or not, of the scheme. The independence of the project is critical to its success. All study sites are kept confidential with no link to cross-compliance, regulation or designation of any sort.

As a reminder, the desired Glastir outcomes are:

- Combating climate change
- Improving water and soil management
- Maintaining and enhancing biodiversity
- Managing and protecting the Welsh landscape and historic environment
- Creating new opportunities to improve access
- Increasing the area and management of woodlands

Commissioning of the Glastir Monitoring and Evaluation Project (GMEP) was through an open competition which emphasised the need for an inter-disciplinary team who would follow an ecosystem approach recognising the inter-dependence between different components of the Welsh landscape. For example bufferstrips change water quality, create wildlife corridors and affect landscape quality. In response to a Ministerial commitment, the project started in parallel with the Glastir scheme itself ensuring good baseline data will be collected.

Results will be delivered during the lifetime of the Glastir scheme allowing for ongoing adaptation and improvements. Uniquely, all aspects of the monitoring work are embedded in a single project ensuring the trade-offs and co-benefits can be quantified. For example Glastir measures for carbon may benefit birds and water quality (or not!).

Project officers

The project team is led by the Centre for Ecology & Hydrology (www.ceh.ac.uk), a public research centre owned by the UK Natural Environment Research Council (www.NERC.ac.uk) and specialising in integrated land and water research. The whole team brings together specialists from public research centres, universities here and abroad, voluntary bodies, and consultancies. There is a contact email for any queries: (GMEP@ceh.ac.uk) with more information on the project available soon on the WG Glastir website.

As an initial general overview the GMEP project has five key elements:

(i) A national monitoring element to quantify ongoing change in the countryside and impacts of Glastir Entry Scheme recognising there are many drivers of change which affect farmers and the Welsh landscape

(ii) A targeted survey to identify impacts of specific measures within the advanced element of the scheme

(iii) New measurements to fill gaps where we are sadly lacking in information e.g. the diversity of Welsh grasslands and their greenhouse gas emissions

(iv) Integration with data from ongoing monitoring schemes by voluntary and agency bodies (e.g. data held by the Biological Record Centre and Natural Resources Wales)

(v) Modelling to quantify outcomes in areas where direct measures are difficult or beyond the resources of the project (e.g. greenhouse gas emissions and diffuse pollution), to estimate potential future outcomes, and to integrate results and explore trade-offs.

The first two elements require a major investment on a large-scale, rolling annual survey across Wales to assess ongoing change and impacts of Glastir measures on multiple aspects of environmental quality. These include plant diversity, pollinators, birds, topsoil quality, habitat extent and condition (features such as hedgerows and woodlands), stream and pond plants and insects, and landscape quality including a condition assessment of some historic features. The assessments will be carried out on land both inside and outside the Glastir scheme. Surveyors are now working across Wales surveying this year's set of 1 km2 sample sites.

For the national monitoring survey, these squares are selected to produce a representative subsample of land types in Wales, whilst for the targeted survey the squares are selected according to the priorities of WG as indicated by the points available for different target outcomes in the Glastir advanced scheme.

Appendix 1.4 Aspects of Applied Biology Paper

Aspects of Applied Biology ***118****, 2013*
Environmental Management on Farmland

An integrated ecological, social and physical approach to monitoring environmental change and land management effects: the Wales Axis II Monitoring and Evaluation Programme

By B A EMMETT and the Wales AXIS II MEP Team
The Centre for Ecology and Hydrology, Environment Centre Wales, Deiniol Rd, Bangor, Gwynedd LL57 2UW, UK
Corresponding Author Email: bae@ceh.ac.uk

Summary

The Welsh Government has commissioned a comprehensive new ecosystem monitoring and evaluation programme to monitor the effects of Glastir, its new land management scheme, and to monitor progress towards a range of international biodiversity and environmental targets. A random sample of 1 km squares stratified by landcover types will be used both to monitor change at a national level in the wider countryside and to provide a backdrop against which intervention measures are assessed using a second sample of 1 km squares located in areas eligible for enhanced payments for advanced interventions. Modelling in the first year will forecast change based on current understanding, whilst a rolling national monitoring programme based on an ecosystem approach will provide an evidence-base for on-going, adaptive development of the scheme by Welsh Government. To our knowledge, this will constitute the largest and most in-depth ecosystem monitoring and evaluation programme of any member state of the European Union.

Key words: Agri-environment, biodiversity, climate change mitigation, soil and water quality, cultural services, economics, ecosystem services

Introduction

This project will provide a scientifically-rigorous approach to the monitoring and evaluation of the new sustainability land management scheme, Glastir. The scheme replaces a fragmented array of existing schemes and pays for the delivery of specific environmental goods and services aimed at combating climate change, improving water and soil management, maintaining and enhancing biodiversity, managing and protecting the Welsh landscape including the historic landscape and creating new opportunities to improve access and increasing the area and management of woodlands. It adopts an ecosystem approach recognising the potential co-benefits and trade-offs individual intervention measures may have on our Natural Capital and the Ecosystem Services that it delivers. Specific elements of the work include monitoring change in biodiversity, soil and water quality, diffuse pollution, climate change mitigation, landscape including historic landscape, access and economics, combined with modelling work to both forecast likely outcomes and help integrate and upscale results. Benefits from the scheme need to be rigorously evaluated to comply with the EC Common Monitoring and Evaluation Framework (CMEF) for the Rural Development Plan (RDP) for Wales 2007–2013 within one of its four key areas (known

as Axes) called "Our Environment and Countryside". A particular emphasis of this Axis and Glastir is to encourage actions that increase environmental sustainability. The project will assess the cost-benefit of impact of specific measures within an ecosystem framework and the wider benefits to society.

It is a novel and highly ambitious project, which will bring together monitoring from different sectors within a hypothesis-led modelling framework that captures our current understanding. The aim is to provide a robust evidence base as an on-going part of the scheme, to allow for fast iterative assessment of outcomes and thus timely adaptation of scheme payments to maximise benefits.

Materials and Methods

Within any ecosystem monitoring programme, there are multiple measures of specific interest and it is essential that the designed survey is good value for money and has sufficiently power and spatial scale to detect changes and trends in these measures and their inter-dependence, enabling trade-offs and co-benefits to be quantified. It is also desirable to develop a sampling unit which will be robust to potential future changes in scheme design from field to farm to catchment to community-based schemes (and back again), depending on political and/or societal pressures. We have selected a 1 km sampling unit which meets these criteria and also exploits and builds on past survey investments which have used the same sampling unit. In addition, we will exploit a rich array of national datasets to contextualise these 1 km squares where this is required, e.g. using the Land Cover Map to quantify connectivity to landscape features outside the squares, such as woodland and hedgerows, and Digital Elevation Maps and River Flow Networks for catchment boundaries and water resource assessments etc.

One difficulty with investigating the sample size of the 1 km squares required to quantify change and impact of interventions statistically is that the metrics vary over differing scales. Some metrics will have high spatial yet low temporal variability, whereas for others the opposite may apply. Thus, designing a survey to enable detection of changes across time and space for multiple metrics is challenging. We have developed a rolling survey so that we can maximise the number of sites we visit across the national spatial scale whilst at the same time monitoring year-on-year at the national scale, such that changes and trends can be detected cost-effectively. In addition, we maximise the efficiency of field teams by covering as wide a number of ecosystem characteristics as possible within a single visit. To ensure sufficient statistical power for most efficient cost we have undertaken a power analysis of the existing 30 year data record from the UK ecosystem-level, integrated monitoring programme called Countryside Survey (CS) (Carey *et al*., 2008) using the Wales-only data record (Smart *et al*., 2009). (There are little or no data available to test the results of the proposed Glastir intervention measures specifically). The power analysis indicated that a rolling programme of 45 1 km squares per year, revisited every 4 years, should deliver sufficient statistical power to identify stock and change of ecosystem indicators on a 4-year reporting cycle, if the powerful statistical modelling approaches developed for CS are employed. We will repeat this activity within areas specifically targeted by Welsh Government for enhanced payments resulting in a total sample size of 90 1 km squares surveyed each year.

Overall there are three main elements to the evidence-gathering components of the project set within this rolling programme: (a) a modelling framework to forecast changes under low, medium and high uptake scenarios by farmers for selected Glastir measures for priority outcomes, and integrate and upscale results as they are delivered, (b) a national monitoring surveillance programme to quantify on-going change in the countryside and impacts of the All Wales Element (AWE) of Glastir, and (c) a targeted survey to ensure sufficient population of data are obtained from within the areas identified by Welsh Government to receive targeted element (TE) payments for specific agri-environment measures for which a holistic evidence base is lacking (Fig. 1).

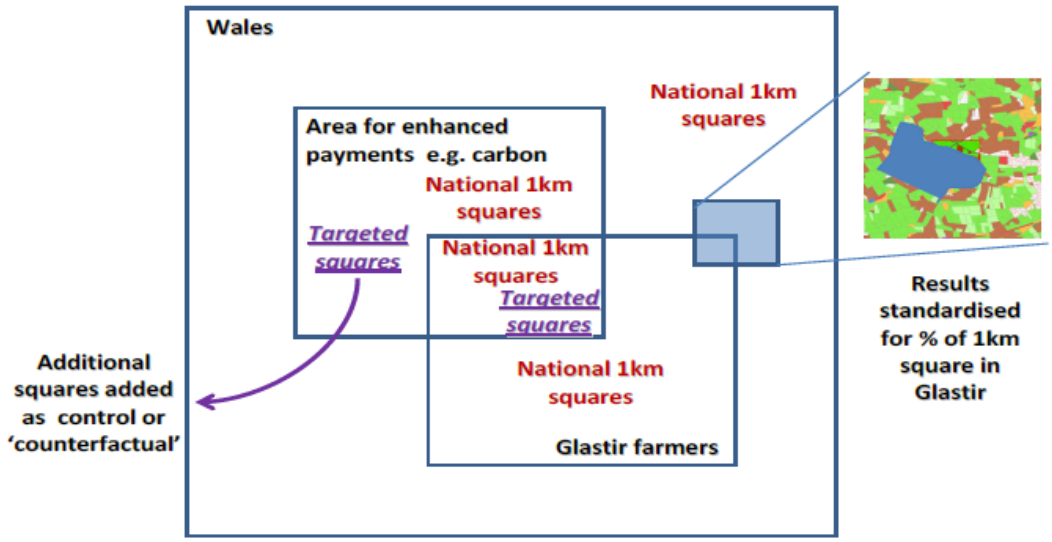

Fig. 1. Schematic illustrating the relationship between the national monitoring scheme and our targeted survey within Wales, targeted areas for enhanced payments and farmers in the Glastir scheme.

For the national monitoring element, a statistically robust, rolling national surveillance programme has been developed, building on methodologies and data from NERC's Centre for Ecology and Hydrology's ecosystem-level monitoring programme called Countryside Survey (CS), which started in 1978 (Carey *et al*., 2008; Norton *et al*., 2012). A Wales-only report was published in 2010 including 30-years of trend information for some aspects of the Welsh environment with implications for ecosystem services reported at a UK level (Smart *et al*., 2009). It is globally unique in adopting an ecosystem approach recording change in plant species, freshwater plants and invertebrates, stream and pond water quality, habitat area, soil quality and linear features, such as stream banks, hedges and walls. This is achieved through a statistically robust sampling design of 1 km squares by a dedicated field team, trained by specialists, with state-of the-art data capture systems, combined with earth observation techniques. We are building on this wealth of data and programme methodology to develop a bespoke, rolling programme for Wales, integrating a range of new social perception and appreciation indicators, visual and historic landscape and access and adding bird and invertebrate monitoring. At the same time, we will ensure full exploitation of a range of other monitoring, modelling and inventory scheme to reduce costs and enhance analysis.

For the targeted survey, additional squares will be selected from areas identified by Welsh Government for enhanced payments for specific measures, e.g. enhanced carbon sequestration, diffuse pollution interventions, habitat creation or protection for specific habitats or species. This will include squares both inside and outside the Glastir scheme to ensure sufficient counterfactuals are available. Monitoring in these squares will be based on the same 4-year rolling programme as for the national monitoring survey and critically, the same full ecosystem level monitoring approach will be followed, by the same survey teams, to enable the full population of both national monitoring and targeted squares to be utilised in any subsequent data analysis.

Data analysis

Rigorous statistical testing of the impact of specific measures and thus scheme impact will be made for the All Wales Element (AWE) as part of the national monitoring surveillance programme comparing change within squares within or outside the AWE scheme against a national average or 'backdrop' and subsets of that data, plus evolution of that change over time (Fig. 2).

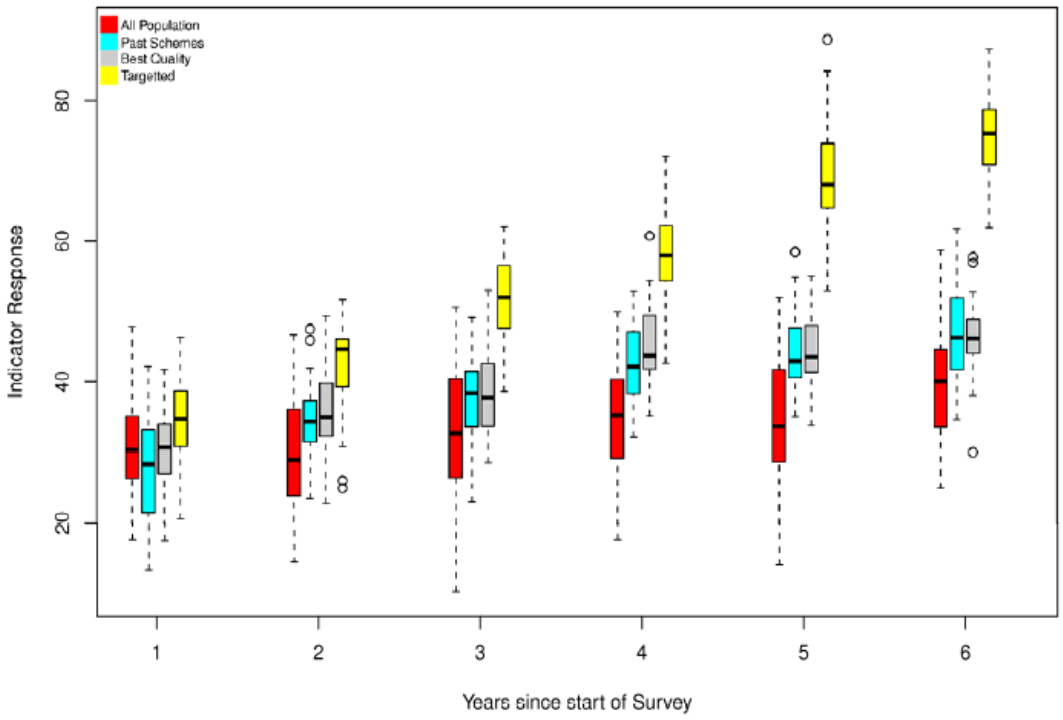

Fig. 2. Potential 'before-after' comparison of hypothetical indicator response from factual and counterfactual monitoring squares in the Wider Wales Countryside (WWC) and Targeted (TS) surveys.

For the Targeted Element (TE) where enhanced payments are available, statistical comparisons will again be made with the national trend data plus with appropriate subsets of this population. If additional control sites have been established to allow a more experimental approach, these will also provide a 'control' (i.e. counterfactual) situation for statistical assessment. We will develop counterfactuals that provide a suitable backdrop against which within scheme measures can be compared, net impact assessed and value for money quantified using the following two tier approach:

Development of a national baseline and trend analysis over time

For the biophysical measures, this will be achieved through our national monitoring element that we have termed the 'Wider Wales Countryside' monitoring or WWC rolling programme, extending the sampling approach developed for Countryside Survey and its 30-year data record. This will provide a general assessment of a robust national average or 'backdrop' against which comparisons can be made, as it will include some sites within and outside the AWE of Glastir, as well as sites with contrasting management within Glastir. Due to the stratified random sampling of the WWC survey, there will be no bias as to which habitat types or other environmental or social-economic heterogeneity exists among the sites surveyed within and outside AWE options. Thus fair comparisons can be made (a) against national averages i.e. a generic comparison, (b) between sites with and without given management and (c) by an approach using 'before-after' comparison following the evolution of the two groups over time in our rolling programme.

Research will take into account knowledge of past agri-environmental policy measures, as well as current and possible future changes in policy (particularly in CAP) and the impact of measures flowing from policy arenas as diverse as the Climate Change agenda, rights of way and rural planning regulations. Such contextual information contributes to the definition of baseline

conditions and provides a framework around which to build indicators of perceptual change against background flux in a wide ranging policy environment. Identification of counterfactual scenarios must take such baseline and contextual conditions into account as well as accommodating changes in those conditions over time.

Targeted element

For assessment of the Targeted Element (TE) of Glastir, additional targeted squares in our Targeted Survey (TS) will ensure as far as possible, there is a sufficient population of squares to identify the impact of the TE. The WWC monitoring will again provide a broad counterfactual scenario and also a comparison between the AWE and TE components of Glastir. Because of this wide-scale monitoring, counterfactuals can be chosen so that within-scheme measures can be compared directly against national averages, or effectively against averages from corresponding subsets or habitat types. For rare components of the targeted elements of Glastir, the WWC survey may not contain sufficient suitable counterfactuals, e.g. when designing a nationwide unbiased survey, these rare habitats are missed because they represent such a small proportion of the national mosaic. In these instances we will survey additional counterfactual sites. These counterfactual sites will be chosen to be as representative as possible of the targeted sites, hence achieving an adequate control. We propose to do this by choosing a site closest to the targeted site in question in an environmental/social ordination space. This ordination space will be based on, amongst other things, land cover, population density, climate, geographic location, geology, road network density and footpath density. For all of these, data are available nationally across Wales, so every 1 km square can be added to the ordination space. This would ensure that any targeted site has sufficient counterfactuals either from specific additional monitoring or from a subset of the WWC.

Measures, changes and trends between the counterfactual scenarios and the Glastir uptake options will be compared using a generalised linear mixed modelling (GLMM) approach. This allows us to compare non-normally distributed data (e.g. Poisson count data), unlike the more simplistic ANOVA methods, and can also account for non-independence resulting from spatial or temporal autocorrelation. Methods ignoring such dependence would underestimate standard errors leading to false inference on any hypothesis testing. The GLMM approach also allows for the inclusion of both main effects of management and interaction terms, allowing for inter-dependence of management effects and background environmental variation. The significance of individual terms in such models is assessed using standard methods, such as likelihood-ratio tests, comparing information criteria or using the non-parametric bootstrap to resample under the null hypothesis. An example potential interaction arises because the societal benefits from changes in habitat quality will depend on whether access rights permit the public to experience the habitat. Delivery of these robust estimates of change are essential for the economic efficiency, cost effectiveness and distributional effect to be undertaken.

Results

Our legacy datasets and trend analyses from past and on-going monitoring programmes will provide an evidence base for Baseline, Result and Impact indicators. A unique strength of our approach is that messages about the causes and consequences of ecosystem and landscape change can be powerfully expressed based on the integrated links between indicators. For example, simultaneously quantifying change in habitat area with the ecological condition of the area by reference to vegetation, soil and waters indicators provides insights into the ecological ‘quality’ of the newly recruited versus lost area, as well as the possible driving variables of which just one driver may be Glastir. Planned work will extend this approach into the landscape, social and economic issues. Thus individual work packages will be relevant for a range of Results and all Impact indicators which will be integrated into an ecosystem services framework. Examples of activities (i.e. Work Packages), indicators and outcomes are listed below:

Species

Work will involve: recording plant species within random permanently marked vegetation plots and additional random plots for eligible Glastir features; bird territory mapping and invertebrate transects; stream kick sampling; stream macrophytes; diatom sampling; topsoil mesofauna and microbial diversity assessments. This will provide Results and Impacts measures indicative of improvement of biodiversity likely to be impacted by agri-environment measures in the wider countryside and their coincidence. This will support reporting for a range of conservation commitments and biodiversity targets, including the Habitats Directive and the Wales Biodiversity Action Plan (which aim to deliver targets set in the Strategic Plan agreed by the Convention on Biological Diversity for 2011–2020). Tested plant species metrics can also be used to quantify impacts of reductions in NO_x and ammonia emissions (estimated from the diffuse pollution work), which cause eutrophication of vegetation and again compromise delivery of biodiversity and conservation targets. This links through to a range of linked policy targets including the National Emission Ceilings Directive and the Gothenburg Protocol 2010 under the Convention on Long Range Transboundary Pollution. More broadly, co-ordinated sampling of such a broad range of biodiversity is unusual and opens many opportunities for investigating co-variation between different groups and the identification of potential proxy indicators.

Habitats

This work package will quantify the creation and loss of habitats both on-going and resulting from Glastir interventions. We will collect data on the extent and condition of habitats (e.g. broad and priority habitats) and landscape features (e.g. hedges) using an existing, GIS system developed for CS. Metrics assessing the permeability and functionality of the landscape (e.g. habitat connectivity, habitat diversity) will be derived from field data and using remotely sensed data, e.g. Land Cover Map, Welsh habitat map and aerial photographs. Data from previous Welsh Agri-environment Schemes (AESs) and past Welsh CS data will be used to assess the fit of the proposed data collection system to report on previous AESs. A field-based pilot phase will determine where additional functionality is required for Glastir. By combining data of cover and quality metrics from across other WPs we will also identify High Nature Value areas of farmland and forestry and maintenance of these areas over time and impacts of interventions. Integrating indicators of habitat cover with other biophysical, social and economic metrics will also provide information on avoidance of marginalization and land abandonment and the role of agri-environment measures and payments in this change. Additional datasets on annual and average change forest cover including new planting from the Forestry Commission will also be exploited if available.

Landscape, historic landscape and access

This workpackage will work closely with the Habitats team and focus on physical and historic aspects of landscape quality. Photographs will be taken from pre-selected positions in all sample squares and an assessment of the current status of selected historic features located in sample squares carried out. Integration of a large number of metrics reported by the survey teams including land use, hedgerow length and condition, other linear features and a range of nationally available data, e.g. digital elevation maps, will enable us to develop 3D ‘viewsheds’ from ‘Rights of Way’ to explore the impact and additionality of interventions on accessibility of the landscape, including historic features, the importance of seasonal change and its overall attractiveness.

Diffuse pollution and climate change mitigation

Activities will exploit a range of modelling, inventory and database tools to report on impacts of interventions on greenhouse gas emissions and diffuse pollution. The main primary dataset will come from a survey of farmer practice with benefits in response to Glastir payments compared to benefits realised from previous AESs that have already quantified using the same survey and

modelling approach (Anthony *et al*., 2012). In addition, two greenhouse gas (GHG) accounting tools, a process-based model and the current UK GHG inventory approaches will be compared to explore their commonalities, suitability and relevance for a range of Welsh Government interests. We will take account of updates in methodologies currently in progress linking through to IACS data and the new rolling Land Cover Map. Data will also provide an evidence base that will contribute towards river basin management planning and reporting under the Water Framework Directive and to the on-going developments of the UK Land Use, Land Use Change and Forestry (LULUCF) and Agricultural Greenhouse Gas Inventories. As there is a critical issue of data limitation in this field, new real-time measurements using eddy covariance equipment will be carried out across Wales on a number of typical farming systems to identify net fluxes of GHG into and out of the systems under a range of soil types, climatic conditions and management.

Soils

Measurements will identify impacts of interventions on a range of topsoil (0–15 cm) quality measures such as soil structure, nutrient status, organic matter, acidity, and biodiversity (mesofauna and microbial). Soil carbon data will also contribute to the evidence base for LULUCF greenhouse gas inventory reporting, with the full suite of measures potentially providing an evidence base should an EU Soils Framework Directive become a reality.

Streams and ponds

Biodiversity assessment of macroinvertebrates, diatoms, macrophytes, and chemical composition of ponds and streams will be integrated with streamside vegetation data, modelled diffuse pollution data and a wide range of national data on landcover, agricultural land-use and water chemistry data within the wider catchment beyond the 1 km square, to identify causal links to a range of drivers including the Glastir interventions. The biological reference condition will be derived using the abiotic environmental data collected in the field entered into existing models: e.g. RICT for stream macro-invertebrates, and LEAFPACS for stream macrophytes. Trends and spatial patterns for ecological quality ratios will be quantified using standard CS statistical methods and integrated with other data.

Economics

This workpackage will focus on economic benefits of intervention measures, with a focus on the impacts of woodlands and capital investments by farmers on their surrounding communities in year 2 and access and recreation in year 4. Linking cost-benefit work to outputs from other work packages will enable the benefits of farmland and forestry payments for ecological quality and function to be assessed. Outputs from the Ecosystem Services workpackage related to changes to a service quantified from the change we record from our monitoring work (both biophysical and social) will provide a basis for establishing benefits, including economic and thus cost-benefit of the additionality of measures. Probability modelling approaches (i.e. Bayesian Belief Networks) will also be adopted, so that further knowledge and uncertainty linking a change we observe to the delivery of the ecosystem service can be included.

Ecosystem services

The aims of this workpackage are to integrate information from across the monitoring and evaluation programme into an ecosystem service framework by linking measurements to service production, and their use, to the likely beneficiaries and whether these are local (e.g. agricultural production), national (e.g. water services) or global (e.g. greenhouse gas emission). To explore the importance of the spatial positioning of measures within the landscape down to a sub-field scale and to enable scenario testing (climate and land management), an ecosystem service analysis tool originally developed in Wales called Polyscape (Jackson *et al*., 2013), now adapted to include climate change scenario and water quality capabilities and called LUCI will be used. The model will be further developed over time to include GHG accounting, improved

biodiversity capabilities by inclusion of the Multimove biodiversity modelling tool (Smart *et al*., 2010) and cultural service measurement incorporating valuation, thereby providing a tool that can be used for a range of purposes by end users.

Quality assurance, data security, outreach and reporting

All data, trend analysis and reports will be made available through a web portal and a stakeholder liaison group who will meet with the project management team once every 6 months to help the team understand farmer perceptions of Glastir and how to best communicate the findings from the project to landowners and the wider community. Data security will be a priority, as will effective and rigorous project management, quality assurance and control.

Discussion

The aims of Glastir are focussed on a wide range of biodiversity ad environmental targets. Through the Glastir interventions, Welsh Government will subsidise farmers for a change in land management practice for goods and benefits to be realised by both current and future generations at local, national, and, in a minor way, global scales. Welsh Government recognize through their spending commitment that the actions of farmers and land owners have value to society, in terms of public goods and services beyond the value received by the farmer in terms of profit derived from maximizing production. Many of these goods and services do not currently have markets or they have markets that are only just emerging. Thus Glastir interventions can substitute and 'purchase' greenhouse gas emission mitigations and biodiversity protection whilst compensating farmers for the reduction in crop or livestock productivity. The key question this monitoring and evaluation programme will ask is: how successful is the Glastir scheme in achieving these public goods and services for the costs incurred? Then, what is the likely outcome in the future and what is the relative effect compared with e.g. other on-going drivers, past schemes in Wales and similar AES elsewhere?

Acknowledgements

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Appendix 1.5. Milestones and Deliverables

M or D	Description of activity	Deadline (End of Month)
WP1 Project management		
M	Project Management team, Project lead and WP leaders in post	1
M	Inception meeting	1
M	Strategy and priorities for targeted element to be discussed with Steering Committee	9
D	Annual stakeholder workshop	3,5
M	Project Board telecon (quarterly)	3 and quarterly
M	Project support staff in post	1,6
D	Steering Committee Meetings (6 monthly)	9 and 6 monthly
D	Quarterly update report including WP analysis	month 3 and quarterly
D	Delivery report against milestones in order to award extension	24
D	Annual report	month 12 and annually
D	Annual report - amendments to accommodate revised CMEF requirements	24
D	Final report	49
D	Policy workshop	49
WP2 Field teams		
M	Biophysical field surveyors in post	8 and annual
M	Socio-economic field surveyors in post	17
M	Purchasing of soil and water sampling kit	7,8
M	Selection of test squares for national and targeted elements	7
M	Training for all field teams	8 and annual
M	Uploading all GIS and data required for year 1 survey	7
M	Start survey of 45 rolling programme years 2-4	20 and annual
D	End survey of 45 rolling programme	26 and annual
WP3 Informatics		
M	Purchase IT kit	1
M	Review and editing of field survey protocols	1
M	Purchase of sample set of field sampling kit	1
M	Development of IT/software tools	2
M	Statistical approach formalised	2
D	Delivery of statistical scripts for automated analysis direct from field to portal	24
M	Selection of test squares for national and targeted elements	7

M or D	Description of activity	Deadline (End of Month)
M	Uploading all GIS and data required for test squares for year 1 survey	7
M	Databasers in post	3
M	web portal designer in post	17
D	Web portal design and launch	35
M	Pilot Phase I – testing field methodologies, protocols and kit	5
D	Database design	8
M	Pilot review and revision	1,9
WP4 Landscape		
M	Extract LandMAP	2
M	Construct Natural / Crop calendars	3,9,19,20
M	Coding / GIS methods	4,15,16,34,37
D	Viewshed construction, 3D analysis	5
M	Development of seasonal Swatches	14,21,28
M	Targeted element, landscape change impact on quality, 10 years on	8,19,24
M	Development of landscape perception approach	12
M	Web-based study to assess perceptions of landscape quality	24
D	Detailed Visualisation work for sample landscapes	24 and annual
WP5 Habitats		
M	Recruitment of analytical staff	3
M	Training analytical staff	7,
M	Further collection and collation of data e.g. remotely sensed data to add value to field survey	11,22,33
M	QA	11,22,33
M	QC	18,30, 42
M	Collate data for woodland habitat and compare to GMEP data	12 and annual
M	Explore possible metrics for HNV reporting and liaise with stakeholder groups	12
D	Deliver outcome of study exploring possible metrics for HNV and apply to GMEP data if required by WG	24
D	Analysis and reporting of field data; basic analyses-stock and change of habitat and habitat connectivity	18,30, 42
D	Analysis and reporting of field data: attribution to explanatory variables	18,30, 42
D	Analysis and reporting of field and remotely sensed data: Development of habitat species indices	18,30, 42
WP6 Species		
M	Collation & analysis of previous AES effects	15,28,40, 49
M	Bird surveys	4, 15,28,40, 49
M	Plant surveys	4, 15,28,40, 49
M	Invertebrate surveys	4, 15,28,40,

M or D	Description of activity	Deadline (End of Month)
		50
M	Species QA	9
D	Build scheme of plausible causal/correlative relationships between all indicators and driving variables	15
M	Provisional trend assessment from Biological Recording Data from Wales	12
D	MulitMOVE model calibration and parameterisation for 6 interventions for 2 test catchments	12
M	Further development of Multimove model to enable national projections	24
D	Analysis and reporting of field data; basic analyses-stock and change of species,	18,30, 42
D	Analysis and reporting of field data: attribution to explanatory variables	18,30, 42
D	Analysis and reporting of field and remotely sensed data: Development of species indices	18,30, 42
WP7 Water		
M	Collation of existing data	16
M	Laboratory Analysis of Water Samples	14 to 46
D	Laboratory Analysis of Water, Macro-invertebrate Samples	16
D	Modelling relationships between biotic and abiotic characteristics	24
M	Linking temporal metrics of biodiversity and water chemistry	19, 31, 46
M	Laboratory Analysis of Diatom Samples	16 to 49
D	Data analysis and reporting -integrated field survey and data for existing sources.	24
WP8 Soils and carbon		
M	Sample collection in rolling programmes	15,28,40,47-
M	Sample prep., analysis, QA and QC	6,7,8
M	Data synthesis	24 and annual
M	Peatland and Biodiversity method testing	12
D	Delivery of national erosion risk model outputs	12
D	Analysis and reporting of field survey data	24
WP9 Diffuse pollution and Climate change mitigation		
M	Design of farm-based questionnaire	15
M	Development of modelling framework for load and emission estimation	9
M	Capture of farm-based data	15, 27, 39
M	Purchase flux tower equipment	12
M	Deploy towers in the field	15
M	Develop methods for wider benefits of Glastir Efficiency Grants	12
D	ADAS model calibration and parameterisation for selected interventions at national scale	12 and annual
D	Bangor carbon footprinting tool application for selected interventions for test farms	12 and annual
D	ECOSSE calibration and parameterisation for selected interventions at national scale	24 and annual

M or D	Description of activity	Deadline (End of Month)
D	Estimate national diffuse pollutant loads and greenhouse gas emissions	12 and annual
D	Provide estimates of current emissions of GHG from range of Welsh grasslands	24
D	Provide assessment of wider benefits of Glastir Efficiency Grants	24
D	Comparison of modelling approaches to inform strategy for Yr2 onwards	12
D	Report of modelled GHG fluxes, implications for Glastir and for national GHG accounting	24
D	Further development of ADAS model to test out interventions not currently in Glastir scheme	24
WP10 Economics		
M	Systematic assessment of literature to identify existing valuation evidence for benefits transfer.	6
M	Develop questions for inclusion in WP 9 Farmer Practice Survey	15
M	Conduct benefits transfer analysis.	22
D	Interim economic valuation report based on benefits transfer and preliminary results of WPs2-11	24
M	Review qualitative information collected by WP 9	16
M	Pilot study to assess Common Land scheme perceptions	12
D	Conduct study into evidence gap area (Commons or woodlands)	24
WP11 Integration and Ecosystem Services trade-offs		
M	Re-analyse CS Wales data only to explore convergence of ecosystem functions	12
D	LUCI calibration and parameterisation for selected interventions at national scale	12
D	Explore trade-offs using the LUCI model for 2 test catchments for 6 interventions	15
D	Explore trade-offs using the LUCI at a national scale for 6 interventions	24
D	further develop LUCI to incorporate additional services and apply to new interventions	24

Appendix 2.1. Technical Characterisation of Selected Management Options

(AWE 9b) Create Streamside Corridor on Improved Land with Tree Planting

The Glastir technical guidance requires that the average total width of the corridor is 7 m and that it is planted with broadleaf trees at a density of 30 per 100 metres. The corridor extends across both sides of a stream. Livestock are excluded by fencing and no applications of manufactured fertiliser or manure are permitted. We assumed that the whole of the corridor area is taken from adjacent improved grassland or arable land, resulting in the introduction of a riparian buffer strip that did not previously exist. The average areas of improved grassland and arable fields are 2.4 and 3.6 ha respectively (Land Parcel Information System, 2009), and the streamside corridor occupies an entire side length. The productive forage area and total livestock numbers on a farm participating in Glastir are reduced in proportion to the corridor area and estimated typical improved grassland stocking rates of 1.06 GLU ha^{-1} for sheep, 1.36 GLU ha^{-1} for beef cattle and 2.89 GLU ha^{-1} for dairy cattle, based on a sample of farms with no rough grazing (Wales Farm Practice Survey, 2012).

Modelled baseline pollutant losses from livestock excreta and the spreading of managed manures are reduced in proportion to the change in total livestock number on a farm. Losses from manufactured fertiliser applications are reduced in proportion to the change in the improved grassland and arable area receiving fertiliser. A mature corridor with dense undergrowth is also estimated to reduce soluble and particulate pollutant losses in surface runoff from immediately adjacent fields by 50 and 80% respectively (Zhang *et al*., 2010; White and Arnold, 2009). This runoff infiltration and pollutant trapping function is retarded by up to 50% in areas of steep slopes as runoff is concentrated and moves too fast for the corridor to be effective (Collins *et al*., 2009). Damage to the river bank by trampling and shear are prevented and bank retreat rates are estimated to decline by 50% along the length of the corridor providing that animals are totally excluded from the watercourse (Agourdis *et al*., 2005; Collins *et al*., 2010).

Both LUCI and MultiMOVE modelling assumed that the target habitat would be broadleaved woodland. For LUCI, a proportion of streamside segments meeting the criteria for establishment and consistent with the projected estimated uptake were sampled and assigned as broadleaved woodland with the appropriate parameters. For MultiMOVE, estimates of changes in soil properties and canopy height were gained from literature sources tracking the changes occurring as a result of succession following agricultural abandonment (Poulton *et al*., 2003; Bossuyt *et al*., 1999). Soil pH decreased by an average of 1.33 units and C:N ratio increased by 1.01 over 23 years of woodland growth. The period was chosen as the shortest period for which there were estimated values of soil change due to succession. Changes in cover weighted canopy height (CWCH), based on the canopy height classes of Grime (1988), and were estimated by taking an average from streamside plots in the Countryside Survey recorded as woodland in 2007 that were mid-successional semi-improved or improved habitats in 1990. Average cover weighted canopy height increased from 10-30 cm (arable) or 30-60 cm (improved grass) to 1-3 m for woodland plots. The creation of streamside corridors is assumed to have the same impact on soil properties and canopy height as woodland expansion (AWE 24) due to lack of specific data on woodland establishment on streamsides.

The total number of farms participating in the Glastir scheme limits the impact of the management option at landscape scale, as does the proportion of these with fields located adjacent to watercourses that are not already buffered by existing walls, hedge or tree lines. Participation and uptake of the management option was targeted at the Lowland and Less-Favoured-Area Cattle and Sheep farms (CS-LOW and CS-LFA) and prioritised within the areas identified as Water Quality Priority Catchment areas (Welsh Government, 2011). Maximum projected uptake was 73% of farms within the Priority Catchment areas and 35% elsewhere. The proportion of all fields managed by these farms that are adjacent to a watercourse varies regionally between 20 and 80% with a national

average of 50% (OS Master Map, 2001). It is estimated that 67% of lowland and 75% of upland field boundaries marked by streams presently lack a streamside corridor (Countryside Survey - Linear Boundary, 1998). These values are similar to the 52% of DAIRY and 78% of CS-LFA farms reported to permit livestock direct access to watercourses for drinking (Wales Farm Practice Survey; Anthony *et al*., 2012).

(AWE 28) Retain Winter Stubbles

The Glastir technical guidance requires that straw be removed within 2 weeks of harvest and natural regeneration of grasses and broad leaf plants is allowed. The stubble must not be cut before 15th February or ploughed, cultivated or direct drilled before 15th March. It is permissible to graze the stubble to a maximum level of 0.4 livestock units per hectare. Maize and under-sown stubbles are not acceptable. The use of herbicides is not permitted except for spot treatment of notifiable weeds of invasive alien species.

For this study we assumed that the management option is applicable only to the area of spring cereals and oilseed rape that comprises 30% of the total arable land area in Wales (June Agricultural Census, 2010). We assumed that stubble without desiccants achieves a ground cover of between 20 and 40% that protects the soil from raindrop impact (British Trust for Ornithology, 2002). This directly reduces the baseline modelled mobilisation and loss of sediment and particulate phosphorus by an estimated 30% over the winter months. Delaying tillage until spring also delays the stimulation of soil nitrogen mineralisation and reduces total nitrate leaching by an estimated 30% (Stenberg et al., 1999; Hansen and Djurhuus, 1997; Vinten et al., 1991; Silgram and Shepherd, 1999). Sowing of a catch or cover crop in place of winter stubbles will stimulate soil nitrogen mineralisation. This is compensated for by nitrogen uptake by an actively growing crop and nitrate leaching is reduced by an estimated 60% providing there is early and good establishment (Silgram, 2005; Lord et al., 1999). Improved ground cover also reduces soil losses by an estimated 60% (Stevens and Quinton, 2009). However, catch crops are unpopular because of the additional cost of sowing an additional crop and the risk of late establishment of the following spring crop. An estimated 60% of the arable land area (excluding the area of autumn sown winter crops) in Great Britain is left over winter under plant residues or stubble from previous harvests, in comparison to less than 10% under a purpose-sown catch crop (Survey of Agricultural Production Methods, 2010). The analysis presented is therefore for retained winter stubbles only.

The total number of farms participating in the Glastir scheme limits the impact of the management option at landscape scale, as does the relatively small area of relevant spring cereals (24,000 ha) in comparison to other arable land and improved grassland (1,215,000 ha). Participation and uptake of the management option was targeted at all of the Grazing Livestock and Arable Cropping farm types (CS-LFA, CS-LOW, DAIRY, MIXED, CEREAL and GENERAL) and prioritised within the areas identified as Water Quality Priority Catchment areas (Welsh Government, 2011). Maximum projected uptake was 73% of farms within the Priority Catchment areas and 35% elsewhere.

(AWE 41a) Grazing Management of Open Country

The Welsh Government (2012) defined sustainable stocking rates and estimated typical stocking rates for each type of habitat mapped by the Phase One Habitat Survey for Wales (Countryside Council for Wales, 2004):

Habitat Type	Sustainable Rate	Typical Rate
Unimproved acid grassland	0.30	0.60
Dry basic heath	0.30	0.40
Bracken	0.20	0.30
Blanket bog	0.05	0.23
Dry heath/acid grassland mosaic	0.40	0.50
Marshy grassland Molinia dominated	0.30	0.75
Acid/neutral flush	0.20	0.25
Wet heath	0.20	0.38
Wet modified bog	0.05	0.23
Wet heath/acid grassland mosaic	0.30	0.49
Dry modified bog	0.05	0.23

Table.1 Sustainable and estimated typical stocking rates (GLU ha-1) for habitat types (Welsh Government, 2012)

The sustainable stocking rates are similar to those that can be derived from the analyses of Pakeman and Nolan (2009) and limiting utilisation of a year's vegetative growth to between 20 and 30% to achieve no change in the proportions of heather and grasses on moorland. For this study a provisional map of Open Country (excluding any common land) was combined with the Phase One Habitat Survey map to identify relevant agricultural fields and their habitat type. The total habitat area was 146,100 ha and the majority was unimproved acid grassland (33%) or dry acid heath (20%).

Habitat land is defined as vegetation which has a composition of less than 25% sown agricultural species, as per the Environmental Impact Assessment (Agriculture) (Wales) (EIA) Regulations 2007. For this study it is assumed to be synonymous with unimproved or rough grassland that may have been treated with low levels of farmyard manure but should not have had sufficient applications of manufactured fertiliser to alter the sward composition. We assumed that only sheep are grazed on unimproved or rough grassland. The product of the habitat areas and the difference between the sustainable and typical stocking rates therefore defined a maximum reduction in total adult sheep numbers of 34,100 GLU nationally. The area-weighted average stocking rate on the Open Country habitat area declines by 45%. The potential reduction in sheep numbers was distributed between catchment areas according to the map of Open Country.

LUCI was parameterised to support changes in stocking rates and fertiliser applications by fitting regression equations to data from Anthony et al. (2012). This data was also used to estimate baseline average nutrient export with average stocking and fertiliser rates for consistency. Other estimates (e.g. carbon) retained the default parameterisation for the input land cover class, as the literature is unclear on magnitude and directions of change caused by interventions of this type on most of the other processes represented within the LUCI set of models.

Participation and uptake of the management option was targeted at the Less-Favoured-Area Cattle and Sheep farm type (CS-LFA) that manage 194,580 ha out of 201,900 ha of sole rights rough grazing nationally. Maximum projected uptake was 100% of all farms within the catchments identified as containing Open Country land and zero elsewhere. Modelled baseline pollutant losses arising from sheep excreta and managed manure were reduced in proportion to the change in total adult sheep numbers on a target farm, and soil erosion on the rough grazing area caused by over-grazing was also reduced proportionally.

(AWE 24) Allow Woodland Edge to Develop Out into Adjoining Fields

The Glastir technical guidance requires that the woodland edge is extended 6 m out into the adjacent field and fenced off to exclude livestock if present. No under-grazing is permitted, and no

supplementary feed can be provided to stock in the affected field. The effect is to reduce the productive forage and crop areas.

The average areas of improved grassland and arable fields are 2.4 and 3.6 ha respectively (Land Parcel Information System, 2009), and the woodland expansion occupies an entire side length. The productive forage area and total livestock numbers on a farm participating in Glastir are reduced in proportion to the new area of woodland and estimated typical improved grassland stocking rates of 1.06 GLU ha-1 for sheep, 1.36 GLU ha-1 for beef cattle and 2.89 GLU ha-1 for dairy cattle (Wales Farm Practice Survey, 2012).

Modelled baseline pollutant losses from livestock excreta and the spreading of managed manures are reduced in proportion to the change in total livestock number on a farm. Losses from manufactured fertiliser applications are reduced in proportion to the change in the improved grassland and arable area receiving fertiliser. As this is an extension to an existing woodland parcel at the field boundary there is no change in the overall connectivity of the landscape or the buffering of pollutants in surface runoff from the field. There is a long-term reduction in soil nitrogen and phosphorus content under the woodland extension and soil erosion and nutrient leaching decline to levels modelled for existing woodland parcels in a catchment.

For the MultiMOVE modelling, as discussed in relation to streamside corridors, estimates of changes in soil properties and canopy height as a result of woodland expansion were gained from literature sources tracking the changes occurring as a result of agricultural abandonment (Poulton et al., 2003; Bossuyt et al., 1999). For woodland expansion the starting habitat was assumed to be improved grassland and the target habitat to be broadleaved woodland. The changes in soil properties were averaged between studies to produce estimates of a decrease in pH of 1.33 units and an increase in C:N ratio of 1.01 over 23 years of woodland growth. Changes in cover weighted canopy height (CWCH), based on the canopy height classes of Grime (1988), were estimated by taking an average CWCH from plots in the Countryside Survey recorded as woodland in 2007 that were mid-successional semi-improved or improved habitats in 1990. Average canopy height increased from 30-60 cm in the improved grass baseline to 1-3 m for woodland plots. The LUCI model is already set up to support Welsh broadleaved woodland as an input. Similarly to the 'Streamside Corridor' option, a proportion of the segments meeting the criteria for woodland expansion and consistent with the projected estimated uptake were sampled and assigned to be broadleaved woodland.

The total number of farms participating in the Glastir scheme limits the impact of the management option at landscape scale, as does the proportion of these with fields located adjacent to existing woodland that can be extended. Participation and uptake of the management option was targeted at the Lowland and Less-Favoured-Area Cattle and Sheep farms (CS-LOW and CS-LFA) and prioritised within the areas identified as Water Quality Priority Catchment areas (Welsh Government, 2011). Maximum projected uptake was 73% of farms within the Priority Catchment areas and 35% elsewhere. The proportion of all fields managed by these farms that are adjacent to existing woodland averaged 50% for improved grassland and 40% for arable land (Land Parcel Information System, 2009; Phase One Habitat Survey, 2004).

(AWE 15) Grazed Permanent Pasture with No Inputs

The Glastir technical guidance requires that no manufactured or organic fertiliser nitrogen be applied to permanent pasture. The pasture must continue to be grazed, although a reduction in overall stock number carried by a farm may be expected if the option is applied to a large area.

Average stocking rates on a sample of Welsh sheep farms using or claiming not to use manufactured fertiliser nitrogen are 1.04 GLU ha-1 and 0.83 GLU ha-1 respectively. For farms with beef cattle only, the average stocking rates are 1.41 GLU ha-1 and 1.08 ha-1 respectively (Wales Farm Practice

Survey, 2012). These data suggest a 20% reduction in total stock number in the absence of manufactured nitrogen. Modelling of forage production with the N-CLOVER model (Scholefield et al., 1991) at specific nitrogen fertiliser rates typical of cattle and sheep farms in Wales predicted a larger 26 to 35% reduction if all fields were initially receiving nitrogen (see Appendix 2.2). The modelled reduction would be higher on dairy farms utilising high rates of fertiliser nitrogen, and on farms that do not sow a clover mix. The British Survey of Fertiliser Practice (2008 to 2010) reports that only 56% of permanent pasture in Wales receives manufactured fertiliser nitrogen, and the Wales Farm Practice Survey (2012) reported that only 57% of farms with sheep and beef cattle only (not dairy cattle) claimed to use manufactured fertiliser nitrogen (see Appendix 2.2).

For this study we assumed that the management option is taken up on all permanent pasture on a farm. Hence, modelled baseline pollutant losses from manufactured fertiliser are reduced to zero. We also assumed a 15% reduction in grazing livestock number, averaged across the farms presently using and not using manufactured fertiliser nitrogen. Baseline pollutant losses from livestock excreta and the spreading of managed manures are reduced in proportion to the change in total livestock number on a farm.

For MultiMOVE modelling grazed pasture with no inputs was assumed to have a starting habitat of improved grassland and a target habitat of neutral grassland. Changes in soil pH and C:N ratio as a result of removing nitrogen inputs were estimated from three studies of fertilizer cessation on improved grasslands (Olff and Bakker, 1991; Pywell et al., 2007; MICROSITES final report, unpublished). A 12 year time period was used as this corresponded to available literature. Average values from the literature indicated an increase in C:N ratio of 0.86 and a decrease in pH of -0.50 units. Because the prescription defined target canopy height (at least 20% below 7 cm and at least 20% above 7 cm) models were run considering an average cover weighted canopy height of either below 10 cm or between 10 and 30 cm. LUCI used the regression equations derived from output from Anthony et al. (2012) to estimate changes in nutrient export, as discussed for the 'Open Country' option, and for other estimates retained its default improved grassland parameters.

Participation and uptake of the management option as targeted at the Lowland and Less-Favoured-Area Cattle and Sheep farms (CS-LOW and CS-LFA) and prioritised within the areas identified as Water Quality and Soil Carbon Priority Catchment areas (Welsh Government, 2011). Maximum projected uptake was 55% of farms within the Priority Catchment areas and 35% elsewhere.

(AWE 44) Mechanical Bracken Control

The Glastir technical guidance requires that bracken be controlled by cutting and rolling rather than spraying chemicals. A minimum of two cuts per year must be undertaken for years 1 to 3, and one cut for years 4 to 5 of a Glastir contract. All cutting must take place between 1st May and 15th August. Spraying is not allowed under this prescription.

MultiMOVE modelling assumed that the starting habitat for bracken control was bracken (defined as having over 95% cover of bracken) and the target habitat was either acid grassland or heath. Prescriptions ran for 10 years which was the longest period for which there was information on soil changes as a result of bracken control. Because none of the published literature followed the Glastir prescription exactly models were run under two scenarios; bracken cut once a year for 10 years and bracken cut twice a year for 10 years. Changes in soils were based on values reported by Mitchell et al. (1999) and Marrs et al. (2007) and predicted an average increase in soil pH of 0.15 units and an increase in C:N ratio of 0.2 (bracken cut once per year) to 1.6 (bracken cut twice per year). Values for the average reduction in percentage cover of bracken on acid grassland and heath were retrieved from a multi-site study by Cox et al. (2007) to calculate changes in cover weighted canopy height. Bracken control on acid grassland was more successful, averaging a reduction of 93-96% in percentage cover compared to a reduction of 33-80% in heath. In both cases cutting twice a year

reduced bracken cover further than cutting once a year. Starting cover of bracken was also variable between target habitats, averaging 50% on acid grassland and 95% on heath. These values were used to estimate changes in cover weighted canopy height from 10-30 or 30-60 cm in bracken in acid grassland and heath respectively to less than 10cm in bracken stands on acid grassland cut twice a year with intermediate values for heath stands and acid grassland stands cut once a year.

Participation and uptake of the management option was targeted at the Lowland and Less-Favoured-Area Cattle and Sheep farms (CS-LOW and CS-LFA) and prioritised within the areas identified as Bracken Control Priority Catchment areas based on a mapping of bracken stands from the Phase One Habitat Survey dataset (Countryside Council for Wales, 2004). Maximum projected uptake was 65% of farms within the Priority Catchment areas and 35% elsewhere.

Appendix 2.2 Supporting Survey and Independent Model Data

Livestock Type	Stock Density (GLU ha^{-1})			
	Without Fertiliser		With Fertiliser	
	Average (*s.e*)	*n*	Average (*s.e*)	*n*
Sheep	0.83 (0.07)	46	1.04 (0.15)	29
Beef Cattle	1.08 (0.12)	27	1.41 (0.15)	36
Sheep and Beef Cattle	1.24 (0.08)	86	1.49 (0.10)	111
Dairy Cattle	2.39 (0.17)	3	2.82 (0.12)	44

*Stocking rate is per hectare of improved grassland and sole rights rough grazing

Table B4.1 Average stocking rates (GLU ha^{-1}) and numbers of farms using manufactured nitrogen fertiliser, for a sample of conventional Welsh farms with sheep, beef or dairy cattle only (Wales Farm Practice Survey; Anthony *et al*., 2012).

Robust Farm Type	Overall Rate (kg N/ha)		Field Rate (kg N/ha)		Pasture Area Receiving Nitrogen (%)
	Average (*s.e*)	*n*	Average (*s.e*)	*n*	
DAIRY	138 (8.09)	115	154 (7.7)	100	90
CS-LOW	39 (8.35)	44	88 (10.20)	25	44
CS-LFA	38 (2.35)	394	67 (2.70)	256	56
MIXED	60 (9.44)	36	93 (9.57)	21	65

Table B4.2 Average rates of manufactured fertiliser nitrogen applied to permanent grassland in Wales, by Robust Farm Type (British Survey of Fertiliser Practice, 2008 to 2010).

Soil Type	Sward Age (yrs)	Clover	Dry Matter Production (kg yr^{-1})	
			No Fertiliser	With 70 kg N ha^{-1} Fertiliser
Clay Loam	7 to 10	Yes	7,825	8,259
	21+	Yes	8,022	8,455
	7 to 10	No	2,820	4,873
	21+	No	3,803	5,665
Sandy Loam	7 to 10	Yes	7,755	8,193
	21+	Yes	7,933	8,368
	7 to 10	No	2,584	4,671
	21+	No	3,476	5,391

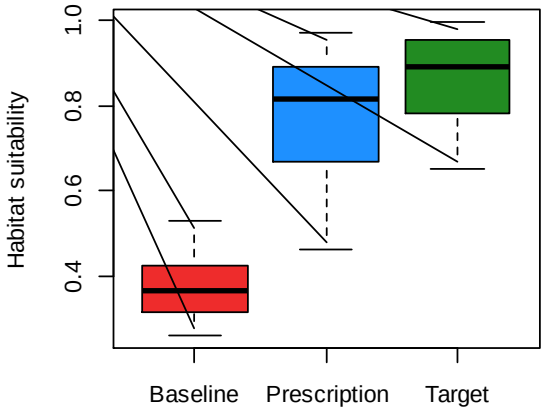
Table B4.3 Modelled annual dry matter production for grazed permanent grassland in Wales, calculated using the N-CLOVER model (Scholefield *et al*., 1991) for swards with and without clover, at typical field rates of manufactured fertiliser nitrogen.

Appendix 2.3 MultiMOVE modelling results

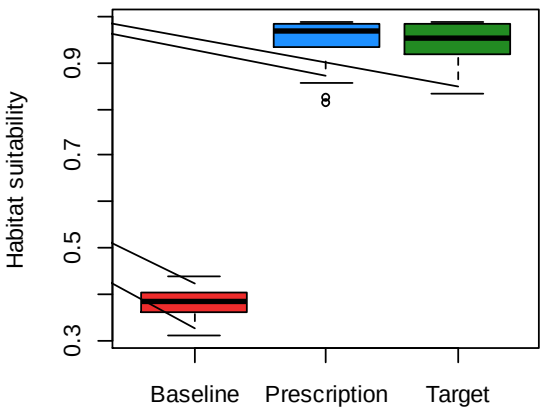
Woodland expansion (AWE 24)

Scenarios cover 23 years of natural succession based on the Geescroft and Broadbalk datasets. Baseline habitat is improved grassland and target habitat is broadleaved woodland; representative data taken from the CS vegetation data to provide information on soils and canopy height in starting and target habitats.

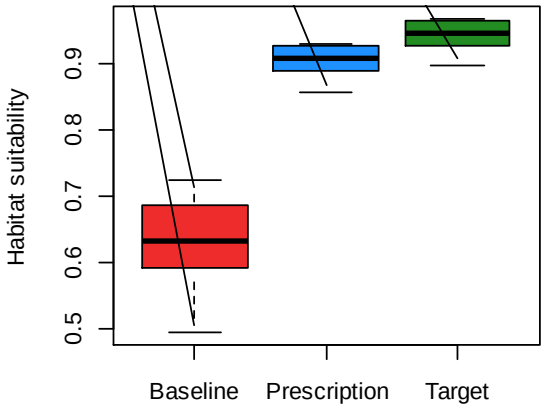
Rubus fruticosus



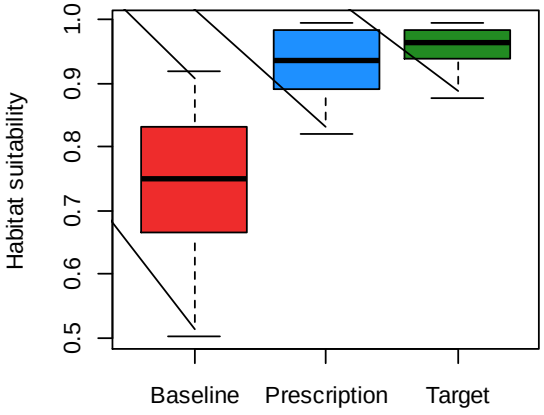
Fraxinus excelsior



Corylus avellana



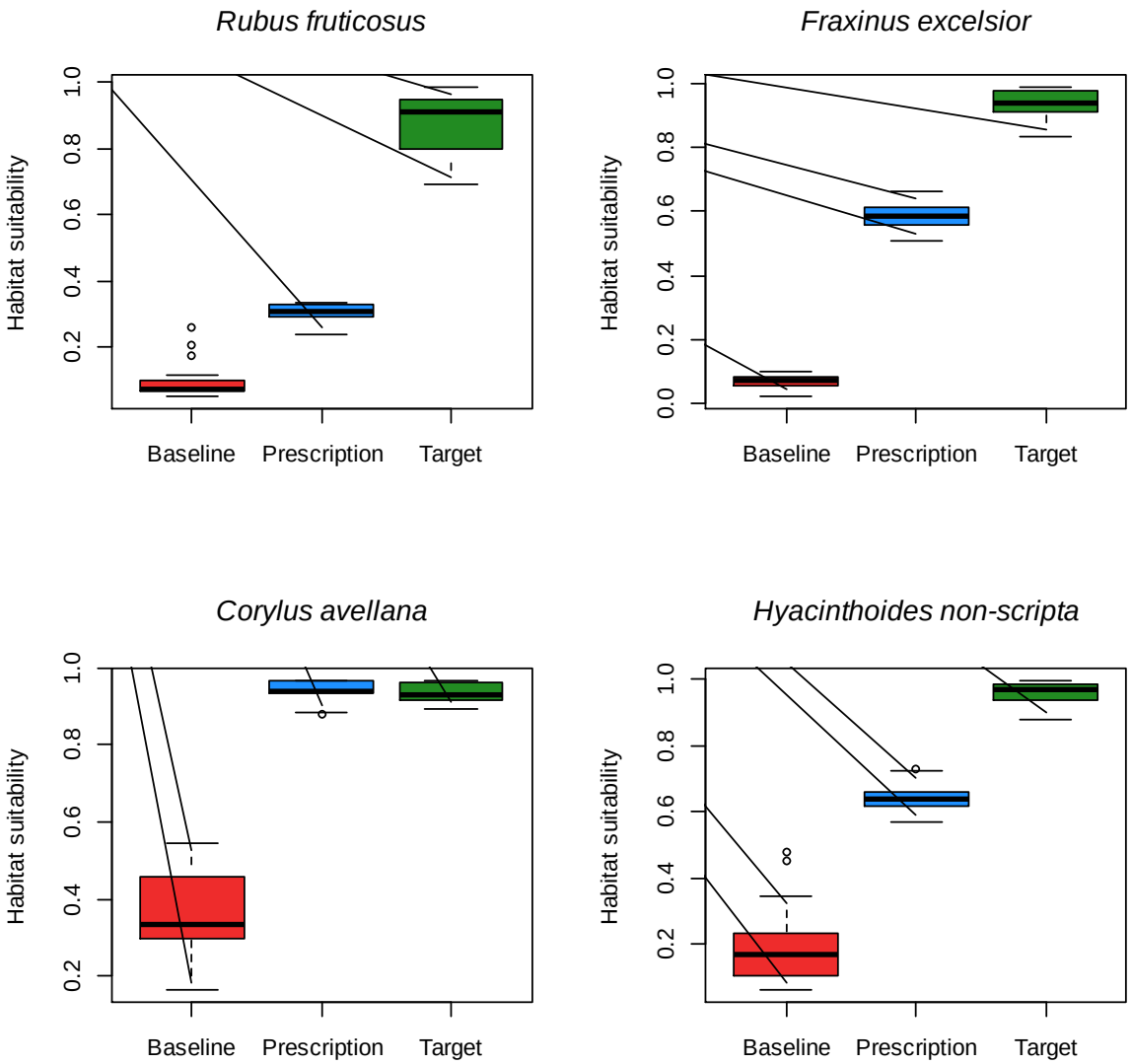
Hyacinthoides non-scripta



Streamside buffer strips (AWE 9B)

Prescription impacts modelled for creation of streamside corridors on either improved grassland or arable land. Due to lack of data on effects of corridor formation on soils and canopy height values used are the same for woodland expansion as the target habitat is the same. Therefore, only results for corridor establishment on arable land are presented as the results for improved grassland are the same as for the woodland expansion prescription.

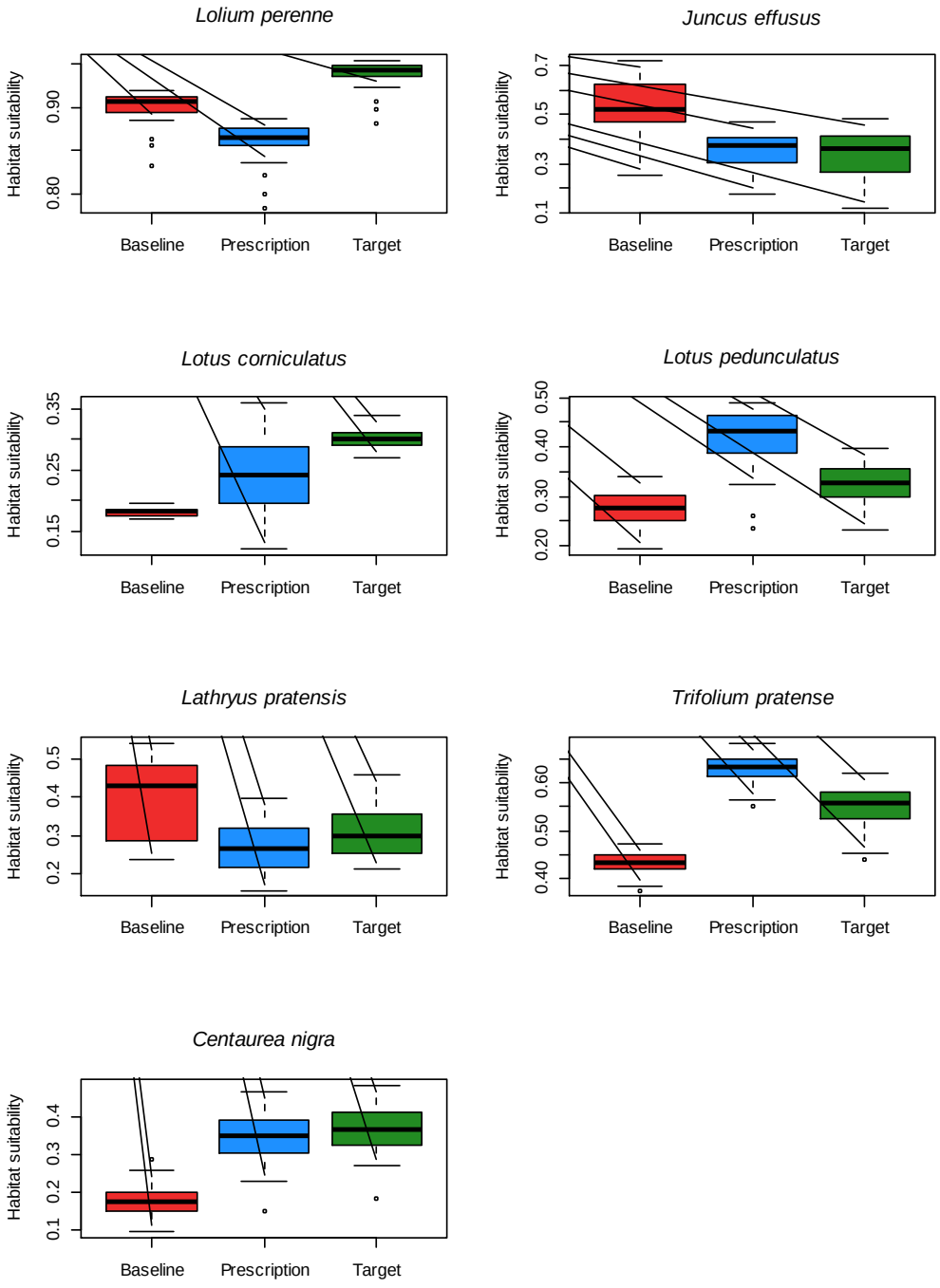
On arable land



Low input grassland (AWE/Advanced 15)

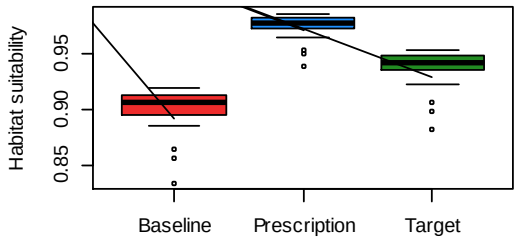
Prescriptions were for low inputs of N (no fertiliser) over 12 years on improved grassland (baseline habitat). Target habitat is considered to be neutral grassland. Vegetation height is also defined by the prescription as 20% below 7cm and 20% above 7cm therefore models were run under two average vegetation height scenarios (below 10cm and 10-30cm).

Average sward height < 10cm (class 1)

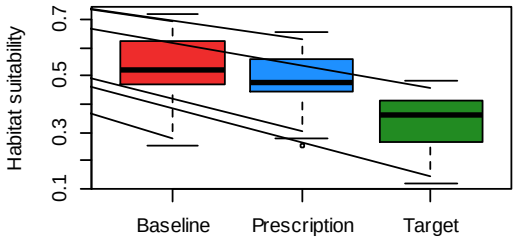


Average sward height 10-30cm (class 2)

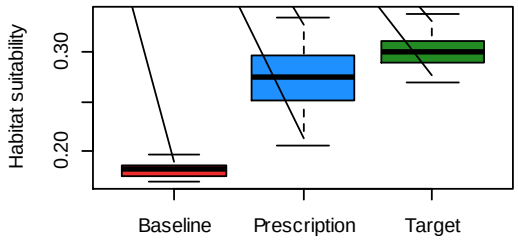
Lolium perenne



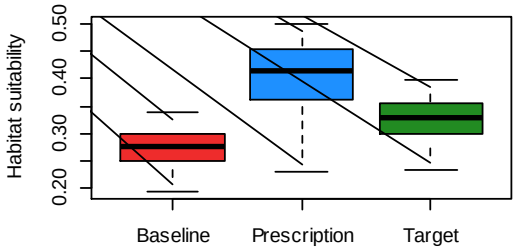
Juncus effusus



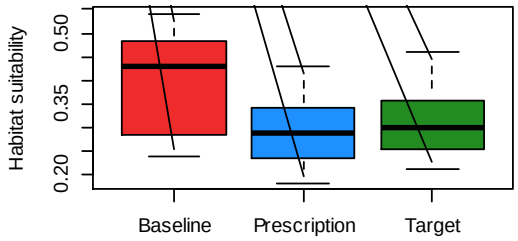
Lotus corniculatus



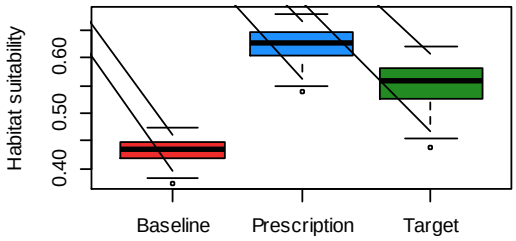
Lotus pedunculatus



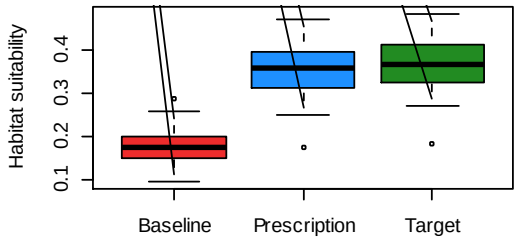
Lathryus pratensis



Trifolium pratense



Centaurea nigra



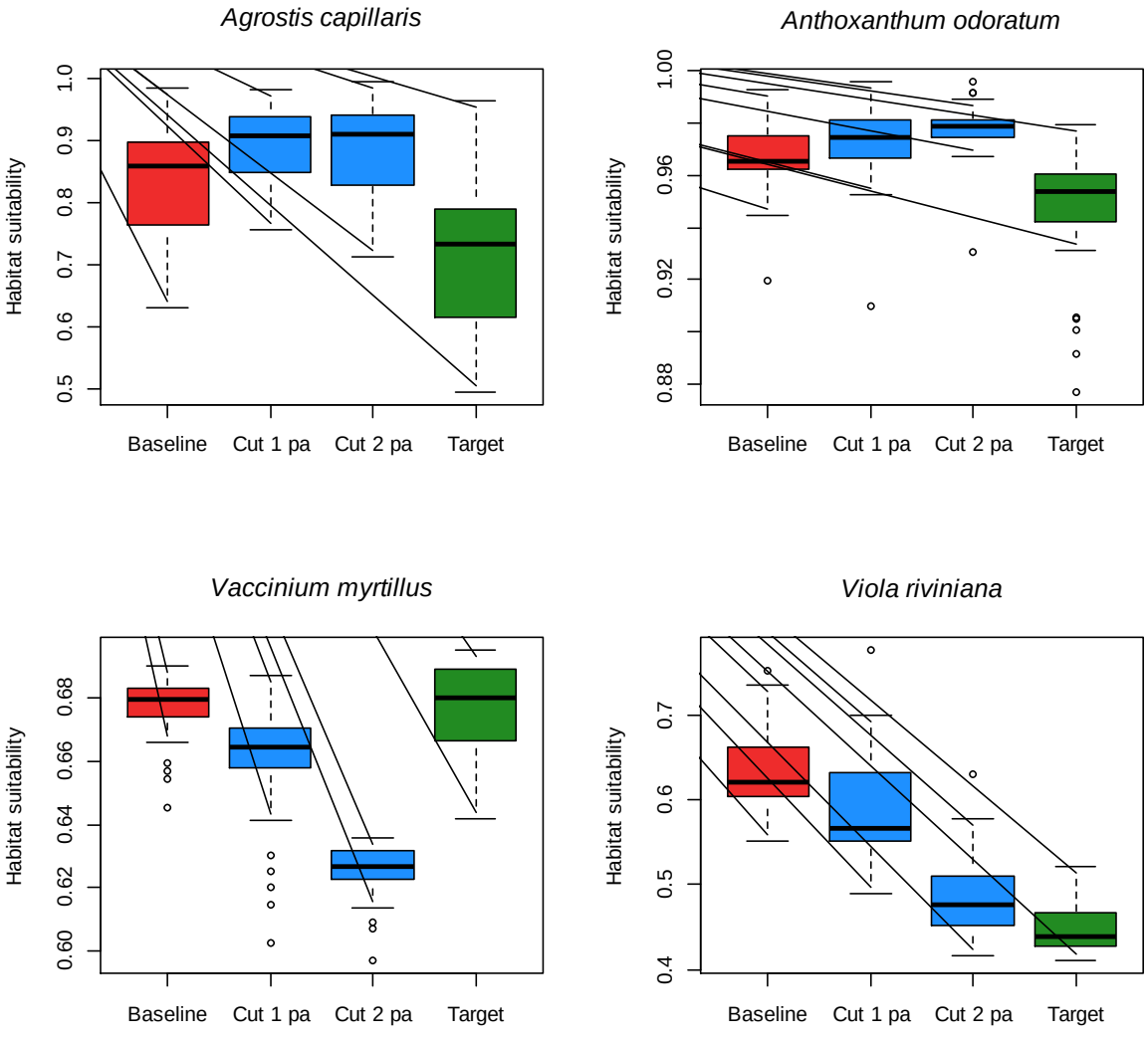
Bracken control (AWE 44/Common land)

Prescription is for mechanical bracken control, here considered on either heath or acid grassland. The prescription states that bracken control must occur at least twice per year in the first two years, and at least once per year in following years. Models were run for 10 years with either cutting once a year or twice a year. Models were run for two catchments – Conwy and Plynlimon

Conwy catchment

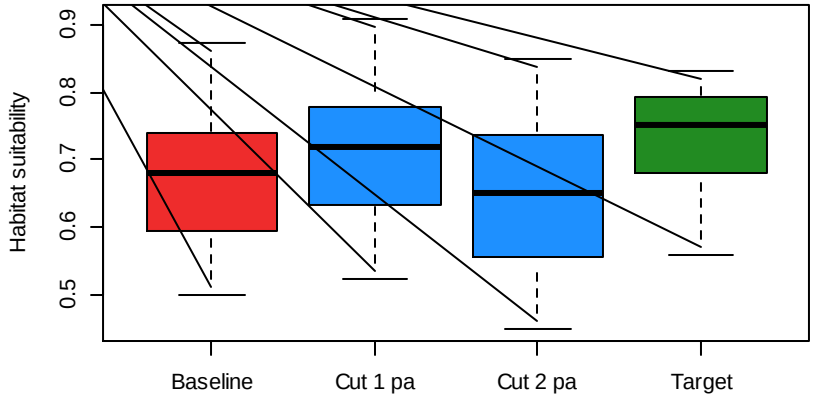
On acid grassland

NOTE – no data on soil change under acid grassland bracken control so soil changes from heath studies applied.

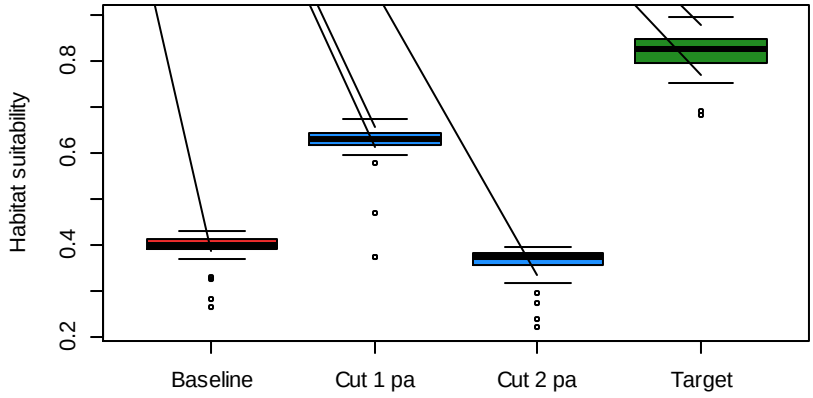


On heath

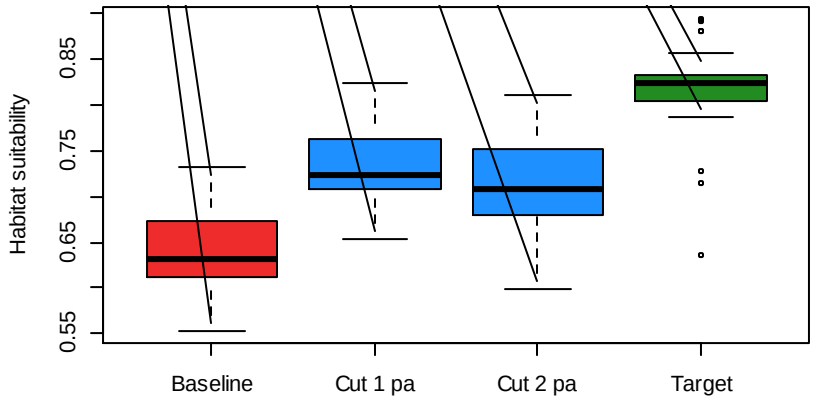
Hylocomium splendens



Calluna vulgaris

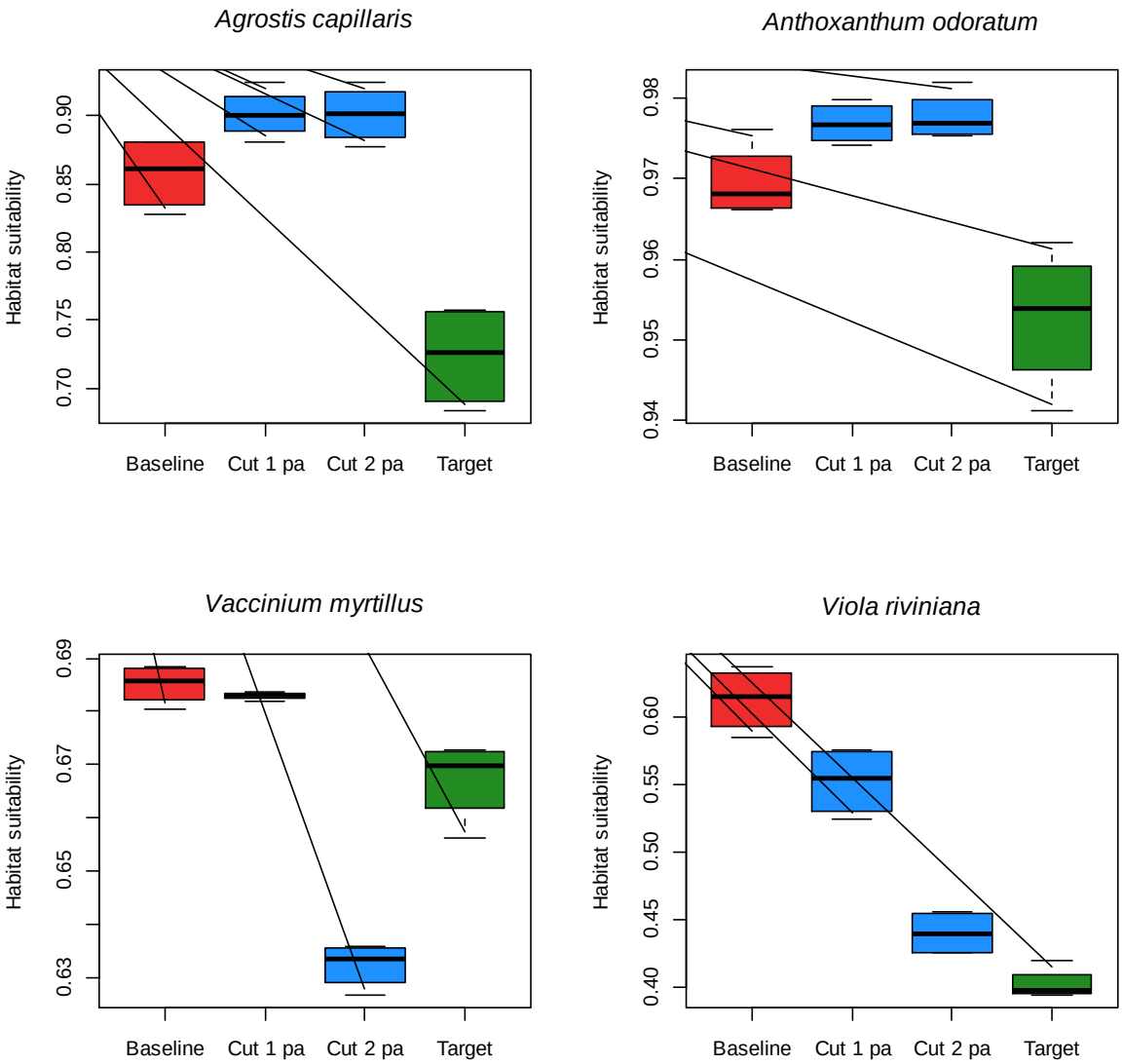


Festuca ovina



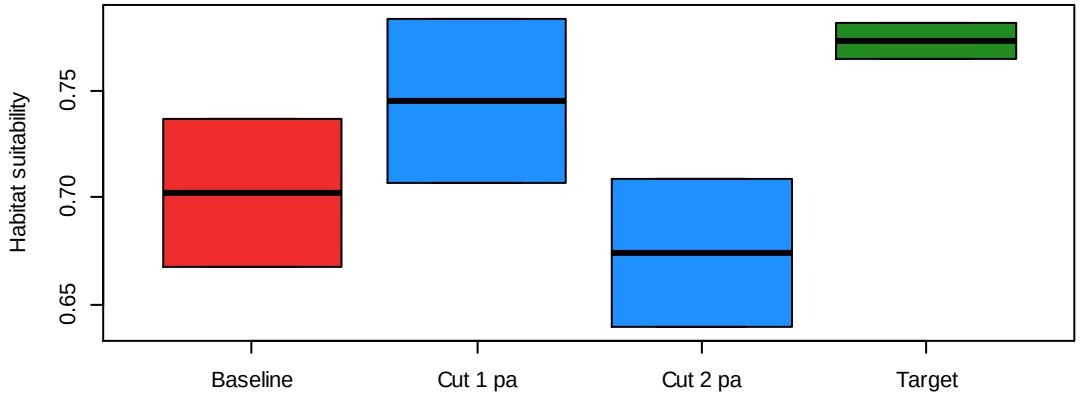
Plynlimon catchment

On acid grassland

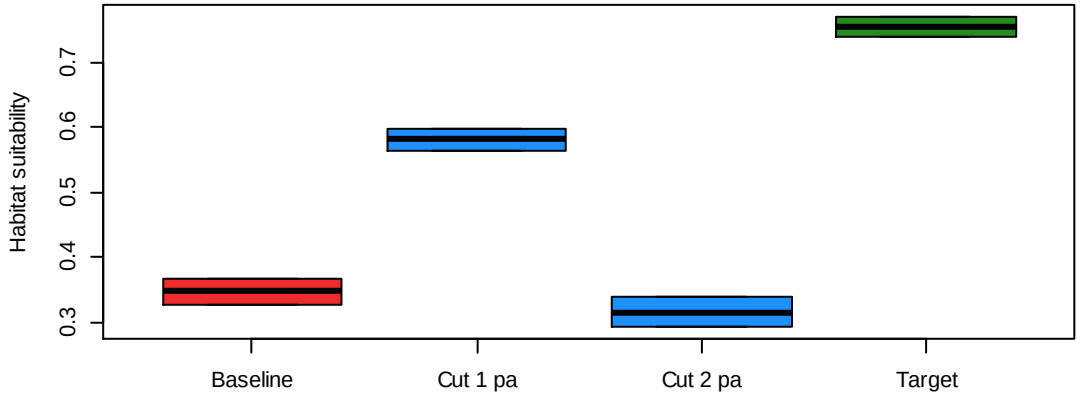


On heath

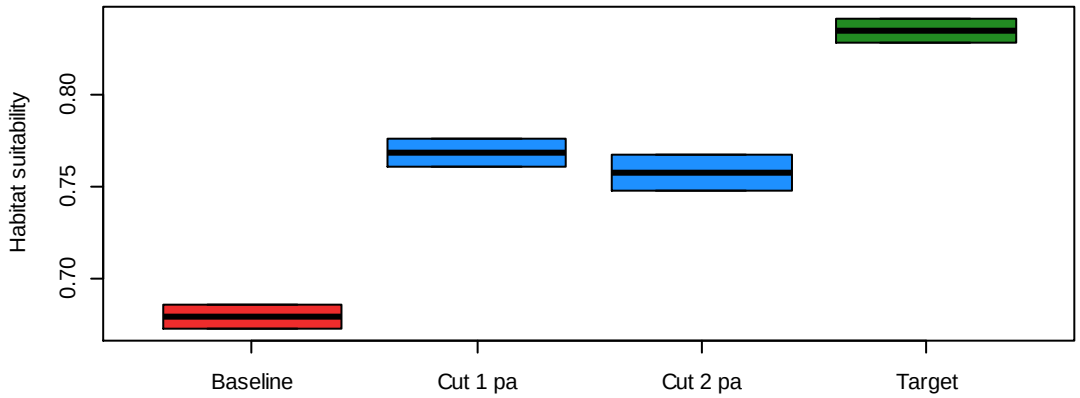
Hylocomium splendens



Calluna vulgaris



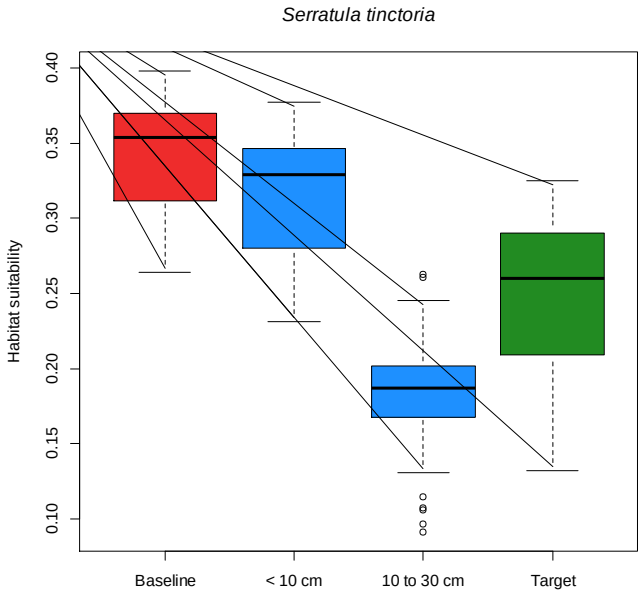
Festuca ovina



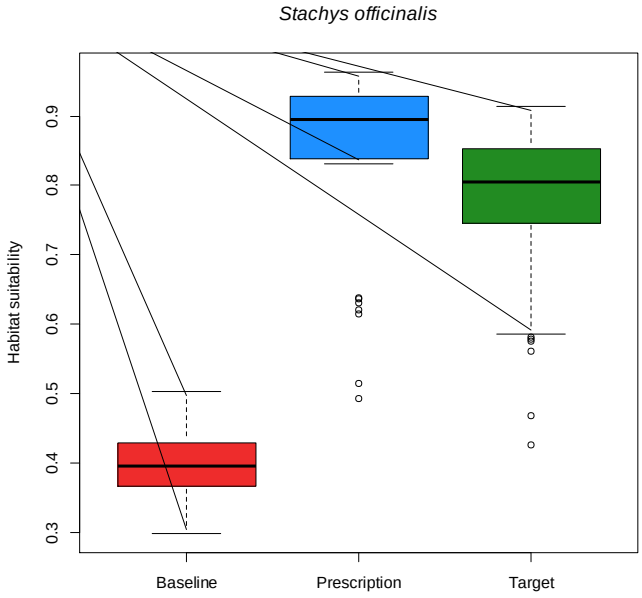
Rare species modelling

To evaluate the effect of prescriptions on rare species, five rare species of interest were selected with relevant prescriptions.

Serratula tinctoria low input grassland on IG



Stachys oficinalis - woodland expansion on IG



Appendix 2.4: Deriving MultiMOVE baseline data – species, soil and climate

Assembly of plant species pools, soil and climate data comprises three separate tasks that require querying of various Oracle database tables. The most complex was the selection of the species pool lists. This was subdivided into selection based on existing Countryside Survey quadrat data representing the habitats and 1km squares of interest within each of the two catchments and a second selection from the BRC 10km square species pool that served to identify and include any additional plant species known from the target area but not present in the CS dataset. Hence the BRC species pools were particularly important in selecting rarer species known in the target area and associated with the habitat and feature combination specific to each modelled Glastir prescription.

All three datasets were required to provide the species that were modelled and the soil and climate variables that were used as initial input to MultiMOVE to estimate habitat suitability for the species pool prior to applying Glastir impacts. Magnitudes of change in canopy height and soil variables were then applied to each species using MultiMOVE. These magnitudes of change were as far as possible represented the potential impact of the Glastir prescription over a specified time interval derived from the literature reviews.

In order to build initial confidence in the MultiMOVE output we derived Habitat suitability scores (Hs) for species known to be in the CS squares and habitats of interest. Expectations of a good correspondence between Hs and actual occurrence were highest in this situation since we ran MultiMOVE based on soil and climate data for these same explicit 1km squares where the soil data came from CS X plot soil samples.

Species pool selection by Broad Habitat type using Welsh CS data (steps taken):

1. Extract and tabulate species frequency by relevant Broad Habitats and plot types for
    a. all CS squares in Conwy and Plynlimon based just on the plots in these squares
    b. all relevant Broad Habitats and locations within the Conwy and Plynlimon catchments. Here we select datasets designed to be as representative as possible of the ecology and habitats in each catchment. We do this by selecting species from all the plots in Welsh CS squares where each plot is within the relevant Broad Habitat and also within the same ITE land-class that the habitat occurs in inside each catchment. For example if Bog occurs in three 1km squares in Plynlimon two of which are in one land class and the third in another, then a species pool is determined by selecting all quadrats in Bogs in Wales but only where quadrats occurred in these in these two land classes.
2. Broad Habitats and plot types to be used for each Glastir measure are given in Table 1. As a result, two sets of species pools will be derived. 1a will apply just to CS survey squares in each catchment and will just be based on plots in those squares. 1b will be based on representative plots from the rest of Wales but where plots are constrained to be in the same habitat type and land classes as in the catchment.

Additional species selection by Broad Habitat type using the BRC 10km square species pools:

1. Find the BRC 10km squares that correspond with all 10km squares covered by each catchment. Note those 10km squares that also contain a Welsh CS square. Achieve a link with the BRC species pool list using the grid reference.
2. Extract species in the corresponding BRC list that are NOT in the lists for 1a and 1b selected above in step 1. This gives lists 2a and 2b where 2a = total BRC species pool for each relevant 10km square minus species in 1a and is a species pool targeted on just those 10km squares that contain Welsh CS squares. 2b = a total BRC species pool derived from all the 10km squares covered by each catchment minus the species already present in 1b.

3. Note that the BRC pools could be further constrained by the Broad Habitat with which they are commonly associated. We could for example use the preference indices in PLANTATT for this purpose. However, we assume that the soil, climate and canopy height data used as input to MultiMOVE will be a more effective and model-based way of quantifying the affinity of the species with the target habitat. Whether this is true will emerge from modelling the baseline data; a step that can therefore be considered an initial validation of MultiMOVE for the location of interest.

Soil data selection steps:

1. Extract all X plot soil data for each Broad Habitat for;
    a. All CS squares in Conwy and Plynlimon
    b. For all Wales CS squares in each land class plus Broad Habitat combination found in each in each catchment as in the species pool selection step above.
2. Calculate means and sample variances for each of 1a and 1b. These parameters provide the distributions from which values of the MultiMOVE input variables can be drawn so that a population of MultiMOVE habitat suitability projections is achieved for each species. This will allow us to quantify the uncertainty in the projections that reflects the variation in soil conditions for each habitat in each land class.

Determination of long-term annual average climate values for each Welsh 1km square:

1. Extract variables from the IA datasets for each corresponding 5x5km square in Conwy, and Plynlimon. These long-term annual average climate variables are also input data for MultiMOVE. In the absence of climate change scenarios these values stay the same when modelling the baseline and modelling change.

Table 1: Broad Habitats and plot types to be used as criteria for defining measure-specific species pools derived from querying CS plot data.

Glastir measure	Broad and Priority Habitats	Plot types
Low-input grassland (AWE/Advanced 15)	Neutral, Acid, Calcareous and Improved Grasslands, Fen, Marsh & Swamp	All (X, RV, SW, U, Y, B, H)
Buffer strips (AWE 9B)	As above, plus Broadleaf woodland and Arable	All as above
Stock reduction (Advanced 411 and 41A)	All specified by WAG in CroW 'open country' definition as follows; Acid Grassland, Bracken, Other Bog, Purple Moorgrass & Rush Pasture, Blanket Bog, Neutral Grassland, Improved Grassland, Dwarf Shrub Heath	X,SW,U,Y
Woodland expansion (AWE 24)	Broadleaved woodland, Neutral and Improved Grassland, Fen, Marsh & Swamp, Calcareous and Acid Grassland	All (X, RV, SW, U, Y, B, H)
Bracken control (AWE 44/Commons)	Bracken, Neutral, Acid and Improved Grasslands, Dwarf Shrub Heath, Bog	X,SW,U,Y

Appendix 2.5 Determining the potential locations of Glastir measures selected for modelling

Low-input grassland (AWE/Advanced 15)

We have agreed to target Improved Grassland. The prescription funds reduction of N inputs to zero but keeps animals. We queried local CS quadrat data so as to include Neutral grassland species in the modelled pools and use literature review results to evaluate and apply magnitudes of change in soil parameters. We assumed 50% uptake of Improved Grassland under this measure either at random spatially or favour adjacency to other semi-natural low productivity grasslands.

The Glastir prescription specifies vegetation heights to be achieved. Such that 20% of grassland <7cm and 20% >7cm. Hence we will run MultiMOVE at 2cm, 5cm, 20cm and 50cm.

Details from scheme documentation

ADVANCED[1] AND ENTRY[2]

Option 15 - Grazed permanent pasture with no inputs

 Maintain as grassland.

 Manage by grazing to maintain a sward with a range of heights during the growing season.

 At least 20% of the grassland must be less than 7 centimetres high and at least 20% of the grassland must be more than 7 centimetres high.

 Manage by grazing to remove the year's grass growth.

 The rules for habitat under the Whole Farm Code apply to all the land within this option.

Do not:

 supplementary feed.

 top at any time except to control injurious weed species. Rush may be topped after 15 July. A record of topping undertaken on land under this option needs to be kept in the Activity Diary.

 roll or harrow between 15 March and 15 July. A record of rolling or harrowing on land under this option needs to be kept in the Activity Diary.

NOTES: The text is exactly the same in Advanced and Entry level guidance documents. Both indicate that the measure can apply to Improved (I) or Habitat (H) land.

Buffer strips (AWE 9B)

Here we target riparian locations not including ditches. We acquired river network maps for Conwy and Plynlimon catchments and then estimated what proportion were not fenced and are not already wooded. Note that this spatially explicit information is only needed for mapping. We defined species pools and starting points based simply on existing Welsh CS data in the same land classes, for example boundary and streamside plots in non-wooded assemblages. For the Conwy and Plynlimon catchments we therefore needed to know how much of the total proportion of the watercourses (excluding ditches) in each catchment are in each Wales land-class.

Then the Glastir prescription specifies the following:

- Not to be applied on 'habitat land'. Hence we target only Improved Grassland and Arable in at least a 1m strip next to each watercourse.
- On each bank of the watercourse, fence off a 3.5m wide buffer strip moving out from the edge of the bank.

[1] Page 7, 130221glastir-advanced-management-options-en.pdf

[2] Page 40, 121227glastirentry2014technicalguidanceen.pdf

- A minimum of 1m width of the 3.5m must be improved land and the rest can be riparian habitat.
- Native trees must be planted. Therefore the presumption is that mid-successional or scrub/tall herb vegetation is to be planted but if it is already woodland it is not eligible.

Exclude this prescription from within Protected Zones 1 (Red Squirrel), 2 (Water Vole) and 4 (Club-tailed dragonfly)[3]

The uptake scenario is for 75% and 50% allocated randomly. However in terms of spatial location we could allocate it to best improve connectivity, flood defence and therefore prioritise existing woodland patches or hydrological optimal locations.

Of the two test catchments this measure is only relevant to the Conwy as there is negligible Improved Grassland in Plynlimon.

Details from scheme documentation[4]
Only available if the Beneficiary has management control of both sides of the watercourse.
 An average area of 7 square metres per 1 metre length of watercourse should be fenced off to exclude stock.
 A minimum width of 1 metre of the corridor must be improved land on either side of the watercourse. The remainder can be riparian habitat.
 All measurements should be taken from the edge of the bank
 If Japanese knotweed or Himalayan balsam occur or colonise within the corridor, seek and retain guidance from the Environment Agency Wales and act in accordance with that. Details of action taken needs to be recorded in the activity diary.
 Trees must be planted at a density of 30 per 100 linear metres, using native species of local provenance.
 All failed plantings must be replaced in the next planting season.
 The rules for habitat under the Whole Farm Code apply to all the land within the corridor.
 The fencing and planting are considered as Capital Works. All works must be completed within the first two years of this contract. They must be maintained (or replaced as necessary) for the term of the contract. The fencing must be completed to the standards set out in the Technical Specifications.

Do not:
 straighten, widen or re – route the watercourse.

TECHNICAL SPECIFICATIONS (RELEVANT TO OPTIONS 7A, 7B, 8, 9A, & 9B)
 Access gates may be included.
 Trees should be sourced from suppliers who grow using local seed or propagation material (see table 1.1 for suitable species). Ornamentals must not be used.
 Trees should be staked if specimens of more than 2 years old are planted. Rabbit guards should be used.
 Avoid planting in very wet or frosty weather.

Woodland expansion[5] (AWE 24)

Woodland is allowed to develop out into adjoining fields where these are on improved land. We take this to mean non-habitat land and so included only arable and improved grassland. It should not therefore replace semi-natural mid-successional habitat. The amount of additional woodland was

[3] Protected zones defined on page 19 of Glastir Entry technical guidance.
[4] Page 33, 121227glastirentry2014technicalguidanceen.pdf

limited to a 6m buffer around the existing woodland. Existing woodland was defined by occurrence on the NFI spatial layer.

Determining starting conditions was therefore straightforward and simply relied on incrementing canopy height based on a broadly defined local species pool but where soil conditions were based on Improved Grassland they acted as a strong filter on habitat suitability.

Details from scheme documentation[6]

This option is only available on improved land, where no known archaeological feature is situated.
 The existing fence between the woodland and field must be removed and a new fence line created 6 metres out into the field from the old fence line to exclude stock.
 The rules for habitat under the Whole Farm Code apply to the land fenced out for this option.
 The fence is considered Capital Works. All works must be completed within the first two years of this contract. They must be maintained (or replaced as necessary) for the term of the contract. The fencing must be completed to the standards set out in the Technical Specifications.

Do not:
 supplementary feed.
 graze, cut, or subject to any other management which prevents vegetation growth.

Bracken control[7] (AWE 44/Commons)

Exclude Bracken control from areas in Protected Zone 7 (Butterflies).

Includes all areas of dense Bracken but control is only mechanical. *Spraying is not allowed under this prescription.*

Details from scheme documentation[8]

Can be undertaken on improved or habitat land.
 Areas of bracken may be part parcel and this option can be selected in addition to another option selected within the same parcel (i.e. can be overlayed).
 Mechanical Cutting and rolling are acceptable methods of control
 A minimum of 2 cuts / rolls per year must be undertaken for years 1 – 3 of the contract and 1 cut / roll per year for years 4 and 5.
 All Cutting / rolling must take place between 1 May and 15 August.
 Details of any cutting / rolling to be recorded in the activity diary
Do not;
 control bracken by spraying

[6] Page 47, 121227glastirentry2014technicalguidanceen.pdf

[8] Page 66, 121227glastirentry2014technicalguidanceen.pdf

Summary of spatial locations eligible for each measure

The technical guidance describing the target habitats and locations for each Glastir prescription can be summarised in Table 2. Note that for CS squares, field survey data can be used to delimit eligible areas without recourse to LCM or Phase 1. However it would be useful if we have time to compare the size and location of eligible areas within CS squares when determined by CS field survey data versus the other census datasets. This would help explore the uncertainties associated with modelling impacts outside of CS squares where less detailed or older map data must be used.

Table 2: Matrix of eligible habitats and features by target prescription.

Prescription	**Broad and Priority Habitats**	**Other criteria for spatial mask**	**Datasets required**
Low-input grassland (AWE/Advanced 15)	Improved Grassland, Neutral Grassland	None	Phase 1 and LCM2007 CS square field maps Plynlimon and Conwy catchment boundaries
Buffer strips (AWE 9B)	Improved Grassland and Arable	3.5m width where arable or improved grassland occurs next to flowing watercourses ie. excludes ditches. The measure is prohibited from Protected Zones 1,2 and 4 This means prioritising watercourses with no woody vegetation currently present using LIDAR, Aerial photographs or Phase 1.	River network for Plynlimon and Conwy Phase 1 and LCM2007 CS square field maps Protected Zone layers
Stock reduction (Advanced 411 and 41A)	All semi-natural habitats inside CROW unenclosed upland mask; Fen, Marsh & Swamp, Dwarf Shrub Heath, Bog, Acid Grassland, Rough low-productivity grassland (*sensu* LCM2007), Calcareous Grassland, Neutral Grassland, Inland rock	Because of the possible benefits to bird species listed in Target checker (see Table 1) overlays of the Glastir target layers for each species with the case-study catchments and CS squares will be needed. From this we can say to what extent thee is spatial coincidence between bird species and potential application of the supporting measure.	CROW spatial mask, Phase 1 habitats, LCM2007, Priority Habitat 1km dot map, Target layers for all bird species in Table 1 except Corn Bunting and then determine if there is any overlap with the two catchments and their CS squares
Woodland expansion (AWE 24)	Broadleaved woodland adjacent to Improved Grassland	6m buffer around parcels identified on NFI layer where buffer extends into Improved Grassland	NFI layer for each catchment Phase 1 habitats and LCM2007
Bracken control (AWE 44/Commons)	Bracken from LCM2000 as no longer discriminated in LCM2007 plus dense Bracken from CS field maps	Exclude from Protected Zone 7	Phase 1 habitats, LCM2000, CS square field maps Protected Zone layer

Table 3: Species, habitats and features expected to benefit from each modelled measure "in a wider range of situations" (bold entries in the Target Checker spreadsheet).

Species, Habitat, Feature	**Grazed permanent pasture with no inputs (15)**	**Buffer strips (9B)**	**Woodland expansion (24)**	**Mechanical Bracken control (44)**
Barbastelle bat		*	*	
Bechstein's bat		*	*	
Brown-Banded Carder Bee	*			
Carbon Soils	*			
Chough	*			
Coastal habitats	*			
Ditch landscapes	*			
Dormouse			*	
Freshwater Pearl Mussel	*	*		
Great Crested Newt	*		*	
Greater Horseshoe bat	*	*	*	
Greenland White-fronted goose	*			
Gwyniad	*	*		
Heathland Plants				*
High Brown Fritillary	*			*
Historic features & landscape				*
Lesser Horseshoe Bat		*	*	
Lichens of old trees and parkland	*			
Lowland Grassland	*			
Parkland & Wood pastures	*			
Pearl-bordered fritillary				*
Protected landscape	*		*	*
Rare plants	*			
Red Grouse				*
Red Squirrel			*	
Scheduled Ancient Monuments	*			*
Sensitive Lakes	*	*		
Sensitive Rivers	*	*		
Shrill Carder Bee	*			
Twite	*			
Upland Limestone Grassland	*			
Water Quality	*	*	*	
Water Quality Priority Area	*	*	*	
Water Quantity	*	*	*	
Woodland			*	

Appendix 3.1. A synthesis of all data being collected, utilised or modelled within the GMEP project mapped to Glastir outcomes

Outcome	Data collected, utilised or modelled	Data source	Method/comments
Biodiversity	Plant diversity	Field Survey	Permanent vegetation plots per 1km^2 • Nested (200m^2); provides a random sample of common vegetation types. 5 per 1km^2 • Targeted (2x2m); samples Priority Habitats and locations eligible for Glastir. Up to 5 per 1k m^2 • Unenclosed (2x2m); samples unenclosed Broad Habitats. Up to 10 per 1km^2 • Boundary (10x1m); runs adjacent to field boundaries. Up to 5 per 1km^2 • Arable (100x1m); Arable field edges centred on each boundary plot. Up to 5 per 1km^2 • Field margin (2x2m); records new arable field margins that form part of land management agreements. Up to 15 per 1km^2 • Hedgerow (10x1m); records diversity alongside hedgerows. 2 per 1km^2 • Hedgerow diversity (30x1m); records woody linear features and their physical condition. Up to 10 per 1km^2 • Streamside (10x1m); records streamside diversity. Up to 5 per 1km^2 • Stream bank (10x1m); samples the upslope habitats perpendicular to stream side plots.
	Habitat suitability for higher and lower plants	MultiMOVE model. Input data from literature reviews, observed field data and other models	Projections are derived from c.1300 empirical niche models trained on paired species and environment data for GB.
	Birds	Field Survey	Territory mapping. Walk within 200m of all areas of each 1km^2 recording all species seen/heard. Four visits, April-July. Compatible with Breeding Bird Survey.
	Birds	BTO; RSPB	Range of data available including Breeding Bird Survey; Bird Atlas; range of data on rare species etc
	Pollinators	Field Survey	Butterflies and day flying moths, bees, hoverflies, and insect-pollinated plant groups recorded using Wider Countryside Butterfly Survey methodology; 2x1km fixed transect (500m apart) through each square with additional 10 minute timed count survey to monitor pollinator-plant interactions. Two visits, July & August.
	Wide range of invertebrate species	Biological Records Centre (who collate wide range of voluntary organisations)	Trend analysis and spatial modelling for Wales. ~12 candidate groups include: *ants, bees, bryophytes, butterflies, centipedes, dragonflies, flowering plants, grasshoppers and crickets, ground beetles, ladybirds, millipedes, moths, woodlice*
	Habitat areas, linear features and point features; diversity and stock	Field survey	Habitat areas (>20m x 20m) are mapped and attributes recorded • Agricultural/natural, Forestry, Buildings and structures, Recreation, Inland Physiography, Inland water, Coastal feature (all recorded with features and associated usage) • Detail on habitat type or a feature such as a pond, an indicator of woodland structure or a crop • Supporting attribute data e.g. grass ley, burnt vegetation • Species (2-4 dominant species recorded) • Species cover (<10%, 10-25%, 25-50%, 50-75%, 75-95%, 95-100%) • Features: e.g. forestry features; deer fences, grey squirrel damage • Use e.g. stock, cattle, sheep, Timber production Linear features are mapped and attributes and condition assessed. Linear features must be at least 20m long and not more than 5m wide

Outcome	Data collected, utilised or modelled	Data source	Method/comments
			• Woody linear features – with an unnatural shape (hedgerows) – With a natural shape (lines of trees) – Extensive data recorded on woody linear features condition e.g. base height, species composition, management, margin • Streams and ditches • Grass strips • Banks, walls, fences • Footpaths, tracks Point features are individual landscape elements that occupy less than an area of 20x20m • Forestry – Primary attributes: individual trees, clumps of trees, patches of scrub, veteran trees – 2ndary attributes: buffers zones, DBH, species etc • Inland water e.g., springs, ponds • Inland physiography e.g. cliffs, rock outcrops • Structures e.g. buildings, quarries, wind turbine
	Soil biodiversity	Field survey	4 x 0-15cm cores in same location as permanent vegetation plots. Mesofauna extracted + genomic approaches for microbial/faunal/pathogen community diversity and structure
	Range of biodiversity and habitat data	NRW	Discussions underway to identify key datasets to contribute to e.g. High Nature Farmland reporting; up-scaling from 1km squares etc
Climate Change mitigation	National GHG inventory statistics including scenario analysis for potential impacts of Glastir	LULUCF GHG model	Inventory approach within Land Use, Land Use Change and Forestry Inventory for biomass and soil carbon. Known to be insensitive to many management changes. (IPCC Tier 1 approach)
	Modelled change in tree biomass carbon	NRW; Forest Commission Edinburgh data, statistics and CARBINE model	To be agreed with FC Edinburgh / NRW
	Modelled change in emissions of direct and indirect GHG emissions	ADAS Model	National maps of calculated present day methane, nitrous oxide and carbon dioxide emissions from agricultural land, and the projected long term impact of selected Glastir land management. Pollutant losses, sources and indirect emissions are reported separately. Losses are reported for Water Framework Directive (WFD) water-bodies calculated using variants of the IPCC Tier 1 and 2 models.
	Modelled change in emissions of direct and embedded GHG emissions	Bangor carbon footprint model	Impact of GEGs to be assessed. Requires input from farmer questionnaires. Direct and indirect GHG emissions including embedded losses. No soil losses (IPCC Tier 1 approach)
	Modelled change in soil GHG emissions	ECOSSE model	Process modelling of soil GHG losses (IPCC Tier2/3 approach)
	Change in soil carbon	Field survey	See entry in soil and water management category
	Change in peatland accumulation rates	Test sites	See entry in soil and water management category
	GHG emissions from range of Welsh grassland types	Test sites	New baseline data collection across Wales collecting real-time data using eddy tower flux methods for methane, carbon dioxide and nitrous oxide together with real-time soil moisture methods.
	Survey of farmer and local community survey involved in GEGs	Test sites	Survey of samples of farmers and local communities involved in GEGs scheme to identify wider economic and social benefits in Yr 2
Soil and Water Management	Soil status as indicated by soil physical and chemical properties	Field Survey	3 x 0-15cm cores in 5 locations across the 1 km squares co-located with permanent vegetation plots for a range of physical and chemical measurements. Measures include: organic matter content, pH, carbon, nitrogen and phosphorus content, available phosphorus (Olsen-P), texture, volumetric water content, bulk density, water repellency. Methods of analyses for all determinands are as outlined in the

Outcome	Data collected, utilised or modelled	Data source	Method/comments
			CS Technical Report No.3/07: Soils Manual which is available on the web and in the CS Soils report: http://www.countrysidesurvey.org.uk.
	Soil status as indicated by biological measurements	Field Survey	1 x 0-8cm core cores in 5 locations across the 1 km squares co-located with permanent vegetation plots for mesofauna extractions using methodology described in CS Technical Report No.3/07: Soils Manual which is available on the web and in the CS Soils report: http://www.countrysidesurvey.org.uk. Also, 1 composite 0-15cm sampled from 5 gouge auger samples for microbial diversity estimates using terminal restriction fragment length polymorphism (TRFLP) which provides information on the relative abundance of different bacterial and fungal species and Ion Torrent® PGM platform, to undertake phylogenetic analysis of the soil microbial community to provide genus-level information which can be related back to soil processes.
	Stream water and pond water quality as indicated by conductivity and pH, alkalinity, soluble reactive phosphorus and total oxidisable nitrogen	Field survey	2x1lt bottles of water taken from one selected water course with in each $1km^2$. Conductivity and pH recorded on-site. Water sample filtered on site and sent to labs to analysis for alkalinity, soluble reactive phosphorus and total oxidisable nitrogen.
	Stream water quality as indicated by diatom community	Field survey	Benthic diatom samples are collected from submerged surfaces in a single headwater stream in each $1km^2$ to collect taxa representative of the site. Samples are preserved and sent to lab for identification.
	Stream water quality as indicated by freshwater invertebrate community	Field survey	Freshwater invertebrates are collected from a 10-15m reach of stream. Manual searches of animals from the water surface and submerged rocks, logged or vegetation and a kick sample. Samples are preserved and sent to lab for identification. Stream characteristics are recorded (water width, depth, substratum, velocity, filamentous algae and street lighting).
	Stream water quality as indicated by aquatic macrophytes	Field survey	Macrophyte and bryophyte presence and cover recorded along a 100m reach of watercourse.
	River Habitat Survey- assessing habitat character and quality of rivers based on physical characteristics	Field survey	Over 150 potential characteristics recorded on a one 500m stretch of river in each $1km^2$ e.g. land use within 50m of banktop; bank profile, extent of trees and associated features, extent of channel and bank features, channel dimensions, notable nuisance plant species, channel vegetation types, physical attributes, bank modification
	Pond quality assessment as indicated by water quality, pond characteristics, macroinvertebrate community, macrophyte cover and abundance	Field survey	All ponds are mapped in each 1km2 and physical and environmental data collected. Ponds are classified as waterbodies holding water for at least 4 months a year between $25m^2$ and 2ha. Presence and abundance of aquatic plants are recorded. Macroinvertebrate are sampled with a sweep net over 3 minutes and 1 minute direct searching. Pond attributes recorded: • Pond area and hydroperiod • Sediment and water depth • Inflows and outflows • Substrate • Potential sources of pollution • Waterfowl/fish/amphibian presence • Management • Surrounding land use
	Soil and water monitoring and catchment sensitive farming data	NRW	Initial soils data from Glastir Advanced assessments already agreed to be exchanged. Other datasets to be discussed.
	Modelled change in sediment, N, P, agri-chemicals	ADAS model	National maps of calculated present day nitrate, phosphorus and sediment delivery from agricultural land and non-agricultural sources and the projected long term impact of selected Glastir land management options.
	Modelled change in water flow, sediment delivery, N and P	LUCI model	Hydrological and export coefficient modelling to forecast change in water flow and diffuse pollution impacts

Outcome	Data collected, utilised or modelled	Data source	Method/comments
	Peat accumulation rates	Test sites	Estimates of recent rates of peat accumulation on short (0.5 m) peat cores, using 2 methods (i) a range of radioisotopes (^{210}Pb, ^{137}Cs, ^{241}Am) and spherical carbonaceous particles and (ii) extended satellite-based augmentation systems (SBAS) (Short Baseline Subset) technique to process ENVISAT radar data
	Farmer management survey	Test sites	Telephone survey of 600 farmers (50% in Glastir scheme and 50% other) to evaluate changes in management practices due to scheme.
Landscape, Historic Environment and Access	Condition assessment of Historic Environment Features	Field survey	Cadw and Regional Archaeological Trusts identify Scheduled Ancient Monuments and Historic Environment Features for basic condition assessment and potential threats to longer term viability of the feature.
	Range of habitat and structural data built in to detailed 3D viewsheds for 1km sites and surrounding 3 x 3km	Field survey, OS terrain data combined with GIS modelling.	Fixed point photography from the centre of each quadrant of each 1km^2. A photograph is taken along each cardinal line (i.e. N, S, E, W) in each quadrant. Landscape quality assessed using a range of measured characteristics including: water features, topography, habitat diversity, landscape heterogeneity, anthropogenic features.
	Presence and length of Public Rights of Way (PROW), including open access areas and beaches.	Field survey with additional input from OS data	The status and length of all footpaths in each 1km2 are recorded as part of the habitat mapping methodology including where blocked; overgrown; under repair etc. PROW data constructed from OS data and field survey information.
	Public views on landscape quality to assess impact of Glastir interventions.	Landscape photographs (field survey).	Photographic preference surveys undertaken online through multiple nodes (urban forums, rural forums, youth groups, outdoor etc.). To assess the value the Welsh public place on particular landscape features and to assess the link between ecological condition and landscape quality. Additional data collected face to face at 2 public events to be held in Wales (yet to be identified).
	LANDMAP, Countryside Survey data, Land Cover data and other secondary economic datasets.	NRW, field survey and other sources.	Secondary data used to extend the 3D viewsheds into the surrounding landscape to incorporate the wider landscape setting.
Woodland creation and management	Woodland mapping	Field survey	Woodland areas (>20m x 20m) are mapped and attributes recorded: Broad/Priority Habitat, Belt of scrub, Belt of trees, Clump of trees, Dead lying trees, Standing dead trees, Scattered scrub/trees, Modal DBH; species; species cover Associated features include: Deer fences, felling, grazing, natural regeneration, planting, pollards, recent management, tree protectors, wind blow Uses recorded include: Landscape, conservation, sporting shelterbelt, timber production, orchards
	Woodland ground flora	Field survey	Randomly allocated 'nested' plots (200m^2) can fall into patches of woodland; 'targeted' plots are placed in priority woodland habitat; and streamside plots detect riverine woodland where they coincide.
	Tree health	Field survey	Piloting the capture of information on tree diseases – Chalara (ash dieback), sudden oak death, Phytophtora, Dutch elm disease, and 'other'
Ecosystem services, co-benefits and trade-offs	Land Cover Map; Nat Map soils map; River Network etc	LUCI model	Scenario analysis of impacts of intervention measures including spatial analysis, trade-offs and optimisation in Yr 1. Impacts of actual uptake levels in Yrs 2 onwards.
	Impact of Commons element	Test sites	Survey of Commons within Glastir scheme to identify value and perceptions by local groups
	Wider economic and social impact of GEGs element	Test sites	See climate change mitigation entry
	Inputs from all activities + range of available economic information	Economic cost-benefit analysis	Overall high level cost-benefit analysis of Glastir scheme

Appendix 3.2. Power analysis to determine yearly sample size of rolling programme

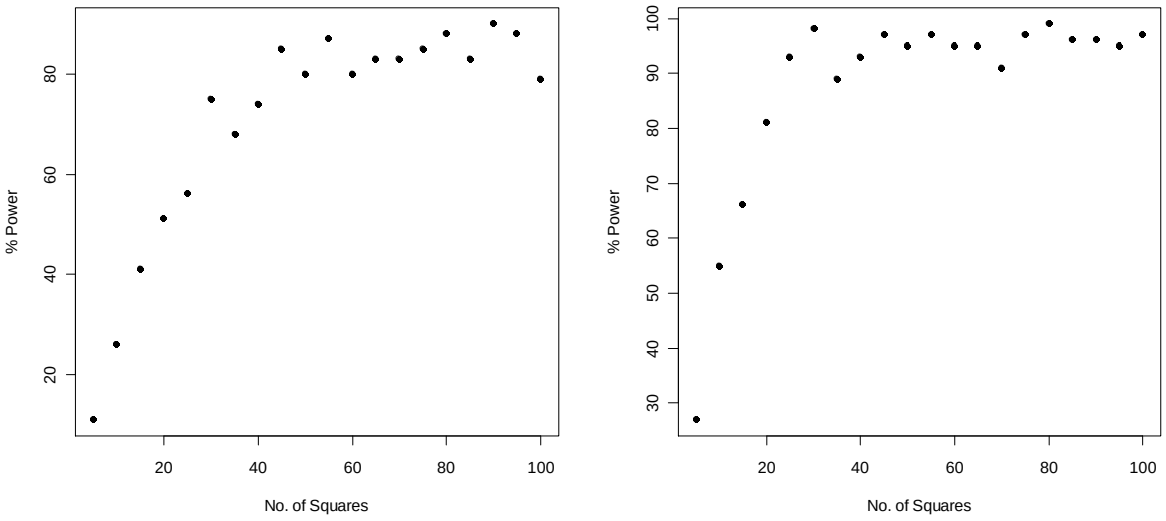
In order to ensure statistical robustness, we must have a sufficient number of sites sampled in each year such that changes can be detected with an appropriate level of statistical power. To investigate this in detail, we conducted a power analysis looking at the power to detect changes over time in multiple metrics based on differing sample sizes within each year.

The power analysis was performed using existing information from the Countryside Survey (CS). CS can provide information on the expected changes and variation in multiple metrics over 8 years (2 full cycles of the rolling programme) using data from across two surveys (e.g. 1990 – 1998). Further to this a subset of squares in the 1998 survey were actually recorded in 1999. This enables us to look at the combination of a spatial AND temporal year to year variability that we would see in the rolling programme setup.

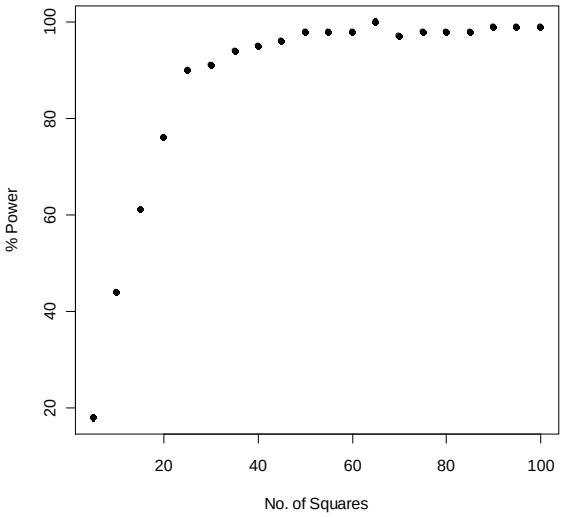
Metrics of soil Carbon (%LOI), plant species richness, water quality and habitat were analysed to assess the necessary number of sites for statistical robustness. For soil Carbon and species richness, a subset of data from 1998 together with the data collected in 1999 was modelled so that the between year variability expected in the rolling programme could be estimated. Note that this variability contains both temporal (1 year) and spatial (different subset of sites) variation exactly as the rolling programme would. Once this variability had been estimated, we can use it together with the estimated change over an 8 year period (an equal year on year change was assumed) and site-specific temporal variation over 8 years to simulate data as we would expect to obtain from the rolling programme. Under different sample size scenarios ranging from 5 per year to 100 per year, 1000 simulated data sets under the rolling programme were obtained. Each data set was then modelled to test for a) a trend over time and b) differences between the first full cycle and the second full cycle. The proportion of the 1000 datasets with significant results for each test was stored for every sample size scenario, providing the statistical power.

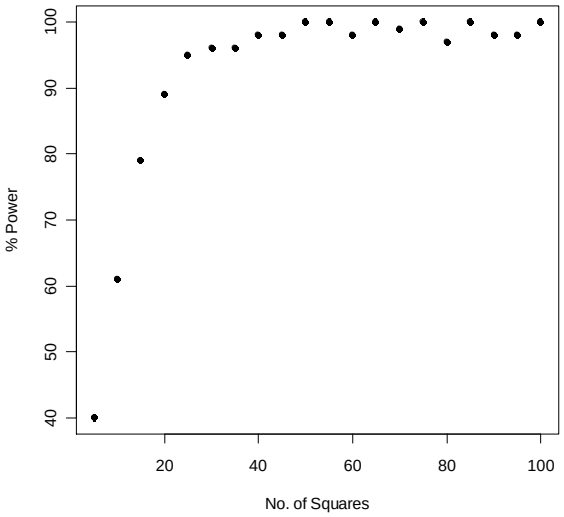
Plots below show some results from this power analysis for soil Carbon and species richness. Plots of the power to detect a trend over time (left hand plot) and change between full rolling programme cycles (right hand plot)

Soil Carbon

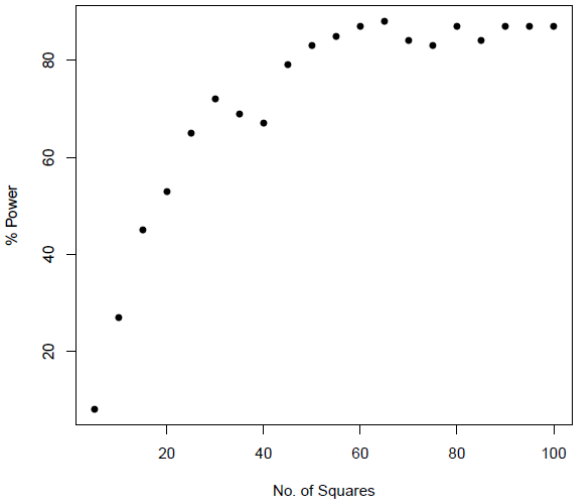


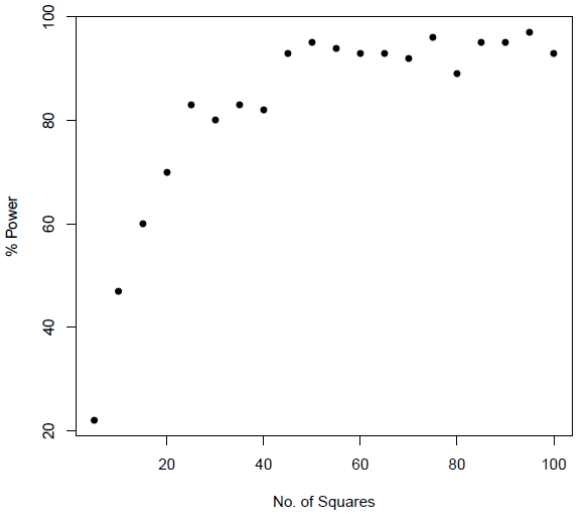
Species Richness





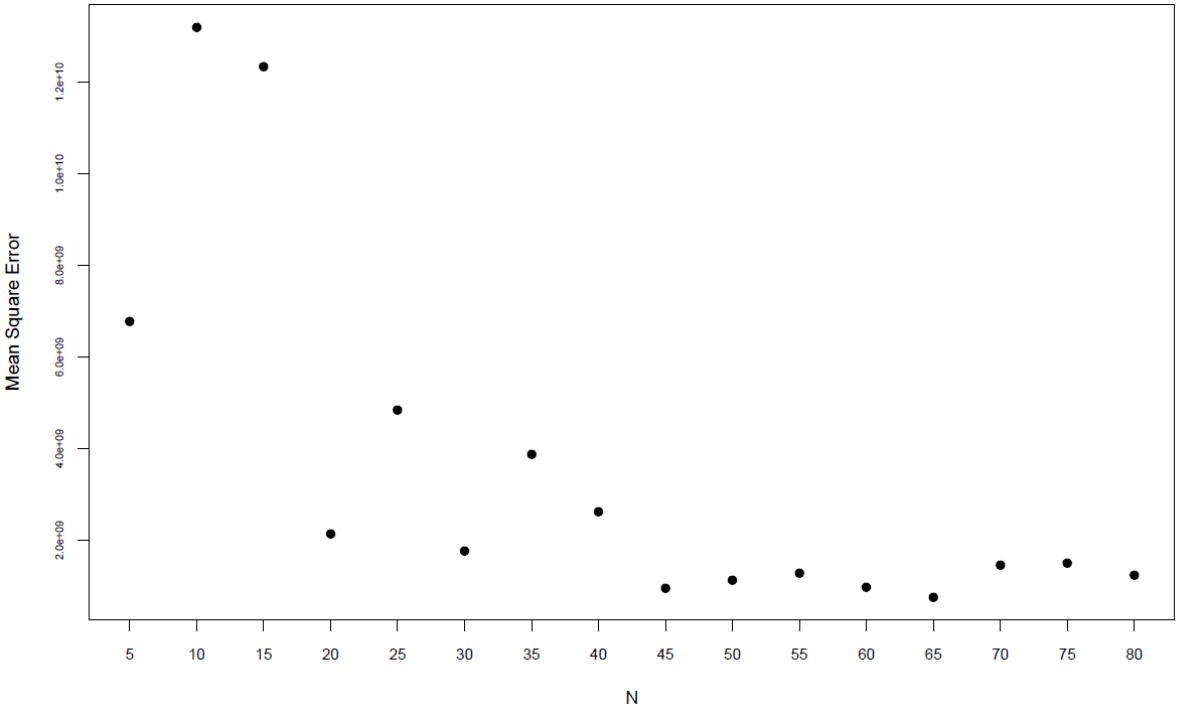
In order to assess power across differing spatial scales, all power analyses were also conducted across different environmental zones and habitats within Wales. Plots of the power to detect a trend over time (left hand plot) and change between full rolling programme cycles (right hand plot) for soil carbon in improved grassland are shown below.





As well as looking at stock and change in individual indicators, the WWC field survey will also estimate habitat extents across Wales. To investigate the value gained by adding more squares to the field survey, an assessment of the accuracy of the sample to estimate habitat stock was made. Land Cover Map 2007 was used as the basis of this assessment. From the LCM2007 map a sample of 1km squares were masked out and from these the habitat extents estimated according to existing CS methodology. This was done for a range of sample sizes and at each stage the estimates were compared with what the full LCM20078 habitat estimates were across Wales. The plot below shows

how the mean square error between the truth and the estimates varies according to the sample size chosen.



Conclusion

Across all the power analyses conducted so far it seems that a sample of 45 squares per year is the minimum number of squares we can sample before losing significant power to detect change.

Appendix 3.3 Table of Glastir Advanced priority layers together with their score as assigned by WG

CAPIT Category	CAPIT Objective ENG	Priority	Layer	Score
Access	Permissive Access (Optional)	Access	Wales Coastal Path	4
Access	Permissive Access (Optional)	Access	Communities first / Regeneration Areas	2
Access	Permissive Access (Optional)	Access	Dragon route (bridleway)	6
Access	Permissive Access (Optional)	Access	National trails	4
Access	Permissive Access (Optional)	Access	Trail centres 1km buffer	6
Biodiversity	Coastal Habitats	Biodiversity - Habitats	Coasts	4
Biodiversity	Ditch Landscape	Biodiversity - Habitats	Ditch	6
Biodiversity	Lowland Grassland	Biodiversity - Habitats	Calaminarian grassland	3
Biodiversity	Lowland Grassland	Biodiversity - Habitats	Lowland calcareous grassland	4
Biodiversity	Lowland Grassland	Biodiversity - Habitats	Lowland grassland (acidic, neutral & marshy)	1
Biodiversity	Lowland Heathland	Biodiversity - Habitats	Lowland heathland	2
Biodiversity	Montane Heath	Biodiversity - Habitats	Montane heath	6
Biodiversity	Orchard	Biodiversity - Habitats	Orchard	2
Biodiversity	Parkland And Wood Pasture	Biodiversity - Habitats	Parkland and wood pasture	6
Biodiversity	Pond Landscape	Biodiversity - Habitats	Pond	1
Biodiversity	Rock Ledge And Scree	Biodiversity - Habitats	Rock ledge and scree	3
Biodiversity	Sensitive Rivers	Biodiversity - Habitats	River	4
Biodiversity	Sites of Special Scientific Interest and Surroundings	Biodiversity - Habitats	Biological SSSIs & 300m buffer	6
Biodiversity	Sites of Special Scientific Interest and Surroundings	Biodiversity - Habitats	Prioritised Biological Coastal and Lowland SSSI	48
Biodiversity	Upland Heath	Biodiversity - Habitats	Upland heath (core)	3
Biodiversity	Upland Heath	Biodiversity - Habitats	Upland heath (outer)	1
Biodiversity	Upland Limestone Grassland	Biodiversity - Habitats	Upland calcareous grassland	4
Biodiversity	Wetland (Upland And Lowland Bog & Fen)	Biodiversity - Habitats	Wetland (upland and lowland bog & fen)	1
Biodiversity	Woodland	Biodiversity - Habitats	Woodland - Ancient and Semi-Natural Woodland (ASNW)	3.2
Biodiversity	Woodland	Biodiversity - Habitats	Woodland - Non Ancient Broadleaf	1.8
Biodiversity	Woodland	Biodiversity - Habitats	Woodland - Non-PAWS Conifer above 5 ha	1.2
Biodiversity	Woodland	Biodiversity - Habitats	Woodland - Non-PAWS Conifer below 5 ha	1.2
Biodiversity	Woodland	Biodiversity - Habitats	Woodland - Primary cores	3
Biodiversity	Woodland	Biodiversity - Habitats	Woodland - Primary Networks	0.8
Biodiversity	Woodland	Biodiversity - Habitats	Woodland - Plantations on Ancient Woodland Sites (PAWS)	4
Biodiversity	Woodland	Biodiversity - Habitats	Woodland - Secondary cores	2.4
Biodiversity	Woodland	Biodiversity - Habitats	Woodland - Secondary Networks	0.6
Biodiversity	Woodland	Biodiversity - Habitats	Woodland - At risk water catchments	0.2
Biodiversity	Great Crested Newt	Biodiversity - Species - Amphibians	Great Crested Newt 1km	3

CAPIT Category	CAPIT Objective ENG	Priority	Layer	Score
Biodiversity	Black Grouse	Biodiversity - Species - Birds	Black grouse (targeted management)	4
Biodiversity	Chough	Biodiversity - Species - Birds	Chough (targeted management)	4
Biodiversity	Corn Bunting	Biodiversity - Species - Birds	Corn bunting (targeted management)	10
Biodiversity	Curlew	Biodiversity - Species - Birds	Curlew (targeted management)	4
Biodiversity	Golden Plover	Biodiversity - Species - Birds	Golden plover (targeted management)	8
Biodiversity	Greenland Greater White-Fronted Goose	Biodiversity - Species - Birds	Greenland greater white-fronted goose (targeted management)	10
Biodiversity	Lapwing	Biodiversity - Species - Birds	Lapwing (targeted management)	4
Biodiversity	Red Grouse	Biodiversity - Species - Birds	Red grouse (targeted management)	4
Biodiversity	Ring Ouzel	Biodiversity - Species - Birds	Ring ouzel (targeted management)	6
Biodiversity	Turtle Dove	Biodiversity - Species - Birds	Turtle dove (targeted management)	8
Biodiversity	Twite	Biodiversity - Species - Birds	Twite (targeted management)	8
Biodiversity	High Brown Fritillary	Biodiversity - Species - Butterflies & moths	HBF key area	3
Biodiversity	Marsh Fritillary	Biodiversity - Species - Butterflies & moths	Marsh Fritillary - post 1990	1
Biodiversity	Pearl Bordered Fritillary	Biodiversity - Species - Butterflies & moths	Pearl Bordered - post 1990	3
Biodiversity	Welsh Clearwing	Biodiversity - Species - Butterflies & moths	Welsh Clearwing	2
Biodiversity	Gwyniad	Biodiversity - Species - Fish	Gwyniad	6
Biodiversity	Barbastelle Bat	Biodiversity - Species - Mammals	Barbastelle Bat	2
Biodiversity	Bechstein's Bat	Biodiversity - Species - Mammals	Bechstein's Bat	4
Biodiversity	Dormouse	Biodiversity - Species - Mammals	Dormouse - core	3
Biodiversity	Dormouse	Biodiversity - Species - Mammals	Dormouse - outer	1
Biodiversity	Greater Horseshoe Bat	Biodiversity - Species - Mammals	Greater Horseshoe Bat	2
Biodiversity	Lesser Horseshoe Bat	Biodiversity - Species - Mammals	Lesser Horseshoe Bat	1
Biodiversity	Red Squirrel	Biodiversity - Species - Mammals	Red Squirrel - core	2
Biodiversity	Red Squirrel	Biodiversity - Species - Mammals	Red Squirrel - outer	1
Biodiversity	Water Vole	Biodiversity - Species - Mammals	Water Vole	2
Biodiversity	Grassland Fungi	Biodiversity - Species - Non Vascular Plants & Fungi	Grassland fungi	4
Biodiversity	Lichens Of Old Wayside Trees And Parklands	Biodiversity - Species - Non Vascular Plants & Fungi	Lichens of old wayside trees and parklands	3
Biodiversity	Heathland Plants	Biodiversity - Species - Vascular plants	Heathland plants	3
Biodiversity	Rare Plants	Biodiversity - Species - Vascular plants	Campanula patula	3
Biodiversity	Rare Plants	Biodiversity - Species - Vascular plants	Euphrasia anglica	1
Biodiversity	Rare Plants	Biodiversity - Species - Vascular plants	Lesser butterfly orchid	1
Biodiversity	Rare Plants	Biodiversity - Species - Vascular plants	Upland Juniper	6

CAPIT Category	CAPIT Objective ENG	Priority	Layer	Score
Biodiversity	Rare Plants	Biodiversity - Species - Vascular plants	Arcti_Alpine	4
Carbon	Carbon Soils	Carbon	Upland Priority 1	20
Carbon	Carbon Soils	Carbon	Upland Priority 2	10
Carbon	Carbon Soils	Carbon	Upland Priority 3	4
Carbon	Carbon Soils	Carbon	Lowland Priority 1	30
Carbon	Carbon Soils	Carbon	Lowland Priority 2	15
Carbon	Carbon Soils	Carbon	Lowland Priority 3	6
Historic Environment	Historic Features and Landscape	Historic Environment	Historic features	1
Historic Environment	Parks and Gardens	Historic Environment	Parks and gardens: registered	20
Historic Environment	Parks and Gardens	Historic Environment	Parks and gardens: unregistered	40
Historic Environment	Scheduled Ancient Monuments	Historic Environment	Scheduled ancient monuments	12
Historic Environment	Traditional Buildings	Historic Environment	Traditional farm buildings	1
Landscape	Protected Landscape	Landscape	AONBs	3
Landscape	Protected Landscape	Landscape	Ffridd	2
Landscape	Protected Landscape	Landscape	National parks	1
Water	Water Quality	Water quality	Priority 3	2
Water	Water Quality	Water quality	Priority 4	1
Water	Water Quality	Water quality	Priority 5	0.5
Water	Water Quality Priority Area	Water quality	Priority 1	30
Water	Water Quality Priority Area	Water quality	Priority 2	10
Water	Water Quantity	Water quantity	Proportion of catchment where land management can reduce flood risk & protect water supplies 40-50%	1
Water	Water Quantity	Water quantity	Proportion of catchment where land management can reduce flood risk & protect water supplies 50-60%	2
Water	Water Quantity	Water quantity	Proportion of catchment where land management can reduce flood risk & protect water supplies 60-70%	10
Water	Water Quantity	Water quantity	Proportion of catchment where land management can reduce flood risk & protect water supplies 70-80%	18
Water	Water Quantity	Water quantity	Proportion of catchment where land management can reduce flood risk & protect water supplies 80-90%	32
Water	Water Quantity	Water quantity	Proportion of catchment where land management can reduce flood risk & protect water supplies 90-100%	60
Water	Water Quantity	Water quantity	Reduce flood risk (Water Storage and flood peak regulation - wetland and washland restoration and creation)	20
Water	Water Quantity	Water quantity	WFD & protected areas which have a deadline for achieving environmental objective by 2015	20

Appendix 3.4. Permissions letter

Canolfan
Ecoleg a Hydroleg
CYNGOR YMCHWIL YR AMGYLCHEDD NATURIOL
Centre for
Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

Canolfan Ecoleg a Hydroleg/
Centre for Ecology & Hydrology
Canolfan yr Amgylchedd Cymru/
Environment Centre Wales
Fforddd Deiniol/Deiniol Road, Bangor
Gwynedd, LL57 2UW, United Kingdom

Ffôn/Tel: +44 (0) 1248 374500
Ffacs/Fax: +44 (0) 1248 362133

www.ceh.ac.uk
12th March 2013

Ref no.

Dear ,

Re : Glastir Monitoring and Evaluation Programme – Summer 2013

I am writing to inform you that the Centre for Ecology & Hydrology (CEH), on behalf of the Welsh Government will be carrying field surveys during this summer as part of the Glastir Monitoring and Evaluation Programme (Glastir MEP).

The Glastir MEP will monitor and evaluate Glastir against broader baseline information from across Wales, including farms not participating in any agri-environment schemes. The Glastir MEP will evaluate the impact of the scheme on habitats, species, water, soils, diffuse pollution, climate change mitigation, landscape, wider social benefits and economics.

Your land has been randomly identified for survey
This letter is to inform you that your land has been randomly identified for survey and we would like to visit your farm to carry out this work. If you are not a Glastir contract holder and you would rather we did not visit your farm please can you contact me to discuss.

The survey we are conducting is not related in any way to any compliance inspection process, for Glastir, Single Payment Scheme or any other scheme, and will not affect your payments.

The surveyors will be visiting your area during summer 2013. You are not required to accompany the surveyors. I or the survey team leader will contact you nearer the time to let you know details of our movements on the day and registration of the vehicle. If you wish, the surveyors can meet you during the visit and explain what the survey involves. An overview of the survey is included with this letter.

Your personal data is protected by the Data Protection Act 1998. The information we gather through the survey will be the property of the Welsh Government and will be subject to the appropriate data security restrictions.

As Welsh Government contractors we assure you that we will abide by all required bio security measures, including disinfecting boots and vehicle wheels, when undertaking the survey.

If there are other people who will need to know of our presence e.g. gamekeepers, please could you let the surveyors know who to contact.

Yours Sincerely,

Anthea Owen,
Glastir MEP Farmer Liaison Officer

Canolfan
Ecoleg a Hydroleg
CYNGOR YMCHWIL YR AMGYLCHEDD NATURIOL
Centre for
Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

Canolfan Ecoleg a Hydroleg/
Centre for Ecology & Hydrology
Canolfan yr Amgylchedd Cymru/
Environment Centre Wales
Ffordd Deiniol/Deiniol Road, Bangor
Gwynedd, LL57 2UW, United Kingdom
Ffôn/Tel: +44 (0) 1248 374500
Ffacs/Fax: +44 (0) 1248 362133
www.ceh.ac.uk

Rhif cyf.

12fed Mawrth 2013

Annwyl ,

Par : Rhaglen Fonitro a Gwerthuso Glastir – Haf 2013

Rwy'n ysgrifennu i roi gwybod i chwi y bydd Canolfan Ecoleg & Hydroleg (CEH), ar ran Llywodraeth Cymru, yn gwneud arolygon maes yn ystod yr haf fel rhan o Raglen Fonitro a Gwerthuso Glastir (RhFG Glastir).

Bydd RhFG Glastir yn monitro a gwerthuso Glastir yn erbyn gwybodaeth waelodlin ehangach a gasglwyd ledled Cymru – yn cynwys ffermydd na fydd yn cymryd rhan mewn unrhyw cynllun amaeth-amgylcheddol. Bydd RhFG Glastir yn gwerthuso effaith y cynllun ar gynefinoedd, rhywogaethau, dŵr, priddoedd, gwasgaru llygredd, lliniaru newid hinsawdd, tirwedd, buddiannau cymdeithasol ehangach ac economeg.

Mae eich tir wedi cael ei nodi ar hap ar gyfer cynnal arolwg
Diben y llythur yma yw rhoi gwybod i chwi fod eich tir wedi cael ei nodi ar hap ar gyfer arolwg ac y byswn yn hoffi ymweld ag eich fferm er mwyn cwblhau y gwaith yma. Os nad oes gennych gontract Glastir a'i bod yn well gennych petaem yn peidio ymweld â'ch fferm, a wnewch chi os gwelwch yn dda gysylltu â mi i drafod hyn.

Nad oes unrhyw gysylltiad o gwbl rhwng yr arolwg rydym ni'n ei wneud ag unrhyw broses arolygu gydymffurfio, gan Glastir, Cynllun Tailiad Unigol nag unrhyw arall, ag wneith ddim cael effaith ar eith taliadau.

Bydd y syrfewyr yn ymweld â'ch ardal chi yn ystod haf 2013. Nid oes angen i chi hebrwng y syrfewyr o gwmpas y tir. Byddaf i neu arweinydd y tîm arolwg yn cysylltu â chwi yn nes at y dyddiad er mwyn rhoi gwybod i chwi beth fydd ein cynlluniau ar y diwrnod a beth fydd rhif cofrestru ein cerbyd. Os ydych yn dymuno hynny gall y syrfewyr eich cyfarfod yn ystod yr ymweliad ac egluro beth fydd yn digwydd yn ystod yr arolwg. Mae trosolwg o'r arolwg wedi'i amgau gyda'r llythyr hwn.

Mae eich manylion personol wedi'i diogelu gan y Ddeddf Gwarchod Data 1998. Eiddo Llywodraeth Cymru fydd y wybodaeth y byddwn yn ei gasglu yn ystod yr arolwg a bydd yn atebol i'r cyfyngiadau diogelwch data perthnasol.

Fel contractwyr Llywodraeth Cymru rydym yn eich sicrhau y byddwn yn cadw at yr holl fesurau diogelwch bio gofynnol tra'n gwneud yr arolwg, sydd yn cynwys diheintio esgidiau ac olwynion cerbydau.

Os oes yna bobl eraill sydd angen gwybod ein bod yn gwneud yr arolwg e.e. ciperiaid a wnewch chi os gwelwch yn dda adael i'r syrfewyr wybod gyda phwy y dylent gysylltu.

Yr eiddoch yn gywir,

Anthea Owen
Swyddog Cyswllt Ffermwyr RhFG Glastir

Appendix 3.5. GMEP project Flier

Glastir

Llywodraeth Cymru
Welsh Government

Glastir Monitoring and Evaluation

The Glastir Monitoring and Evaluation Programme will deliver a scientifically-rigorous approach to the monitoring and evaluation of Glastir. The main objective of Glastir is for the delivery of specific environmental goods and services aimed at combating climate change, improving water and soil management, maintaining and enhancing biodiversity, managing and protecting the Welsh landscape including the historic landscape and creating new opportunities to improve access and increasing the area and management of woodlands. The impacts of Glastir need to be closely monitored and evaluated in order to comply with the European Commission Common Monitoring and Evaluation Framework. A partnership has been formed to deliver this for Welsh Government led by the Natural Environment Research Council's Centre for Ecology & Hydrology, an independent public research organisation. (http://www.ceh.ac.uk)

The evidence-gathering components of the The Glastir Monitoring and Evaluation Programme will be split into the following two elements;

A national monitoring surveillance element to quantify ongoing change in the countryside and impacts of Glastir Entry.

A targeted element to identify impacts of specific measures within the advanced element of the scheme.

These two components will focus on providing statistical evidence through a national surveillance programme. This data will be collected both from farms within the Glastir scheme and farms outside of the scheme, allowing a comparison of scheme impact. The evidence will be gathered through a variety of techniques using a wide-range of data collected from both past and present schemes to reduce cost and enhance efficiency. Models will be used to estimate possible outcomes to enable fast feedback to Welsh Government on likely success of specific measures, and integrate results to explore co-benefits and trade-offs between measures.

The Glastir Monitoring and Evaluation Programme will seek to work in partnership with steering and stakeholder groups to ensure the full range of appropriate evidence is integrated to allow an ongoing rolling assessment of changes in the Welsh countryside and the benefits to people, whether they are at the local (e.g. soil quality for farmers), national (improved water quality) or global scales (e.g. greenhouse gas emissions).

All data, trend analysis and reports will be made available through a dedicated Glastir Monitoring and Evaluation Programme web portal to be launched autumn 2014. Farmers are being contacted now to request access to land with monitoring due to start in spring 2013. All data will be securely held by the independent monitoring team and will only used for evaluation of the Glastir programme and released in aggregated format so no specific land can be identified.

ADAS
Prifysgol Bangor University
British Geological Survey
BTO Looking out for birds
ECORYS
Centre for Ecology & Hydrology
Canolfan Ecoleg a Hydroleg
Butterfly Conservation
Pond Conservation For life in fresh waters
y cerddwyr ramblers cymru
Staffordshire University
Victoria University of Wellington

Glastir

Llywodraeth Cymru
Welsh Government

Monitro a Gwerthuso Glastir

Bydd Rhaglen Fonitro a Gwerthuso Glastir yn darparu dull manwl wyddonol o fonitro a gwerthuso Glastir. Prif amcan Glastir yw darparu nwyddau a gwasanaethau amgylcheddol penodol gyda'r bwriad o fynd i'r afael â newid hinsawdd, gwella rheolaeth dŵr a phridd, cynnal a gwella bioamrywiaeth, rheoli ac amddiffyn tirwedd Cymru gan gynnwys y tirwedd hanesyddol a chreu cyfleoedd newydd i wella mynediad a chynyddu ardal a rheolaeth coetiroedd. Mae angen monitro a gwerthuso effeithiau Glastir yn ofalus er mwyn cydymffurfio â Fframwaith Monitro a Gwerthuso Cyffredin y Comisiwn Ewropeaidd. Ffurfiwyd partneriaeth i ddarparu hyn i Lywodraeth Cymru dan arweiniad Canolfan Ecoleg a Hydroleg Cyngor Ymchwil yr Amgylchedd Naturiol, sefydliad ymchwil cyhoeddus annibynnol. (http://www.ceh.ac.uk)

Bydd cydrannau casglu tystiolaeth Rhaglen Fonitro a Gwerthuso Glastir yn cael eu rhannu yn ddwy elfen fel a ganlyn :

> Elfen fonitro a chadw golwg genedlaethol i fesur newid cyfredol yng nghefn gwald ac effeithiau Mynediad Glastir.
>
> Elfen wedi'i thargedu i ganfod effeithiau mesurau penodol o fewn elfen uwch y cynllun.

Bydd y ddwy gydran yma yn canolbwyntio ar ddarparu tystiolaeth ystadegol drwy raglen gadw golwg genedlaethol. Bydd y data yma yn cael ei gasglu o ffermydd o fewn cynllun Glastir yn ogystal ag o ffermydd y tu allan i'r cynllun, fel bod modd cymharu effaith y cynllun. Bydd y dystiolaeth yn cael ei chasglu trwy amrwyiaeth o dechnegau gan ddefnyddio ystod eang o ddata a gasglwyd o'r cynllun presennol yn ogystal ag o'r cynllun blaenorol a hynny er mwyn lleihau costau ac er mwyn bod yn fwy effeithiol. Bydd modelau yn cael eu defnyddio i amcangyfrif canlyniadau posib er mwyn rhoi adborth cyflym i Lywodraeth Cymru ar lwyddiant tebygol mesurau penodol, ac i integreiddio canlyniadau er mwyn archwilio manteision ar y cyd a chyfaddawdau rhwng mesuriadau

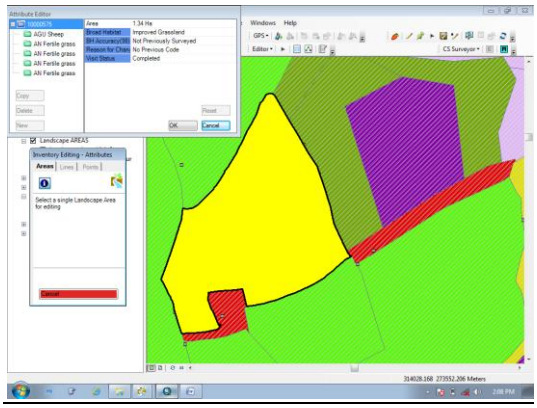
Bydd Rhaglen Fonitro a Gwerthuso Glastir yn anelu at weithio mewn partneriaeth gyda grwpiau llywio a budd-ddeiliaid i sicrhau bod yr ystod lawn o dystiolaeth addas yn cael ei hintegreiddio i gael asesiad parhaus a chyfredol o'r newidiadau yng nghefn gwlad Cymru ac o'r budd i bobl, pru'n ai ar raddfa leol (e.e. ansawdd pridd i ffermwyr), cenedlaethol (gwell ansawdd dŵr) neu yn fyd eang (e.e. allyriadau nwy tŷ gwydr)

Bydd yr holl ddata, dadansoddi tuedd ac adroddiadau ar gael trwy borth gwe un pwrpas Rhaglen Fonitro a Gwerthuso Glastir fydd yn cael ei lansio yn ystod tymor yr Hydref 2014. Gan fod monitro yn dechrau yn ystod Gwanwyn 2013, eir ati i gysylltu â ffermwyr ar hyn o bryd i ofyn caniatad i fynd ar eu tir. Bydd yr holl ddata yn cael ei gadw'n ddiogel gan y tîm monitro a bydd yn cael ei ddefnyddio i werthuso rhaglen Glastir yn unig. Caiff ei gyhoeddi mewn fformat cyfanredol fel na ellir adnabod unrhyw ddarn o dir penodol.

ADAS · Prifysgol Bangor University · British Geological Survey · BTO Looking out for birds · ECORYS · Centre for Ecology & Hydrology · Canolfan Ecoleg a Hydroleg · Butterfly Conservation · Pond Conservation For life in fresh waters · y cerddwyr ramblers cymru · Staffordshire University · Victoria University of Wellington

Appendix 3.6. Software Updates for the GMEP Survey

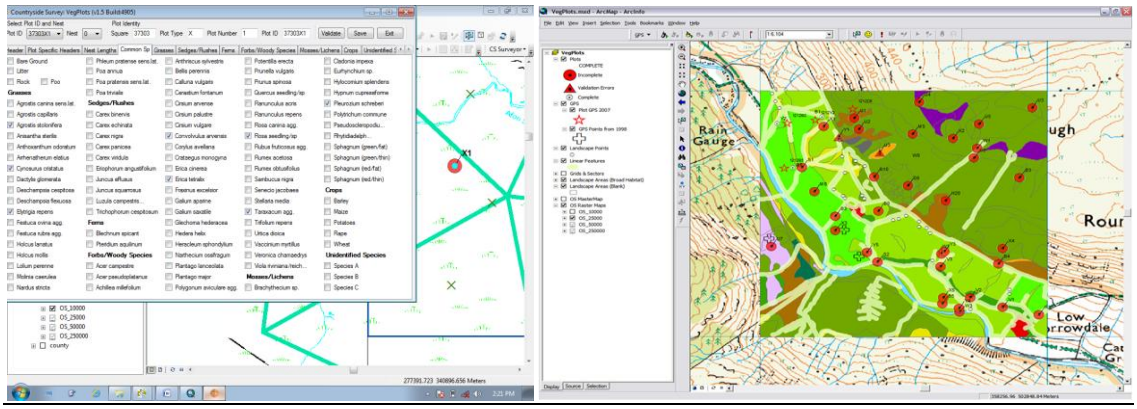
Surveyor



Surveyor is the main software application for mapping and recording all habitat and other physical features within a 1km square. This includes area, point and linear features and associated attributes such as species composition, condition of walls and hedges and sward height. Surveyor is a software application written by ESRI UK for the 2007 countryside survey based on the architecture of "Forester" originally built for the forestry commission. This is a complex piece of software whose updates and maintenance is outsourced to ESRI UK. The updates for this project cost approximately £70k. In the last financial year the Forestry Commission spent well over £200k on maintenance and updates to the original Forester software that surveyor is built on. To date Forestry Commission have spent circa £6M on the Forester software. Updates and modifications for the GMEP survey include:

- Update the software to run on Windows 7 and Arc 10.1.
- Ability to record historic features, together with condition and any signs of damage
- Add a field to record the sward height of polygons. Categories and information in line with Glastir prescriptions.
- Add field to record the tussockiness of polygons.
- Add in extra habitat categories: lowland marshy grassland, calaminarian grassland
- Record presence of habitat boxes for birds and bats

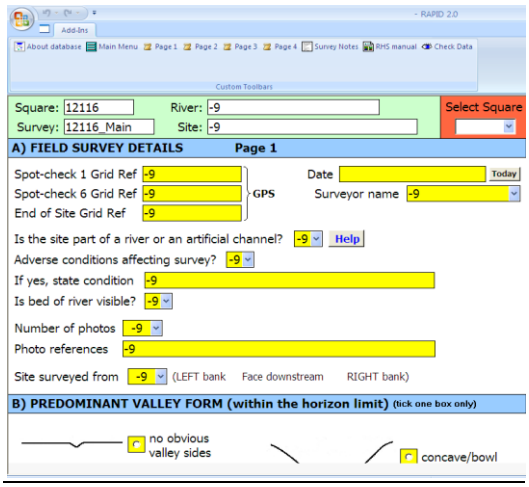
Vegplots



Vegplots is an existing software application from CS2007. Vegplots is used to record the location and species information from all vegetation plots recorded in the 1km square. Vegplots has required extensive updates to run on new versions of ArcGIS and Windows 7. Specific modifications include:

- Addition of P plots (perpendicular to streams to monitor riparian zone)
- Vegetation height categories changed to map onto Glastir interventions.
- Broad habitat recording on x and u plots
- Additional recording of tree health to suggest signs of disease.
- Bespoke vegplots toolbar developed for use in ArcMap to enable easy integration between mapping and vegetation recording.
- Development and review of all species lists within the application.

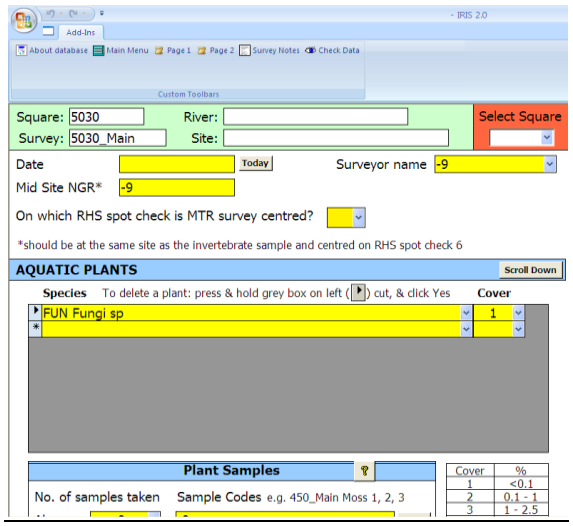
RAPID



Rapid is an existing software application from CS2007 to carry out river habitat survey (RHS). This has needed updating and modifying for use and relevance to GMEP. Specific changes:

- Update to run on Microsoft Access 2007.
- Include new surveyors to record who completed the survey
- Include new square Id list
- Location of Weir / dam added
- Height of Weir / dam added
- Change cover categories from {None, <33%, >33%} to {0, 1-10%, 11-25%, 26-33%, 34-50%, 51-75%, >75%}
- Add location of Side and point bars (opposite or alternate)
- Add the length of the bank that is fenced.

IRIS



IRIS is an existing software application from CS2007 to carry out MTR survey. This needed updating and modifying for use and relevance to GMEP. Specific changes:

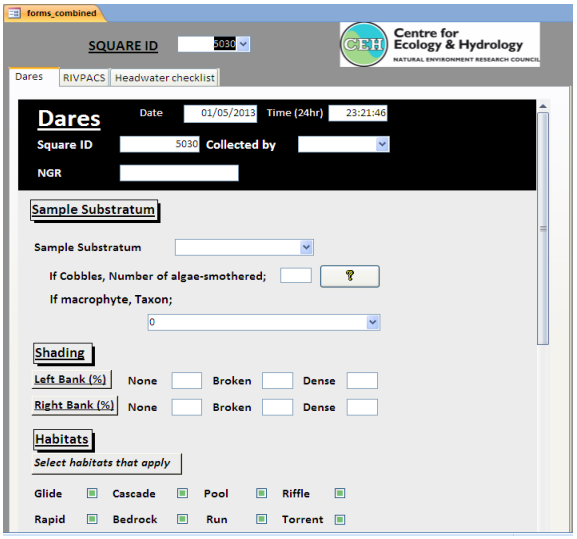
- Update to run on Microsoft Access 2007.
- Include new surveyors to record who completed the survey.
- Include new square Id list
- Record which RHS spot MTR survey was carried out on
- Record whether or not silt was present
- Record any fencing of the banks
- Add in the biomass of the most dominant species.

DARES & RIVPACS FORM

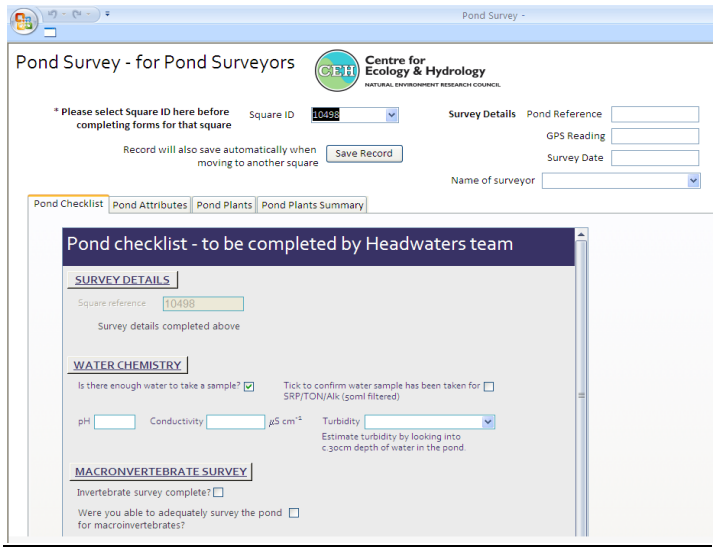
This is a new application for this survey which provides a single database with the diatom (DARES) field form, the RIVPACs (invertebrates) field form and headwater stream checklist. The table structure has been designed to match as far as possible fields within the National Invertebrate Database (NID) held by CEH Wallingford and allow export in the DARES recording format.

Information of sample taken and data for the location the sample was taken from is all recorded. Specifically:

- Water clarity
- Habitat
- Bed stability
- Any additional Photosynthetic organisms
- Water width and depth
- Information on the substratum.
- Basic water chemistry values – ph and conductivity.



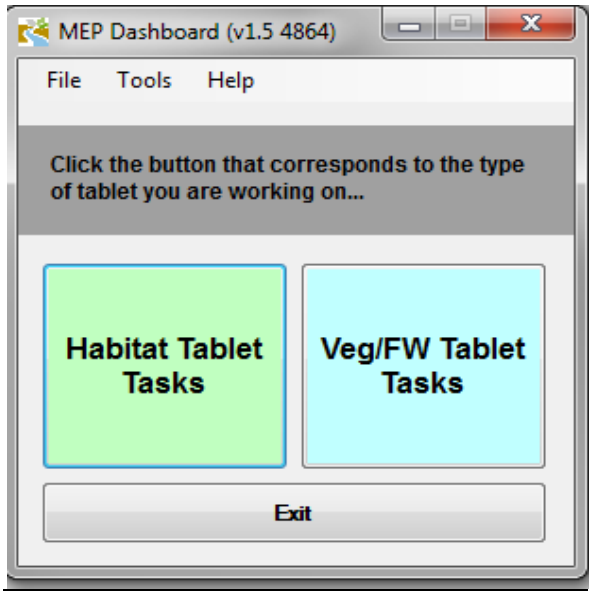
Pond Survey



All information on ponds was previously recorded on paper and sent to pond conservation for analysis. For GMEP we have created a new application to record all the information previously collected electronically. Info includes:

- Water Chemistry
- Age of pond
- Pond base
- Signs and type of pollution
- Any management of the pond
- Record all amphibians present
- Record all plants present – emergents, submerged, floating and algae.
- Surrounding land use.

Dashboard



The Dashboard application was developed for CS2007 to ensure quality control and make it easier for the surveyors to launch applications, download data, upload data and backup the data. This has been updated for the GMEP project so all file paths are correct and so that:

- All additional freshwater applications can be launched from the dashboard
- The user can change where to import data from
- Photos from an SD card will automatically be copied to the corresponding square folder.
- Any length of square number is allowed (previous versions only allowed for 4 digit id's)

Appendix 3.7. Primary datasets obtained or in progress for GMEP

Data Type	Dataset	Description
Contextual	OS Master Map	Ordnance Survey vector line and polygon features.
	OS Raster	Ordnance Survey raster data at scales of 1:10,000; 1:25,000; 1:50,000; and 1:250,000.
	Aerial photography	High resolution Aerial Photography for 2009 covering most of Wales.
	Welsh boundary	Wales country boundary.
	Stocking boundaries	Open Country and Upland Boundary regions, for calculating livestock stocking values.
	Public Rights of Way (PROW)	Linear features displaying public footpaths, bridleways etc.
Habitats	Land Cover Map 2007	CEH land cover type vector and raster mapping.
	BAP Priority Habitats	CCW Biodiversity Action Plan Priority Habitat regions.
	Phase I Habitat Survey	CCW Phase I habitat survey 1km^2 and polygon results.
	Phase II Habitat Survey	CCW Phase II habitat survey polygon features results.
	Ffridd 1km	CCW Fridd habitat 1km^2 locations.
	Habitat Diversity	CCW 1km^2 habitat diversity.
	National Forest Inventory	NFI forest polygons.
	LANDMAP	CCW landscape dataset, including: Geological Landscape, Landscape Habitats, Visual & Sensory, Historic Landscape, Cultural Landscape
Soils	NSRI NATMAP	National Soils Resources Institute (Cranfield University) vector and tabular soils data.
	Hydrology of Soil Types (HOST)	1km^2 soil hydrological properties.
	NRW Soil chemistry	Soil pH, P/K/Mg index values and report.
	BGS Soil Parent Material (data pending)	Pending.
Designated Areas	Sites of Special Scientific Interest (SSSI)	SSSI site boundary polygons.
	Special Areas of Conservation (SAC)	SAC site boundary polygons.
	Special Protected Areas (SPA)	SPA site boundary polygons.
	National Nature Reserves (NNR)	NNR site boundary polygons.
	Ramsar	Ramsar wetlands boundary polygons.

	Biosphere	Biospheric and Biogenetic reserve boundary polygons.
	Areas of Natural Beauty (AONB)	AONB site boundary polygons.
	Heritage	Heritage coastlines polygons.
Hydrology	Detailed River Network (DRN)	Environment Agency/NRW linear rivers features.
	NextMap Digital Elevation Model (DEM)	Intermap 5 x 5m elevation raster.
	Water Quality & Biological Monitoring	EA/NRW water monitoring data.
	Water Table (data pending)	Pending.
	WFD water bodies	EA/NRW Water Framework Directive water bodies (rivers, ditches, canals, lakes etc).
	WFD catchment boundaries	Water Framework Directive hydrological catchment boundaries.
Historic	Historic Landscape	CADW Historic Landscape regions.
	Historic Environment Features (HEF)	Archaeological Trust historic features.
	Historic Parks & Gardens	CADW Parks and Gardens polygons.
	Listed Buildings	CADW listed buildings point locations.
	Scheduled Ancient Monuments (SAMs)	CADW SAM polygons.
	World Heritage Sites	CADW World Heritage Sites and Arcs of View within Wales.
	Designated wrecks	CADW shipwreck locations.
Farm Holdings	Land Parcel Identification System (LPIS)	Land parcel boundary polygons and supporting lookup tables to identify the owners of farms and common land.
	Landowner contact details	Contact details for LPIS land parcels.
	Robust Farm Type	Defra Agricultural Survey farm type results for 2010.
Glastir and Past Schemes	Target Areas	Glastir Target Areas, including: Carbon, Water Quality, Water Quantity, Access, Landscape, Historic Environment, Biodiversity Habitats & Species.
	Glastir Entry Level Scheme	ELS uptake extents and options.
	Glastir Advanced	Advanced uptake extents and options.
	Glastir Commons	Commons Land Element uptake extents.
	Tir Gofal	Tir Gofal extents and options.
	Boundaries of farms in other past schemes e.g. Tir Cynnal (data pending)	Pending.
	ACRES	Agricultural Carbon Reduction and Efficiency Scheme uptake.
	Protected Zones	(Red Squirrel, Water Vole, Chough; request for others with WG).

Appendix 4.1: Understanding the impacts of agri-environment schemes on habitats and species, through analysis of pre-existing data.

Lisa Norton, CEH Lancaster

Background

Countryside Survey (CS) measures change in a range of attributes in a sample of 1km squares across Great Britain. Drivers of change in the extent and condition of habitats, landscape features, species, soils and water are related to a range of drivers including land use change. Agri-environment schemes, which have been in place in GB since the introduction of the Environmentally Sensitive Area (ESA) scheme in 1987, are designed to drive change in a positive direction. The impacts of these schemes on the wider countryside have been considered under two specific projects post CS in the last 2 surveys (1) CS2000 and 2) CS2007). For the purposes of the GMEP work some investigation of the data specific to CS squares in Wales in 2007 has been carried out to discover how the agri-environment data can be used to understand impacts of agri-environment schemes on the wider countryside (3). Finally, the results of the species monitoring work on agri-environment schemes in Wales are presented (4).

Finding Out Causes and Understanding Significance (FOCUS) Q17:

How are agri-environment schemes represented in the CS2000 field survey sample? What evidence is there that agri-environment schemes have contributed to the changes in the Broad Habitats and landscape features recorded in CS2000?

Key findings:

- Spatial coverage data was available for the ESA and Countryside Stewardship (CSS) schemes through English Nature (now Natural England).
- No data were available on options or on location of options within the areas under agreement.
- Less than 10% of CS squares in England and a much lower proportion in Wales contained land under agreement. The total proportion of CS survey land in agri-environment schemes in CS2000 was 0.2%.
- Low sample sizes meant that analysis could not provide statistically valid data on change relating to habitats, landscape features or species. Additional uncertainty about dates of entry into schemes and relatively limited periods of time under agreement made analysis problematic.
- It was concluded that in order to be able to test the efficacy of options under agri-environment schemes a considerable increase in agri-environment coverage within the CS survey sample would be essential. It was also concluded that considerable improvements in the compatibility of data between CS and bodies administrating the schemes was necessary.

Correlative analysis of datasets to assess degree of success in the delivery of Environmental Stewardship objectives (England only):

Assessment of the effects of Environmental Stewardship on landscape character.

Key findings

- Spatial data coverage was available for Environmental Stewardship (ES), Environmentally Sensitive Areas (ESA) and Countryside Stewardship Scheme (CSS) through Natural England.
- In 2007, 30.3% of land in CS squares in England was under ES agreement, 10.6% under CSS agreement and 7.1% under ESA agreement.

- Option data was available for all schemes, but was linked to a single point location in either a field or holding, so it was therefore impossible to know exact locations of agreement options, i.e. which field, which hedge, which tree was under agreement?
- Coarse comparisons between the extents of landscape features in CEH landclasses per unit area and the extents of features under agri-environment options per unit area were possible. These showed that at a coarse scale walls and hedges appeared to be well represented within agri-environment options, whilst ponds and trees were less well represented. Condition of hedges and walls inside and outside of agri-environment land at this scale did not differ.
- Analysis of square level data was complex because of the issues outlined in bullet 2 (above). However, it showed that ES options for hedges and walls did not cover all possible features on agreement land. It also showed that condition of walls on agreement land was better (the proportion of walls in excellent condition was double) than land not under agreement. Hedge condition was more similar between CS and agreement land with the exception of land under ESA which contained more unmanaged hedges and more hedges managed by coppicing or laying.
- Lack of spatial resolution for agri-environment option information and limited representation of agri-environment options in the CS squares (compared to the actual extent of features) make it difficult to pick up any signal of change resulting directly from the agri-environment schemes.

Investigation of Welsh agri-environment data (CS2007)

- Welsh data was provided by CCW including spatial information on the ESA, the Organic Farming Scheme (OFS), Tir Gofal and Tir Cynnal. This information was combined into a single spatial layer in Arc by merging the datasets. However, it should be noted that although a single spatial layer this does not mean that each space is covered by one scheme only. Some areas will have been covered by different schemes at different times e.g. ESA and then subsequently Tir Gofal or by multiple schemes at the same time.
- Agri-environment data for the whole of Wales was provided and then intersected with CS squares in Wales. The total number of polygons included in the agreement data for the whole of Wales was 349,531. Around 30% (118,709) of these polygons had no feature code (the codes associated with options adopted) associated with them. The majority of these (105,991) appeared to be Tir Cynnal agreements, however, the metadata provided with the data was incomplete and thus interpretation of the data was problematic. There were also 7416 polygons (primarily associated with Tir Gofal) with missing data for feature area (although they do have a spatial coverage associated with them).
- Aside from the issues described above, using the data provided it was possible to quantify the total areas, lengths and numbers of different feature types under agri-environment options in CS squares compared to the total overall (Table 1). The numbers, lengths and areas under different options relevant to the different schemes across Wales can also be quantified, see tables 2, 3 and 4. The lack of feature codes in the polygon data mean that for a large area of land in CS squares under agri-environment schemes the options are not known.
- Of the 107 squares surveyed in 2007, 89 contained polygons under agreement, 42 contained point features under agreement and 59 contained linear features under agreement.

Table 1. Features and land under agreement in Wales and in the CS sample in Wales.

	Area under ag_env (ha)	Number points	Length of linear features (m)
Wales	862240.6557	133182	43733198
CS	4143.4708	886	255223.4

Table 2. Point feature options within the CS squares

Description	**Number**
Gate	11
Historic feature	6
Archaeological feature	10
Posts	5
Gates	58
Archaeological/historical feature	5
Barn owl nest boxes	5
Bench seat (timber)	1
Boulder Field	1
Bridle gate (timber)	7
Broadleaved Trees Shrub	575
Culverts	5
Footbridge	1
Gates (timber)	144
Grazing marsh bridge	1
Hard Surfacing for Feeding Pads	1
Ladder stile	2
Other nest boxes	2
Posts for signs waymarks etc (timber)	5
Scrub	5
Soil Bunds	2
Special Projects (Point)	1
Trees & guards (under 10 trees)	2
Water troughs	20
Wooden stile	11
Unknown	5
TOTAL	886

Point options have relevance for different potential measures of improvement such as access (gates, ladder stiles, waymarker posts, benches), species enhancement (nest boxes, trees and guards, broadleaved shrub) or water quality (water troughs).

Table 3. Linear options within CS squares

Description	**Length (m)**
Walls Hedges Earthbanks (stockproof)	1846.55
Walls Hedges Earthbanks (non-stock)	28590.06
Fences	29629.71
Streams	6875.02
Ditches Drains and Grips	1744.03
Monument boundary	2568.5
Option 10.70	1869.37
Option 10.80	34.1
Rock Outcrops	283.46
Hedgerow restoration	24727.21
Wall restoration	2121.8
Stone-faced earth banks	190.74
Earth Banks	291.33
Traditional boundaries	35054
Other boundaries	15527.03
Stream	7174.22
Ditch	10362.32
Piping for water supply	2631.14
Post and Rail fencing (timber)	248.91
Post and wire fencing (timber)	27897.15
Supplement for stock netting	50716.71
Electric fencing	190.15
Restoration of Hedges	583.84
Restoration of Walls and Earthbanks	345.85
Unknown	3720.24
TOTAL	255223.4

The potential for some linear options to enhance environmental quality is clear (e.g. hedgerow and wall restoration). In other cases more details are required about the managements associated with the different options, e.g., are fences to keep stock away from water? What is being done under stream options?

Table 4. Area options within CS squares

Description	Area (m^2)
Semi-Improved Grassland	31581.02
AAPS eligible land	7861.75
Permanent crops	2664.6
Other enclosed land	98565.99
Unenclosed land	29613.76
Grazed woodland	6312.73
Semi-Improved Grassland	3583.21
Semi-Improved Grassland	46451.2
Marshy grassland	33938.7
Raised and Blanket Bog	23601.63
Blanket bog	21845.77
Raised bog	909.004
Reedbeds swamps and fen	13173.01
CGM (Breeding Birds)	648.278
CGM and floodplain grassland - improved grassland (light grazing)	2156.37
CGM and floodplain grassland - imp. land (moderate grazing)	2416.3
Saltmarsh (Breeding waders)	384.4201
Maritime Cliff and slope (grazed)	3826.82
Broadleaved Woodland (Stock exclusion)	39039.39
Broadleaved Woodland (Lightly grazed)	7315.25
Broadleaved Woodland (existing grazing)	26599.2
Scrub Management	11526.49
Grassland of conservational value/rough grazing	67160.13
Pond	162.5603
Wetland	5467.64
Farm woodland/copse (ungrazed)	9473.81
Area of historical/archaeological interest	3387.48
Improved land(grassland):Establish streamside corridors	673.6829
Orchards (Semi-Improved)	406.978
Parkland (Semi-Improved)	12345.1
Orchards (Improved)	132.7251
Parkland (Improved)	2779.46
Heather Management (cutting) NEW CODE	1607.7
Heaths (Upland)	38874.26
Bracken control (mech. or ground spraying)	1319.42
Bracken Control (aerial spraying)	3433.41
Bracken control (ground spraying)	1214.58
Rhododendron Control (outside woodland)	293.7107
Scrub clearance (mechanical)	224.9485
Scrub clearance (by Cutting)	1315.22
Pond creation	38.57257
Creation and restoration of ponds	786.3955
Heaths (Lowland including coastal)	6297.86
Traditional farm buildings	83.35219

Grassland (Enclosed Unimproved acid)	18819.11
Grassland Unenclosed	20422.47
Grassland (Commons)	2500.5
Unimproved neutral grassland (Haymeadow)	3088.04
Neutral grassland	826.0596
Unimproved limestone grassland	986.4495
Broadleaved Woodland	618.3454
Species Rich Grassland	2468.21
Improved and Other Land	61867.77
SNRG	14309.3
Semi Natural Rough Grazing (Heather)	8305
SNRG	5002.73
Broadleaved Trees Scrub	6685.67
Enclosed Unimproved Grassland	17246
Enclosed Partially Improved Grassland	12991.18
Lakes Ponds and Streams	1324.76
Wetlands	2831.9
Hay Meadow	3945.03
Coastal Belt	9234.1
Traditional Farm Buildings (Weatherproof)	34.10229
Rock Outcrops	189.7869
Semi Natural Rough Grazing 5%-50% Heather	508.4371
Broadleaved Woodland (Stock Exclusion)	777.3401
Wetland	212.8065
Hay Meadow	3677.1
Coastal Belt - No Heather	7760.26
Reversion to hay meadow	644.741
Reversion to Coastal Belt	470.5379
Improved and Other Land	323740.8
Trees & Guards (10 trees & over)	2484.69
Unknown (Tir Cynnal?)	40329241
TOTAL	41434708.462

As with linear and point options, detailed understandings of what management the options involve is required to enable any kind of assessment of whether they have produced anticipated improvements. In the cases of options designed to improve bird numbers, or enhance plant species richness, there are clear measurable outcomes. Measuring landscape level effects such as water quality improvement or enhancement of landscape aesthetics require more complex measures.
As yet no analysis of the impacts of the various options on CS data has been carried out for the Wales data. It is anticipated that the analysis would be more easily achieved than that described for the English data (2, above) because of the spatial accuracy of the Welsh data.

Information from a report on species monitoring on agri-environment schemes (AES) October 2012 (MacDonald et al. 2012).

The following summary points have been drawn from the summary of the final report (MacDonald et al. 2012).

- Species chosen on the basis of expected responses to AES management, with a primary focus on Tir Gofal.

- No baseline data so comparisons were pair-wise with non-AES areas, except for use of historical data on grouse and chough.
- Measures of occurrence, abundance and species richness were modelled against AES status, habitat and management variables. Habitat quality was also used to account for patterns of species response.
- Relatively few taxa showed differences in abundance, occupancy or species richness between Tir Gofal and non-AES farms or fields. Differences were largely due to the influence of AES management on arable land, benefits were far less apparent on grassland.
- Lack of baseline data on habitat condition and historical management make it difficult to understand the impact of schemes over and above existing differences between locations.
- Tir Gofal may have impacts over a longer timescale than covered by this project in which many farms had only been under agreement for a relatively short time (under a decade).
- Despite lack of differences between Tir Gofal farms and non-AES farms, Tir Gofal farms frequently held good populations of monitored taxa and play an important role in maintaining habitat for species enabling them to persist in the landscape.
- Individual species enhancements may require more specific targeting than Tir Gofal options provide.
- Bats did not show significant responses to AES with habitat type and quality relatively uniform across the study area. Responses tended to be measurable at landscape level rather than at the level of individual options.
- Habitats were similar between farms, though given time, options being taken up now could mature into valuable habitat for bats.
- Organic management and land under SSSI provided high water quality which benefitted Daubenton's bats.
- Yellowhammers responded well to Tir Gofal management prescriptions in both winter and summer and benefitted particularly from organic management in winter.
- Lapwings were more abundant on habitat managed for lapwings under Tir Gofal than other Tir Gofal land, but were no more abundant on agri-environment land than on non agri-environment land.
- Chough preferentially foraged in fields under Tir Gofal prescriptions but territory occupancy and productivity did not differ according to the amount of Tir Gofal within 300m of nests.
- Prescriptions for unsprayed fields and fallow margins under Tir Gofal led to a more diverse arable plant community; cover was also higher on fallow margins, though not on unsprayed fields. The margins provide a valuable overwinter seed resource. Arable plants were more diverse on Tir Gofal organic farms than on farms in Tir Gofal only.
- No difference in grassland fungi species richness or site quality was found between meadows entered into Tir Gofal and meadows that were conventionally managed.
- There was no clear evidence that Tir Gofal improved the status of target butterfly species despite some evidence of better habitat quality on Tir Gofal farms. There is a potential lag in effect due to habitat establishment, e.g. of hedges.
- Populations of brown hares were greater on Tir Gofal farms than on non AES farms and related to the presence of arable land. Water vole presence was not affected by whether land was in AES or not.

Key conclusions

These various assessments highlight some important considerations for the GMEP work.

- Coverage of Glastir needs to be sufficient within the survey sample to enable monitoring and evaluation of impacts.
- Baseline data on condition and extents of habitats pre-scheme entry (historic management) enable the assessment of scheme impact to be more easily measured.

- High quality spatially accurate agri-environment data and effective liaison between bodies collating data and those monitoring impact is essential to ensure good understanding of datasets. Even so, matching spatial data is complex and time-consuming and may be problematic where features are recorded using different methods.
- Some agri-environment data for previous schemes in Wales is spatially explicit. This provides the potential for exploring how previous scheme entry impacts on the success of Glastir where data allows.
- It is important to set out criteria by which the success of agri-environment scheme options can be measured in order to understand their impacts on the wider Wales countryside.
- Measuring definitive impacts of AES schemes on the wider countryside is difficult, not least because of scales at which responses may be recorded (both in time and space). Options may take a long time to have an impact, e.g. grassland enhancement, hedge restoration, or they may impact on species such as birds and bats at a landscape rather than a field scale.

Additional evidence from AES schemes in England

Evidence requirements to support the design of new agri-environment schemes
BD5011 (FERA, CCRI, ADAS) March 2013

From the Executive Summary

- Scheme objectives need to be clear and well defined, and linked to 'SMART' indicators, with a pre-defined monitoring programme. There also needs to be clear demarcation between what is and what is not within the remit of agri-environment schemes.
- On farm advice is vital to ensure schemes are successfully applied at local levels.
- Targeting of options to achieve maximum benefit may be important under financial constraints, both at an individual farm and a landscape level.
- Arable options provide the most obvious benefits for plants and birds, including nectar mixes.
- Targeted bird options on arable land have also been shown to be effective for certain species as have hedgerow, field margin and ditch options.
- Hedgerows and hedgerow trees have been shown to be beneficial to plants, invertebrates and bats.
- Well targeted buffer strip, overwintered stubble and cover crop options have demonstrated benefits for resource protection, but placement and management implications affect their adoption and their effectiveness.
- Low input grassland options keep nutrient losses down but do not provide much additionality.
- Evidence for impacts on GHG is weak and based on assumptions about management impacts.
- Impacts of Entry Level Scheme on the historic environment have been mostly positive.

<u>Reason for failures of scheme objectives</u>

- Rare arable plants outcompeted by highly competitive weeds
- Management options too costly, e.g. restoration of grasslands
- Non-ideal locations for options, lack of synergy across options at the farm and landscape level addressing landscape issues
- Lack of persistence in clover crops
- Lack of catchment based approach for water issues and insufficient advice and funding
- Insufficient knowledge of archaeological issues

Operational issues

- In many cases farmers adopted options requiring the least additional work/cost. Additionality was highest for HLS, buffers and arable options, least for hedge management and woodland options.
- Understanding farmer behaviours and working more closely with them is key.
- A co-ordinated, locally sensitive approach will be needed to achieve management at a landscape scale.

Has the implementation of Entry Level Stewardship (ELS) and Higher Level Stewardship (HLS) met the objectives of the Environmental Stewardship scheme?

Biodiversity

- For arable plants, uptake of key options is low. There is room for improvement in their implementation of options for the creation, restoration and management of species-rich grassland.
- There are encouraging signs that positive management is making a difference for some pollinating insects, such as in case studies of butterfly populations.
- Most of the HLS options applied in upland agreements were likely to deliver the desired outcomes. HLS monitoring showed that predicted outcomes in limestone areas with a focus on calcicolous grassland were generally good, as were those for historic features.
- Although ELS and HLS options are being shown to have an impact on bird populations locally, the scheme as a whole has not yet reversed the declines of farmland bird populations and further uptake of suitable options is needed.

Resource protection

- The Environment Agency has reported that the extent to which Environmental Stewardship can be successful in tackling water issues is limited because of the lack of options to tackle various issues, the need for multi-objectivity, and catchment-scale approaches.

Climate change

- The role of ES in affecting climate change is modest, through the encouragement of carbon storage in soils (e.g. arable reversion to permanent pasture) and reduction in inputs (especially nitrogen fertiliser). English Nature's Technical Information Note 107 calculated this reduction in emissions to be 4 Mt CO2e per year but this did not account for the displacement of emissions to other parts of the farm, country or elsewhere. ES may be best viewed as a supporting measure for regulation and cross-compliance, which offer greater potential for GHG abatement.

Access

- Access options have resulted in additional access to the countryside. ES options to increase access for the less mobile had provided a significant level of improved access on those sites taking part. However, there is still room for improvement and expansion to include other under-represented groups.

How could the scheme be improved with respect to delivery of specific objectives?

Biodiversity

- Further work is in progress on methods for the control of undesirable, competitive species in uncropped, cultivated margins for arable plants.
- Significant gains in species-richness of species-poor grasslands are unlikely without pro-active measures such as disturbance and/or sowing. Inclusion of the hemi-parasite yellow

rattle (*Rhinanthus minor*) in the seed mix can suppress grasses and enhance forb establishment.

- Studies recommend that heavy grazing is avoided at the base of hedgerows to allow the establishment of native flora, thus providing pollen and nectar sources for pollinators. It is also suggested that options for laying hedgerows should be available.
- The inclusion of options for constructed wetlands may encourage wildlife such as dragonflies (though further evidence is needed of their impact on populations); also the retention of sediments in bunded ditches has the potential to limit sediment and nutrient losses from farms to river systems.
- The potential loss of hefted flocks in the uplands is a subject of concern, as they are difficult to re-establish, and their loss could make the management of grazing and its impacts on the vegetation more difficult. However, more evidence is needed as to whether this issue is affecting the delivery of ES objectives in practice.
- There is evidence that ceasing grazing earlier may be beneficial for maintenance of species diversity in upland hay meadows because it allows greater seed production. Manipulation of cattle and sheep grazing can improve heather establishment and spread during moorland restoration but management needs to be tailored to the local conditions as upland vegetation is highly variable between and within regions.
- Lapwings may benefit from placement of uncropped cultivated areas near to wet features, which have been shown to provide high quality foraging habitat for their chicks.
- Optimum management for birds would provide a range of seed resources through the winter combined with habitats providing higher invertebrate abundance in summer. A new option for supplementary feeding is now available, based on evidence that this can help to bridge the 'hungry gap' in food availability at the end of winter. Heterogeneity of stubble height increases the attractiveness to a range of species.

<u>Resource protection</u>

- Small constructed wetlands are generally effective in removing pollutants through sedimentation, though regular dredging is needed to avoid remobilisation and transport into watercourses. Rural SuDS (sustainable drainage systems) are helpful in managing runoff, lowering flood risk and increasing water absorption, and make existing features more effective. However, they are not currently available as options in ES.

Other potential new options include:
o Grassland loosening and arable tramline management to reduce runoff,
o Use of precision slurry spreading methods to reduce ammonia and greenhouse gas emissions
o woodland creation.

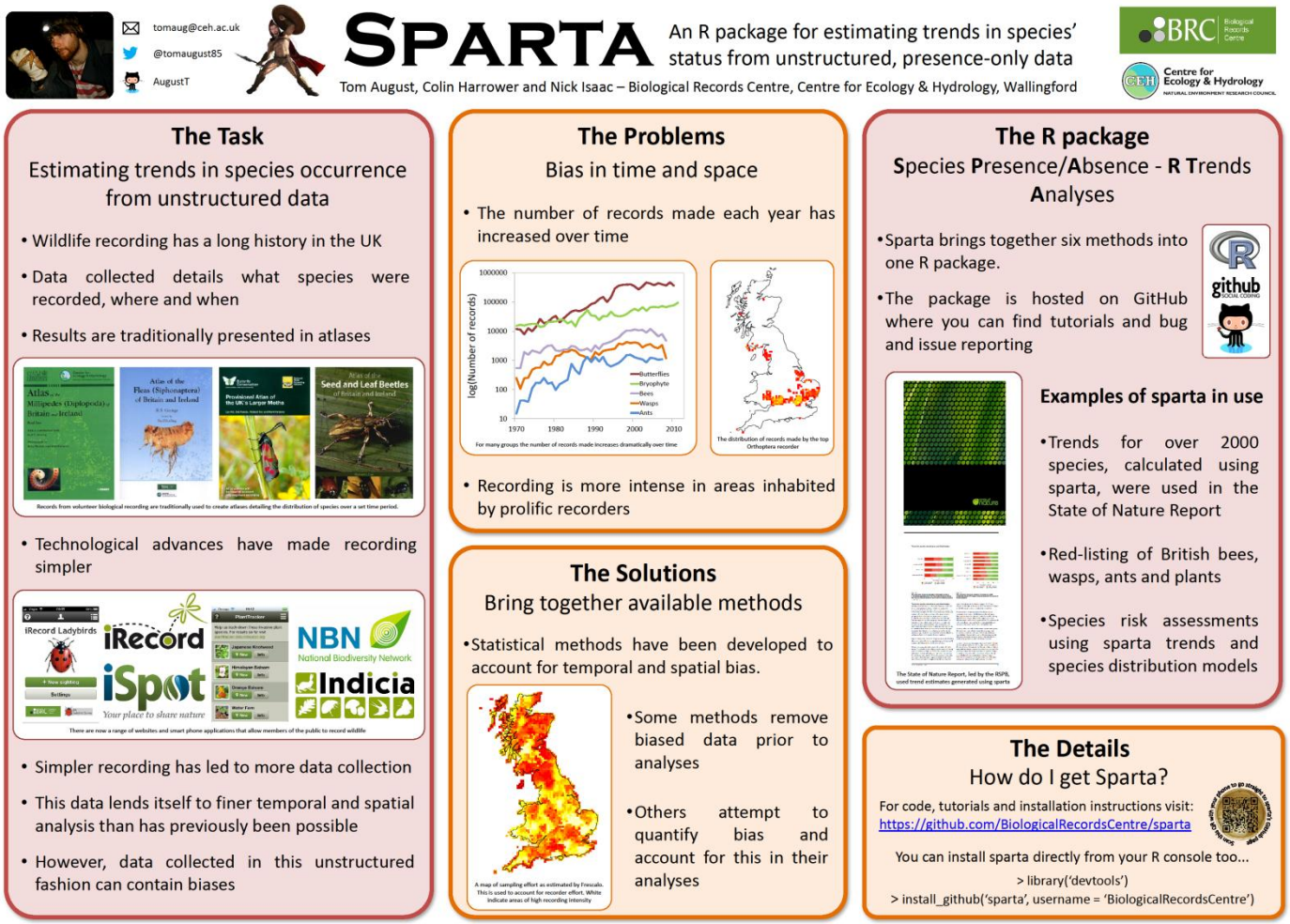
<u>Climate change</u>

- Two areas where ES could make a substantial contribution are in the protection and restoration of blanket bog which provides a carbon store to combat the effects of climate change, and through better use of organic manure nutrients which will reduce the balance of greenhouse emissions. Planting more woodland would also sequester considerable amounts of carbon until the system reached equilibrium, as long as the timber was not harvested.

<u>Historic environment</u>

- The implementation of ES has largely met the objectives of the scheme for the historic environment, although the benefits might be under-recorded. This is because only those options specifically targeted at historic objectives are credited with having an impact but other options may also contribute.

Appendix 4.2. A poster outlining the R package '*sparta*', that was developed as part of the GMEP project.



Appendix 4.3. Modelling the impacts of Glastir measures on plant species' Habitat Suitability – model description

Simon Smart

Modelling of the responses of plant species to Glastir measures used the MultiMOVE R package. This comprises a small ensemble of three statistical modelling techniques; Generalised Linear Models, Multiple Adaptive Regression Splines and Generalized Additive Models. All are well established methods but each has strengths and weaknesses which mean that averaging the outputs from all three techniques is likely to lead to a more robust projection than relying on just one of the techniques (Smart et al 2010a; Randin and Dirnbock 2006). Ensemble approaches thus exploit the power of each method but without the results being heavily influenced by the biases inherent in each method (Araújo and New, 2006).

The data used to train each species model is described in Smart et al (2010b). The input variables are the same for every species and type of model. Three climate variables are used along with estimates of soil pH, soil moisture, carbon to nitrogen ratio and canopy height weighted by the cover of the species present These variables are assumed sufficient to define the essential features of the realized niche of each plant species. Figure 1, for example, shows the modelled niche surface of Round-leaved Sundew in two dimensions indicating that the species grows optimally in peaty (high C:N) and acidic (low pH) situations. Canopy height is extracted from database values for each species rather than the observed canopy height making the projection more likely to reflect the long-term successional status of the vegetation. The soil variables can either be estimated from mean Ellenberg values for species growing in the target vegetation or based on actual measurements (De Vries et al 2010). Translation between soil data and mean Ellenberg values is achieved via a further series of regression equations (Rowe et al 2011; Smart et al 2010b).

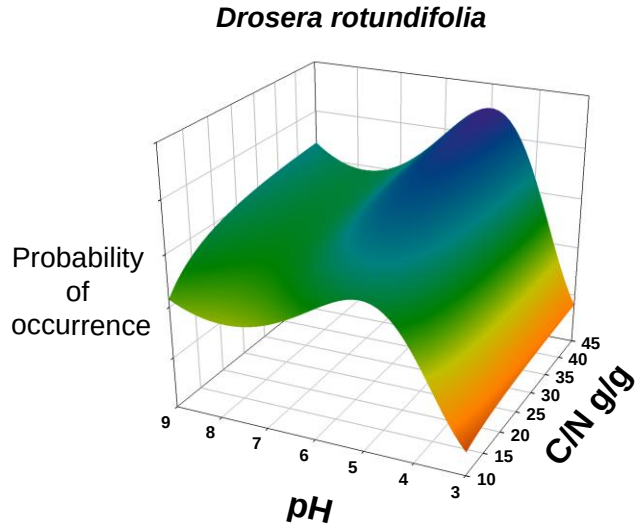


Figure 1: Niche surface for Round-leaved Sundew projected by its MultiMOVE GLM along two abiotic axes.

Interpretation of model output

The MultiMOVE ensemble produces probability of occurrence values for each species. Interpreting these directly is problematic because rare species will have a lower maximum probability at their niche optimum than common species simply because of differences in prevalence across the sampled region represented in the training data used to build each model. It is more informative and sensible to use the models to estimate the suitability of conditions for each species on an equal basis for all species. This places the emphasis on the potential of the habitat to support the species *if it were in the local species pool* and reduces emphasis on outputs as a prediction of presence. For this reason all raw probabilities were rescaled by the distribution of probabilities in the training data so as to correct for differences in overall frequency. The resulting values still range between 0 and 1 but can be compared on an equal basis between species.

Appendix 4.4. Stocking reduction and impacts on bird habitat suitability - a summary of the evidence required for MultiMOVE modelling of changes in species composition and vegetation height

Markus Wagner

The literature review of stocking reduction effects on vegetation height aims to also include the effects of this option on habitat suitability for a number of bird species thought to be likely beneficiaries of stocking reduction in a wider range of situations.

A preliminary review suggests that evidence in the literature directly linking stocking reduction with bird habitat suitability is scarce. Therefore, an extended literature review with the aim to yield sufficient information to allow meaningful predictive modelling of stocking reduction effects on bird population densities has to be split into two separate parts, with the first part covering the effects of stocking reduction on vegetation condition, and the second part covering the relationship between vegetation condition and habitat suitability for candidate bird species for modelling.
Results so far of the latter part of the review suggest that the link from a reduction in grazing intensity via an increase in average vegetation height to bird habitat suitability may not always be positive, and that some bird species could actually be negatively affected. For example, densities of golden plover usually are positively correlated with the extent of short, open vegetation (Pearce-Higgins & Grant, 2006), and a reduction in grazing intensity could thus negatively affect population densities in this species. Furthermore, for some bird species, more of a specific vegetation structure may be beneficial up to a point, but not any further. For example, tall swards that support higher invertebrate abundances are important for black grouse broods (Baines et al., 1996), but where such tall swards become too extensive, breeding success of black grouse usually declines (Calladine et al., 2002).

Importantly, the effects of grazing on vegetation condition tend to be quite complex, and not just restricted to vegetation structure, as grazing also affects plant species composition. In addition, the relationship between vegetation condition and habitat suitability is similarly complex for many bird species, and is not just mediated by vegetation structure, but also by vegetation composition.
Changes in grazing pressure do usually not only affect mean vegetation height, but also height variability and plant species composition. For example, in heather moorland, increased grazing pressure usually results in a reduction of heather *Calluna vulgaris*, and an increase of unpalatable species, including certain graminoids such as rushes *Juncus* spp. and mat-grass *Nardus stricta* (e.g. Welch, 1986). The effects of grazing on vegetation structure and composition will also vary in relation to whether the grazing is done by sheep, by deer or by cattle. Importantly, changes in grazing pressure usually affect vegetation structure and taxonomic composition at different rates, with structure usually responding much faster than species composition (Pearce-Higgins et al., 2009).

As already mentioned, some of the bird species under consideration for being modelled may be influenced by shifts in vegetation composition, and not just by shifts in vegetation structure. For example, red grouse depend strongly on the availability of heather as a food plant (Jenkins et al., 1963). Accordingly, red grouse densities are usually related to heather cover: The precise relationship tends to be non-linear, being positive across the lower range of heather cover, peaking at c. 50-60% cover and slightly dropping off at even higher values (Pearce-Higgins & Grant, 2006). On the other hand, some bird species such as ring ouzel and black grouse specifically require the presence of graminoid-dominated vegetation which is used by them as a feeding habitat (Baines, 1994; Starling-Westerberg, 2001; Burfield, 2002), while at the same time, they also requiring taller,

heather-dominated dense vegetation that can be used for nesting (Stillman & Brown, 1994; Picozzi, 1996; Buchanan et al., 2003).

Such complex relationships between grazing level and vegetation condition on the one hand, and between vegetation condition and the species-specific habitat requirements of birds on the other hand, mean that in order for modelling to yield realistic predictions of the effects of stocking reduction on bird population densities, several requirements have to be met. First of all, it must be possible, on the basis of a review of previous research, to define the habitat niche of a particular bird species sufficiently accurately with respect to both vegetation structure and vegetation composition requirements, and most likely also with respect to proportion and spatial configuration in the landscape of various habitat types required by the species under consideration for vital activities such as nesting, foraging, and so on. More work on this part of the review is needed to see for which of the bird species under consideration such descriptions of habitat requirements can be achieved with sufficient precision and with sufficiently widespread validity. At the same time, a more comprehensive approach is required with respect to reviewing the literature on the effects of stocking reduction on vegetation condition. This part of the review must take into account the relationship between stocking densities and type of grazing animal on the one hand, and vegetation height and composition – the latter at least at the level of broad functional groups such as graminoids and dwarf shrubs / heather, on the other hand. At the same time, this part of the review must also relate effect sizes on vegetation with time scales over which they are expected to occur. A focus on compositional shifts may also be required as in the presence of such a selective agent of vegetation change as represented by grazing, such compositional shifts may not be entirely predictable on the basis of shifts in mean vegetation height alone.

Finally, given the complexity of the approach required, additional discussions with experts will be needed to verify realism of bird habitat niche descriptions derived from the literature and their usefulness in the context of designing models aiming at predicting the effects of stocking reduction on bird populations.

Appendix 4.5a: Look-up table linking target objectives and Glastir management interventions (from Targetchecker) to GMEP survey datasets.

Columns containing a 'y' indicate that the respective component of GMEP will record the impact of the Glastir intervention on habitat extent, condition, other relevant ecosystem attributes and on the biodiversity target objective listed in the second column. 'tba' indicates that access to the most current biological records will result from ongoing analysis and engagement with the recording community in Wales.

Only management options listed in bold in target checker are included i.e. 'those more likely to deliver in a wider range of situations'.

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
27 Fallow margins	Arable plants	y	y	y		
28 Retain winter stubbles	Arable plants			y		
30 Unsprayed spring sown cereals or legumes	Arable plants	y	y	y		
31 Unsprayed spring sown cereals retaining winter stubbles	Arable plants	y	y	y		
34B Unfertilised and unsprayed cereal headland	Arable plants	y	y	y		
16 Upland heath	Arctic-Alpine plants	y	y	y		
17 Blanket Bog	Arctic-Alpine plants	y	y	y		
18 Upland grassland	Arctic-Alpine plants	y	y	y		
41A Grazing management of open country	Arctic-Alpine plants	y	y	y		
41B Grazing management of open country with mixed grazing	Arctic-Alpine plants	y	y	y		
400 Additional Management Payment - Stock management	Arctic-Alpine plants	y	y	y		
411 Additional Management Payment - Reduce stocking	Arctic-Alpine plants	y	y	y		
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Barbastelle Bat	y	y	tba		
1B Create a 2 metre corridor to include tree and shrub planting on improved land	Barbastelle Bat	y	y	tba		
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Barbastelle Bat	y	y	tba		
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Barbastelle Bat	y	y	tba		
3 Create a wildlife corridor – Establish wooded strip on improved ground	Barbastelle Bat	y	y	tba		
5 Enhanced hedgerow management (on both sides)	Barbastelle Bat	y	y	tba		
6 Double fence gappy hedges	Barbastelle Bat	y	y	tba		
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Barbastelle Bat	y	y	tba		
7A Create a streamside corridor on improved land on one side of a watercourse	Barbastelle Bat	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
7B Create a streamside corridor on improved land on both sides of a watercourse	Barbastelle Bat	y	y	tba		
8 Continued management of an existing streamside corridor	Barbastelle Bat	y	y	tba		
9A Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Barbastelle Bat	y	y	tba		
9B Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Barbastelle Bat	y	y	tba		
11 Restore a traditional orchard	Barbastelle Bat	y	y	tba		
12 Create a new orchard on improved land	Barbastelle Bat	y	y	tba		
13 Plant individual native trees on improved land	Barbastelle Bat	y	y	tba		
23 Allow small areas of improved land in corners of fields to revert to rough grassland and scrub	Barbastelle Bat	y	y	tba		
24 Allow woodland edge to develop out into adjoining improved land	Barbastelle Bat	y	y	tba		
35 Create a wildlife pond on enclosed improved land	Barbastelle Bat	y	y	tba		
35B Create a wildlife pond on enclosed improved land – variable size	Barbastelle Bat	y	y	tba		
36 Buffer existing unfenced in-field ponds	Barbastelle Bat	y	y	tba		
42A Hedgerow restoration with fencing	Barbastelle Bat	y	y	tba		
42B Hedgerow restoration without fencing	Barbastelle Bat	y	y	tba		
43A Double fence restored hedge banks with planting	Barbastelle Bat	y	y	tba		
43B Double fence restored hedge banks without planting	Barbastelle Bat	y	y	tba		
100 Woodland - stock exclusion	Barbastelle Bat		y	tba		
101 Trees and scrub - establishment by planting	Barbastelle Bat	y	y	tba		
102 Trees and scrub - establishment by natural regeneration	Barbastelle Bat	y	y	tba		
103 Scrub - stock exclusion	Barbastelle Bat	y	y	tba		
104 Wood pasture	Barbastelle Bat	y	y	tba		
106 Historic parks and gardens	Barbastelle Bat			tba		
123 Lowland unimproved neutral grassland - pasture	Barbastelle Bat	y	y	tba		
124 Lowland unimproved neutral grassland - haymeadow	Barbastelle Bat	y	y	tba		
125 Lowland unimproved neutral grassland - reversion (pasture)	Barbastelle Bat	y	y	tba		
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Barbastelle Bat	y	y	tba		
132 Conversion from improved grassland to semi- improved	Barbastelle Bat	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
grassland (hay cutting)						
133 Lowland marshy grassland	Barbastelle Bat	y	y	tba		
134 Lowland marshy grassland - reversion (pasture)	Barbastelle Bat	y	y	tba		
172 Orchard management	Barbastelle Bat			tba		
173 Streamside corridor management	Barbastelle Bat	y	y	tba		
174 Rough grass buffer zone to prevent erosion and run-off from land under arable cropping	Barbastelle Bat	y	y	tba		
175 Management of rough grassland - enclosed land	Barbastelle Bat	y	y	tba		
405 Additional Management Payment - Grazing management for dung invertebrates	Barbastelle Bat	y	y	tba		
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Bechstein's Bat	y	y	tba		
1B Create a 2 metre corridor to include tree and shrub planting on improved land	Bechstein's Bat	y	y	tba		
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Bechstein's Bat	y	y	tba		
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Bechstein's Bat	y	y	tba		
3 Create a wildlife corridor – Establish wooded strip on improved ground	Bechstein's Bat	y	y	tba		
5 Enhanced hedgerow management (on both sides)	Bechstein's Bat	y	y	tba		
6 Double fence gappy hedges	Bechstein's Bat	y	y	tba		
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Bechstein's Bat	y	y	tba		
7A Create a streamside corridor on improved land on one side of a watercourse	Bechstein's Bat	y	y	tba		
7B Create a streamside corridor on improved land on both sides of a watercourse	Bechstein's Bat	y	y	tba		
8 Continued management of an existing streamside corridor	Bechstein's Bat	y	y	tba		
9A Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Bechstein's Bat	y	y	tba		
9B Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Bechstein's Bat	y	y	tba		
11 Restore a traditional orchard	Bechstein's Bat	y	y	tba		
12 Create a new orchard on improved land	Bechstein's Bat	y	y	tba		
13 Plant individual native trees on improved land	Bechstein's Bat	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
23 Allow small areas of improved land in corners of fields to revert to rough grassland and scrub	Bechstein's Bat	y	y	tba		
24 Allow woodland edge to develop out into adjoining improved land	Bechstein's Bat	y	y	tba		
42A Hedgerow restoration with fencing	Bechstein's Bat	y	y	tba		
42B Hedgerow restoration without fencing	Bechstein's Bat	y	y	tba		
43A Double fence restored hedge banks with planting	Bechstein's Bat	y	y	tba		
43B Double fence restored hedge banks without planting	Bechstein's Bat	y	y	tba		
100 Woodland - stock exclusion	Bechstein's Bat		y	tba		
101 Trees and scrub - establishment by planting	Bechstein's Bat	y	y	tba		
102 Trees and scrub - establishment by natural regeneration	Bechstein's Bat	y	y	tba		
103 Scrub - stock exclusion	Bechstein's Bat	y	y	tba		
104 Wood pasture	Bechstein's Bat	y	y	tba		
106 Historic parks and gardens	Bechstein's Bat			tba		
123 Lowland unimproved neutral grassland - pasture	Bechstein's Bat	y	y	tba		
124 Lowland unimproved neutral grassland - haymeadow	Bechstein's Bat	y	y	tba		
125 Lowland unimproved neutral grassland - reversion (pasture)	Bechstein's Bat	y	y	tba		
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Bechstein's Bat	y	y	tba		
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Bechstein's Bat	y	y	tba		
133 Lowland marshy grassland	Bechstein's Bat	y	y	tba		
134 Lowland marshy grassland - reversion (pasture)	Bechstein's Bat	y	y	tba		
172 Orchard management	Bechstein's Bat			tba		
173 Streamside corridor management	Bechstein's Bat	y	y	tba		
405 Additional Management Payment - Grazing management for dung invertebrates	Bechstein's Bat	y	y	tba		
16 Upland heath	Black Grouse	y	y	y		y
17 Blanket Bog	Black Grouse	y	y	y		y
18 Upland grassland	Black Grouse	y	y	y		y
41A Grazing management of open country	Black Grouse	y	y	y		y
41B Grazing management of open country with mixed grazing	Black Grouse	y	y	y		y
400 Additional Management Payment - Stock management	Black Grouse	y	y	y		y
402 Additional Management Payment - Control burning	Black Grouse	y	y	y		y
403 Additional Management Payment - Re-wetting	Black Grouse	y	y	y		y

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
411 Additional Management Payment - Reduce stocking	Black Grouse	y	y	y		y
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Brown Banded Carder Bee	y	y	y	y	
1B Create a 2 metre corridor to include tree and shrub planting on improved land	Brown Banded Carder Bee	y	y	y	y	
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Brown Banded Carder Bee	y	y	y	y	
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Brown Banded Carder Bee	y	y	y	y	
4 Simple hedgerow management (on both sides)	Brown Banded Carder Bee	y	y	y	y	
4B Hedgerow management of external boundary hedges (on side only)	Brown Banded Carder Bee			y	y	
5 Enhanced hedgerow management (on both sides)	Brown Banded Carder Bee	y	y	y	y	
6 Double fence gappy hedges	Brown Banded Carder Bee	y	y	y	y	
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Brown Banded Carder Bee	y	y	y	y	
15 Grazed permanent pasture with no inputs	Brown Banded Carder Bee	y	y	y	y	
15C Grazed permanent pasture with no inputs and mixed grazing	Brown Banded Carder Bee	y	y	y	y	
19 Lowland marshy grassland	Brown Banded Carder Bee	y	y	y	y	
19B Management of lowland marshy grassland with mixed grazing	Brown Banded Carder Bee	y	y	y	y	
20 Management of lowland and coastal heath	Brown Banded Carder Bee	y	y	y	y	
20B Management of lowland and coastal heath with mixed grazing	Brown Banded Carder Bee	y	y	y	y	
22 Existing haymeadows	Brown Banded Carder Bee	y	y	y	y	
23 Allow small areas of improved land in corners of fields to revert to rough grassland and scrub	Brown Banded Carder Bee	y	y	y	y	
25 Management of sand dunes	Brown Banded Carder Bee			y	y	
25B Management of sand dunes with mixed grazing	Brown Banded Carder Bee			y	y	
26 Fixed rough grass margins on arable land	Brown Banded Carder Bee	y	y	y	y	
26B Rotational rough grass margin on arable land	Brown Banded Carder Bee	y	y	y	y	
27 Fallow margins	Brown Banded Carder Bee	y	y	y	y	
33 Establish a wildlife cover crop on improved land	Brown Banded Carder Bee	y	y	y	y	
34 Unharvested cereal headland	Brown Banded Carder Bee	y	y	y	y	

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
34B Unfertilised and unsprayed cereal headland	Brown Banded Carder Bee	y	y	y	y	
41A Grazing management of open country	Brown Banded Carder Bee	y	y	y	y	
41B Grazing management of open country with mixed grazing	Brown Banded Carder Bee	y	y	y	y	
42A Hedgerow restoration with fencing	Brown Banded Carder Bee	y	y	y	y	
42B Hedgerow restoration without fencing	Brown Banded Carder Bee	y	y	y	y	
43A Double fence restored hedge banks with planting	Brown Banded Carder Bee	y	y	y	y	
43B Double fence restored hedge banks without planting	Brown Banded Carder Bee	y	y	y	y	
115 Lowland dry heath with less than 50% western gorse	Brown Banded Carder Bee	y	y	y	y	
116 Lowland dry heath with more than 50% western gorse	Brown Banded Carder Bee	y	y	y	y	
117 Lowland wet heath with less than 60% purple moor-grass	Brown Banded Carder Bee	y	y	y	y	
118 Lowland wet heath with more than 60% purple moor-grass	Brown Banded Carder Bee	y	y	y	y	
119 Lowland heath habitat expansion - establishment on grassland	Brown Banded Carder Bee	y	y	y	y	
120 Lowland unimproved acid grassland	Brown Banded Carder Bee	y	y	y	y	
121 Lowland unimproved acid grassland - reversion (pasture)	Brown Banded Carder Bee	y	y	y	y	
122 Lowland unimproved acid grassland - reversion (hay cutting)	Brown Banded Carder Bee	y	y	y	y	
123 Lowland unimproved neutral grassland - pasture	Brown Banded Carder Bee	y	y	y	y	
124 Lowland unimproved neutral grassland - haymeadow	Brown Banded Carder Bee	y	y	y	y	
125 Lowland unimproved neutral grassland - reversion (pasture)	Brown Banded Carder Bee	y	y	y	y	
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Brown Banded Carder Bee	y	y	y	y	
128 Lowland unimproved calcareous grassland	Brown Banded Carder Bee	y	y	y	y	
129 Lowland unimproved calcareous grassland - reversion (pasture)	Brown Banded Carder Bee	y	y	y	y	
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Brown Banded Carder Bee	y	y	y	y	
131 Conversion from arable to grassland (no inputs)	Brown Banded Carder Bee	y	y	y	y	
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Brown Banded Carder Bee	y	y	y	y	
133 Lowland marshy grassland	Brown Banded Carder Bee	y	y	y	y	
134 Lowland marshy grassland - reversion (pasture)	Brown Banded Carder Bee	y	y	y	y	
148 Coastal grassland	Brown Banded Carder	y	y	y	y	

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
(maritime cliff and slope)	Bee					
151 Coastal vegetated shingle and sand dunes - creation	Brown Banded Carder Bee			y	y	
153 Red clover ley	Brown Banded Carder Bee	y	y	y	y	
175 Management of rough grassland - enclosed land	Brown Banded Carder Bee	y	y	y	y	
15 Grazed permanent pasture with no inputs	Carbon soils	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Carbon soils	y	y			
16 Upland heath	Carbon soils	y	y			
17 Blanket Bog	Carbon soils	y	y			
18 Upland grassland	Carbon soils	y	y			
19 Lowland marshy grassland	Carbon soils	y	y			
19B Management of lowland marshy grassland with mixed grazing	Carbon soils	y	y			
20 Management of lowland and coastal heath	Carbon soils	y	y			
20B Management of lowland and coastal heath with mixed grazing	Carbon soils	y	y			
22 Existing haymeadows	Carbon soils	y	y			
41A Grazing management of open country	Carbon soils	y	y			
41B Grazing management of open country with mixed grazing	Carbon soils	y	y			
115 Lowland dry heath with less than 50% western gorse	Carbon soils	y	y			
116 Lowland dry heath with more than 50% western gorse	Carbon soils	y	y			
117 Lowland wet heath with less than 60% purple moor-grass	Carbon soils	y	y			
118 Lowland wet heath with more than 60% purple moor-grass	Carbon soils	y	y			
119 Lowland heath habitat expansion - establishment on grassland	Carbon soils	y	y			
120 Lowland unimproved acid grassland	Carbon soils	y	y			
121 Lowland unimproved acid grassland - reversion (pasture)	Carbon soils	y	y			
122 Lowland unimproved acid grassland - reversion (hay cutting)	Carbon soils	y	y			
123 Lowland unimproved neutral grassland - pasture	Carbon soils	y	y			
124 Lowland unimproved neutral grassland - haymeadow	Carbon soils	y	y			
125 Lowland unimproved neutral grassland - reversion (pasture)	Carbon soils	y	y			
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Carbon soils	y	y			
131 Conversion from arable to	Carbon soils	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
grassland (no inputs)						
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Carbon soils	y	y			
133 Lowland marshy grassland	Carbon soils	y	y			
134 Lowland marshy grassland - reversion (pasture)	Carbon soils	y	y			
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Carbon soils	y	y			
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Carbon soils	y	y			
141 Lowland bog and other acid mires - restoration (no grazing)	Carbon soils	y	y			
142 Lowland bog and other acid mires - reversion (pasture)	Carbon soils	y	y			
143 Lowland fen	Carbon soils	y	y			
144 Lowland fen - restoration (no grazing)	Carbon soils					
145 Lowland fen - reversion (pasture)	Carbon soils					
146 Reedbed - stock exclusion	Carbon soils					
147 Reedbed - creation	Carbon soils	y	y			
148 Coastal grassland (maritime cliff and slope)	Carbon soils	y	y			
156 Buffer zones to prevent erosion and run-off from grassland	Carbon soils	y	y			
157 Buffer zones to prevent erosion and run-off from grassland - ditch landscapes	Carbon soils	y	y			
158 Buffer zones to prevent erosion and run-off from land under arable cropping	Carbon soils	y	y			
160 No lime on improved or semi-improved grassland over peat soils	Carbon soils					
175 Management of rough grassland - enclosed land	Carbon soils	y	y			
15 Grazed permanent pasture with no inputs	Chough	y	y	y		y
15C Grazed permanent pasture with no inputs and mixed grazing	Chough	y	y	y		y
16 Upland heath	Chough	y	y	y		y
18 Upland grassland	Chough	y	y	y		y
41A Grazing management of open country	Chough	y	y	y		y
41B Grazing management of open country with mixed grazing	Chough	y	y	y		y
115 Lowland dry heath with less than 50% western gorse	Chough	y	y	y		y
116 Lowland dry heath with more than 50% western gorse	Chough	y	y	y		y
117 Lowland wet heath with less than 60% purple moor-grass	Chough	y	y	y		y
118 Lowland wet heath with	Chough	y	y	y		y

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
more than 60% purple moor-grass						
161 Grassland management for chough (feeding)	Chough	y	y	y		y
400 Additional Management Payment - Stock management	Chough	y	y	y		y
401 Additional Management Payment - Mixed grazing	Chough	y	y	y		y
411 Additional Management Payment - Reduce stocking	Chough	y	y	y		y
15 Grazed permanent pasture with no inputs	Corn Bunting	y	y	y		y
15C Grazed permanent pasture with no inputs and mixed grazing	Corn Bunting	y	y	y		y
20 Management of lowland and coastal heath	Corn Bunting	y	y	y		y
20B Management of lowland and coastal heath with mixed grazing	Corn Bunting	y	y	y		y
21 Grazed saltmarsh	Corn Bunting			y		y
21B Management of grazed saltmarsh with mixed grazing	Corn Bunting			y		y
22 Existing haymeadows	Corn Bunting	y	y	y		y
25 Management of sand dunes	Corn Bunting			y		y
25B Management of sand dunes with mixed grazing	Corn Bunting			y		y
26 Fixed rough grass margins on arable land	Corn Bunting	y	y	y		y
41A Grazing management of open country	Corn Bunting	y	y	y		y
41B Grazing management of open country with mixed grazing	Corn Bunting	y	y	y		y
115 Lowland dry heath with less than 50% western gorse	Corn Bunting	y	y	y		y
116 Lowland dry heath with more than 50% western gorse	Corn Bunting	y	y	y		y
117 Lowland wet heath with less than 60% purple moor-grass	Corn Bunting	y	y	y		y
118 Lowland wet heath with more than 60% purple moor-grass	Corn Bunting	y	y	y		y
119 Lowland heath habitat expansion - establishment on grassland	Corn Bunting	y	y	y		y
131 Conversion from arable to grassland (no inputs)	Corn Bunting	y	y	y		y
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Corn Bunting	y	y	y		y
146 Reedbed - stock exclusion	Corn Bunting			y		y
147 Reedbed - creation	Corn Bunting	y	y	y		y
148 Coastal grassland (maritime cliff and slope)	Corn Bunting	y	y	y		y
149 Saltmarsh - restoration (no grazing)	Corn Bunting	y	y	y		y
150 Saltmarsh - creation	Corn Bunting			y		y
151 Coastal vegetated shingle and sand dunes - creation	Corn Bunting			y		y

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
161 Grassland management for chough (feeding)	Corn Bunting	y	y	y		y
175 Management of rough grassland - enclosed land	Corn Bunting	y	y	y		y
26 Fixed rough grass margins on arable land	Corn Bunting	y	y	y		y
26B Rotational rough grass margin on arable land	Corn Bunting	y	y	y		y
27 Fallow margins	Corn Bunting	y	y	y		y
28 Retain winter stubbles	Corn Bunting			y		y
31 Unsprayed spring sown cereals retaining winter stubbles	Corn Bunting	y	y	y		y
32B Plant unsprayed root crops on improved land	Corn Bunting	y	y	y		y
33 Establish a wildlife cover crop on improved land	Corn Bunting	y	y	y		y
34 Unharvested cereal headland	Corn Bunting	y	y	y		y
34B Unfertilised and unsprayed cereal headland	Corn Bunting	y	y	y		y
162 Unsprayed autumn sown cereal crop for corn bunting (nesting & feeding)	Corn Bunting	y	y	y		y
163 Unsprayed spring sown barley crop for corn bunting (nesting & feeding)	Corn Bunting	y	y	y		y
174 Rough grass buffer zone to prevent erosion and run-off from land under arable cropping	Corn Bunting	y	y	y		y
175 Management of rough grassland - enclosed land	Corn Bunting	y	y	y		y
16 Upland heath	Curlew	y	y	y		y
17 Blanket Bog	Curlew	y	y	y		y
18 Upland grassland	Curlew	y	y	y		y
21 Grazed saltmarsh	Curlew			y		y
21B Management of grazed saltmarsh with mixed grazing	Curlew			y		y
41A Grazing management of open country	Curlew	y	y	y		y
41B Grazing management of open country with mixed grazing	Curlew	y	y	y		y
164 Grassland management for curlew (nesting & chick feeding)	Curlew	y	y	y		y
165 Grassland management for curlew (adult feeding)	Curlew	y	y	y		y
166 Haymeadow management for curlew (nesting)	Curlew	y	y	y		y
3 Create a wildlife corridor – Establish wooded strip on improved ground	Ditch landscape	y	y			
7A Create a streamside corridor on improved land on one side of a watercourse	Ditch landscape	y	y			
7B Create a streamside corridor on improved land on both sides of a watercourse	Ditch landscape	y	y			
8 Continued management of an	Ditch landscape	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
existing streamside corridor						
14 Commit to 100% slurry injection	Ditch landscape					
14B Commit to 75% slurry injection	Ditch landscape					
15 Grazed permanent pasture with no inputs	Ditch landscape	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Ditch landscape	y	y			
22 Existing haymeadows	Ditch landscape	y	y			
26 Fixed rough grass margins on arable land	Ditch landscape	y	y			
26B Rotational rough grass margin on arable land	Ditch landscape	y	y			
27 Fallow margins	Ditch landscape	y	y			
28 Retain winter stubbles	Ditch landscape					
33 Establish a wildlife cover crop on improved land	Ditch landscape	y	y			
34 Unharvested cereal headland	Ditch landscape	y	y			
34B Unfertilised and unsprayed cereal headland	Ditch landscape	y	y			
41A Grazing management of open country	Ditch landscape	y	y			
41B Grazing management of open country with mixed grazing	Ditch landscape	y	y			
120 Lowland unimproved acid grassland	Ditch landscape	y	y			
121 Lowland unimproved acid grassland - reversion (pasture)	Ditch landscape	y	y			
122 Lowland unimproved acid grassland - reversion (hay cutting)	Ditch landscape	y	y			
123 Lowland unimproved neutral grassland - pasture	Ditch landscape	y	y			
124 Lowland unimproved neutral grassland - haymeadow	Ditch landscape	y	y			
125 Lowland unimproved neutral grassland - reversion (pasture)	Ditch landscape	y	y			
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Ditch landscape	y	y			
128 Lowland unimproved calcareous grassland	Ditch landscape	y	y			
129 Lowland unimproved calcareous grassland - reversion (pasture)	Ditch landscape	y	y			
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Ditch landscape	y	y			
131 Conversion from arable to grassland (no inputs)	Ditch landscape	y	y			
133 Lowland marshy grassland	Ditch landscape	y	y			
155 Improve nutrient management through planning and soil sampling	Ditch landscape					
156 Buffer zones to prevent erosion and run-off from grassland	Ditch landscape	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
157 Buffer zones to prevent erosion and run-off from grassland - ditch landscapes	Ditch landscape	y	y			
158 Buffer zones to prevent erosion and run-off from land under arable cropping	Ditch landscape	y	y			
173 Streamside corridor management	Ditch landscape	y	y			
174 Rough grass buffer zone to prevent erosion and run-off from land under arable cropping	Ditch landscape	y	y			
175 Management of rough grassland - enclosed land	Ditch landscape	y	y			
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Dormouse	y	y	tba		
1B Create a 2 metre corridor to include tree and shrub planting on improved land	Dormouse	y	y	tba		
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Dormouse	y	y	tba		
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Dormouse	y	y	tba		
3 Create a wildlife corridor – Establish wooded strip on improved ground	Dormouse	y	y	tba		
5 Enhanced hedgerow management (on both sides)	Dormouse	y	y	tba		
6 Double fence gappy hedges	Dormouse	y	y	tba		
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Dormouse	y	y	tba		
23 Allow small areas of improved land in corners of fields to revert to rough grassland and scrub	Dormouse	y	y	tba		
24 Allow woodland edge to develop out into adjoining improved land	Dormouse	y	y	tba		
40 Management of existing fence on stock excluded woodland	Dormouse			tba		
42A Hedgerow restoration with fencing	Dormouse	y	y	tba		
42B Hedgerow restoration without fencing	Dormouse	y	y	tba		
43A Double fence restored hedge banks with planting	Dormouse	y	y	tba		
43B Double fence restored hedge banks without planting	Dormouse	y	y	tba		
100 Woodland - stock exclusion	Dormouse		y	tba		
101 Trees and scrub - establishment by planting	Dormouse	y	y	tba		
102 Trees and scrub - establishment by natural regeneration	Dormouse	y	y	tba		
103 Scrub - stock exclusion	Dormouse	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Freshwater pearl mussel	y	y	y		
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Freshwater pearl mussel	y	y	y		
3 Create a wildlife corridor – Establish wooded strip on improved ground	Freshwater pearl mussel	y	y	y		
7A Create a streamside corridor on improved land on one side of a watercourse	Freshwater pearl mussel	y	y	y		
7B Create a streamside corridor on improved land on both sides of a watercourse	Freshwater pearl mussel	y	y	y		
8 Continued management of an existing streamside corridor	Freshwater pearl mussel	y	y	y		
9A Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Freshwater pearl mussel	y	y	y		
9B Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Freshwater pearl mussel	y	y	y		
14 Commit to 100% slurry injection	Freshwater pearl mussel			y		
14B Commit to 75% slurry injection	Freshwater pearl mussel			y		
15 Grazed permanent pasture with no inputs	Freshwater pearl mussel	y	y	y		
15C Grazed permanent pasture with no inputs and mixed grazing	Freshwater pearl mussel	y	y	y		
26 Fixed rough grass margins on arable land	Freshwater pearl mussel	y	y	y		
26B Rotational rough grass margin on arable land	Freshwater pearl mussel	y	y	y		
41A Grazing management of open country	Freshwater pearl mussel	y	y	y		
41B Grazing management of open country with mixed grazing	Freshwater pearl mussel	y	y	y		
43A Double fence restored hedge banks with planting	Freshwater pearl mussel	y	y	y		
43B Double fence restored hedge banks without planting	Freshwater pearl mussel	y	y	y		
123 Lowland unimproved neutral grassland - pasture	Freshwater pearl mussel	y	y	y		
124 Lowland unimproved neutral grassland - haymeadow	Freshwater pearl mussel	y	y	y		
125 Lowland unimproved neutral grassland - reversion (pasture)	Freshwater pearl mussel	y	y	y		
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Freshwater pearl mussel	y	y	y		
131 Conversion from arable to grassland (no inputs)	Freshwater pearl mussel	y	y	y		
132 Conversion from improved grassland to semi- improved	Freshwater pearl mussel	y	y	y		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
grassland (hay cutting)						
133 Lowland marshy grassland	Freshwater pearl mussel	y	y	y		
134 Lowland marshy grassland - reversion (pasture)	Freshwater pearl mussel	y	y	y		
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Freshwater pearl mussel	y	y	y		
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Freshwater pearl mussel	y	y	y		
141 Lowland bog and other acid mires - restoration (no grazing)	Freshwater pearl mussel	y	y	y		
142 Lowland bog and other acid mires - reversion (pasture)	Freshwater pearl mussel	y	y	y		
143 Lowland fen	Freshwater pearl mussel	y	y	y		
144 Lowland fen - restoration (no grazing)	Freshwater pearl mussel			y		
145 Lowland fen - reversion (pasture)	Freshwater pearl mussel			y		
146 Reedbed - stock exclusion	Freshwater pearl mussel			y		
147 Reedbed - creation	Freshwater pearl mussel	y	y	y		
155 Improve nutrient management through planning and soil sampling	Freshwater pearl mussel			y		
156 Buffer zones to prevent erosion and run-off from grassland	Freshwater pearl mussel	y	y	y		
158 Buffer zones to prevent erosion and run-off from land under arable cropping	Freshwater pearl mussel	y	y	y		
173 Streamside corridor management	Freshwater pearl mussel	y	y	y		
174 Rough grass buffer zone to prevent erosion and run-off from land under arable cropping	Freshwater pearl mussel	y	y	y		
175 Management of rough grassland - enclosed land	Freshwater pearl mussel	y	y	y		
16 Upland heath	Golden Plover	y	y	y		y
17 Blanket Bog	Golden Plover	y	y	y		y
18 Upland grassland	Golden Plover	y	y	y		y
41A Grazing management of open country	Golden Plover	y	y	y		y
41B Grazing management of open country with mixed grazing	Golden Plover	y	y	y		y
167 Grassland management for golden plover (feeding)	Golden Plover	y	y	y		y
11 Restore a traditional orchard	Grassland fungi	y	y			
12 Create a new orchard on improved land	Grassland fungi	y	y			
15 Grazed permanent pasture with no inputs	Grassland fungi	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Grassland fungi	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
18 Upland grassland	Grassland fungi	y	y			
25 Management of sand dunes	Grassland fungi					
25B Management of sand dunes with mixed grazing	Grassland fungi					
41A Grazing management of open country	Grassland fungi	y	y			
41B Grazing management of open country with mixed grazing	Grassland fungi	y	y			
104 Wood pasture	Grassland fungi	y	y			
106 Historic parks and gardens	Grassland fungi					
120 Lowland unimproved acid grassland	Grassland fungi	y	y			
121 Lowland unimproved acid grassland - reversion (pasture)	Grassland fungi	y	y			
122 Lowland unimproved acid grassland - reversion (hay cutting)	Grassland fungi	y	y			
123 Lowland unimproved neutral grassland - pasture	Grassland fungi	y	y			
124 Lowland unimproved neutral grassland - haymeadow	Grassland fungi	y	y			
125 Lowland unimproved neutral grassland - reversion (pasture)	Grassland fungi	y	y			
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Grassland fungi	y	y			
128 Lowland unimproved calcareous grassland	Grassland fungi	y	y			
129 Lowland unimproved calcareous grassland - reversion (pasture)	Grassland fungi	y	y			
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Grassland fungi	y	y			
131 Conversion from arable to grassland (no inputs)	Grassland fungi	y	y			
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Grassland fungi	y	y			
148 Coastal grassland (maritime cliff and slope)	Grassland fungi	y	y			
172 Orchard management	Grassland fungi					
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Great Crested Newt	y	y	tba		
1B Create a 2 metre corridor to include tree and shrub planting on improved land	Great Crested Newt	y	y	tba		
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Great Crested Newt	y	y	tba		
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Great Crested Newt	y	y	tba		
3 Create a wildlife corridor – Establish wooded strip on improved ground	Great Crested Newt	y	y	tba		
6 Double fence gappy hedges	Great Crested Newt	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Great Crested Newt	y	y	tba		
7A Create a streamside corridor on improved land on one side of a watercourse	Great Crested Newt	y	y	tba		
7B Create a streamside corridor on improved land on both sides of a watercourse	Great Crested Newt	y	y	tba		
8 Continued management of an existing streamside corridor	Great Crested Newt	y	y	tba		
14 Commit to 100% slurry injection	Great Crested Newt			tba		
14B Commit to 75% slurry injection	Great Crested Newt			tba		
15 Grazed permanent pasture with no inputs	Great Crested Newt	y	y	tba		
15C Grazed permanent pasture with no inputs and mixed grazing	Great Crested Newt	y	y	tba		
17 Blanket Bog	Great Crested Newt	y	y	tba		
19 Lowland marshy grassland	Great Crested Newt	y	y	tba		
19B Management of lowland marshy grassland with mixed grazing	Great Crested Newt	y	y	tba		
23 Allow small areas of improved land in corners of fields to revert to rough grassland and scrub	Great Crested Newt	y	y	tba		
24 Allow woodland edge to develop out into adjoining improved land	Great Crested Newt	y	y	tba		
25 Management of sand dunes	Great Crested Newt			tba		
25B Management of sand dunes with mixed grazing	Great Crested Newt			tba		
26 Fixed rough grass margins on arable land	Great Crested Newt	y	y	tba		
26B Rotational rough grass margin on arable land	Great Crested Newt	y	y	tba		
27 Fallow margins	Great Crested Newt	y	y	tba		
35 Create a wildlife pond on enclosed improved land	Great Crested Newt	y	y	tba		
35B Create a wildlife pond on enclosed improved land – variable size	Great Crested Newt	y	y	tba		
36 Buffer existing unfenced in-field ponds	Great Crested Newt	y	y	tba		
40 Management of existing fence on stock excluded woodland	Great Crested Newt			tba		
41A Grazing management of open country	Great Crested Newt	y	y	tba		
41B Grazing management of open country with mixed grazing	Great Crested Newt	y	y	tba		
42A Hedgerow restoration with fencing	Great Crested Newt	y	y	tba		
42B Hedgerow restoration without fencing	Great Crested Newt	y	y	tba		
43A Double fence restored hedge banks with planting	Great Crested Newt	y	y	tba		
101 Trees and scrub -	Great Crested Newt	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
establishment by planting						
102 Trees and scrub - establishment by natural regeneration	Great Crested Newt	y	y	tba		
103 Scrub - stock exclusion	Great Crested Newt	y	y	tba		
104 Wood pasture	Great Crested Newt	y	y	tba		
106 Historic parks and gardens	Great Crested Newt			tba		
109 Calaminarian grassland	Great Crested Newt	y	y	tba		
115 Lowland dry heath with less than 50% western gorse	Great Crested Newt	y	y	tba		
116 Lowland dry heath with more than 50% western gorse	Great Crested Newt	y	y	tba		
117 Lowland wet heath with less than 60% purple moor-grass	Great Crested Newt	y	y	tba		
118 Lowland wet heath with more than 60% purple moor-grass	Great Crested Newt	y	y	tba		
119 Lowland heath habitat expansion - establishment on grassland	Great Crested Newt	y	y	tba		
120 Lowland unimproved acid grassland	Great Crested Newt	y	y	tba		
121 Lowland unimproved acid grassland - reversion (pasture)	Great Crested Newt	y	y	tba		
123 Lowland unimproved neutral grassland - pasture	Great Crested Newt	y	y	tba		
124 Lowland unimproved neutral grassland - haymeadow	Great Crested Newt	y	y	tba		
125 Lowland unimproved neutral grassland - reversion (pasture)	Great Crested Newt	y	y	tba		
128 Lowland unimproved calcareous grassland	Great Crested Newt	y	y	tba		
129 Lowland unimproved calcareous grassland - reversion (pasture)	Great Crested Newt	y	y	tba		
131 Conversion from arable to grassland (no inputs)	Great Crested Newt	y	y	tba		
133 Lowland marshy grassland	Great Crested Newt	y	y	tba		
134 Lowland marshy grassland - reversion (pasture)	Great Crested Newt	y	y	tba		
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Great Crested Newt	y	y	tba		
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Great Crested Newt	y	y	tba		
141 Lowland bog and other acid mires - restoration (no grazing)	Great Crested Newt	y	y	tba		
142 Lowland bog and other acid mires - reversion (pasture)	Great Crested Newt	y	y	tba		
143 Lowland fen	Great Crested Newt	y	y	tba		
144 Lowland fen - restoration (no grazing)	Great Crested Newt			tba		
145 Lowland fen - reversion (pasture)	Great Crested Newt			tba		
146 Reedbed - stock exclusion	Great Crested Newt			tba		
147 Reedbed - creation	Great Crested Newt	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
157 Buffer zones to prevent erosion and run-off from grassland - ditch landscapes	Great Crested Newt	y	y	tba		
158 Buffer zones to prevent erosion and run-off from land under arable cropping	Great Crested Newt	y	y	tba		
173 Streamside corridor management	Great Crested Newt	y	y	tba		
174 Rough grass buffer zone to prevent erosion and run-off from land under arable cropping	Great Crested Newt	y	y	tba		
175 Management of rough grassland - enclosed land	Great Crested Newt	y	y	tba		
403 Additional Management Payment - Re-wetting	Great Crested Newt	y	y	tba		
404 Additional Management Payment - Re-wetting (improved land)	Great Crested Newt	y	y	tba		
405 Additional Management Payment - Grazing management for dung invertebrates	Great Crested Newt	y	y	tba		
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Greater Horseshoe Bat	y	y	tba		
1B Create a 2 metre corridor to include tree and shrub planting on improved land	Greater Horseshoe Bat	y	y	tba		
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Greater Horseshoe Bat	y	y	tba		
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Greater Horseshoe Bat	y	y	tba		
3 Create a wildlife corridor – Establish wooded strip on improved ground	Greater Horseshoe Bat	y	y	tba		
5 Enhanced hedgerow management (on both sides)	Greater Horseshoe Bat	y	y	tba		
6 Double fence gappy hedges	Greater Horseshoe Bat	y	y	tba		
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Greater Horseshoe Bat	y	y	tba		
7A Create a streamside corridor on improved land on one side of a watercourse	Greater Horseshoe Bat	y	y	tba		
7B Create a streamside corridor on improved land on both sides of a watercourse	Greater Horseshoe Bat	y	y	tba		
8 Continued management of an existing streamside corridor	Greater Horseshoe Bat	y	y	tba		
9A Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Greater Horseshoe Bat	y	y	tba		
9B Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Greater Horseshoe Bat	y	y	tba		
11 Restore a traditional	Greater Horseshoe Bat	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
orchard						
12 Create a new orchard on improved land	Greater Horseshoe Bat	y	y	tba		
13 Plant individual native trees on improved land	Greater Horseshoe Bat	y	y	tba		
15 Grazed permanent pasture with no inputs	Greater Horseshoe Bat	y	y	tba		
15C Grazed permanent pasture with no inputs and mixed grazing	Greater Horseshoe Bat	y	y	tba		
19 Lowland marshy grassland	Greater Horseshoe Bat	y	y	tba		
19B Management of lowland marshy grassland with mixed grazing	Greater Horseshoe Bat	y	y	tba		
20 Management of lowland and coastal heath	Greater Horseshoe Bat	y	y	tba		
20B Management of lowland and coastal heath with mixed grazing	Greater Horseshoe Bat	y	y	tba		
21 Grazed saltmarsh	Greater Horseshoe Bat			tba		
21B Management of grazed saltmarsh with mixed grazing	Greater Horseshoe Bat			tba		
22 Existing haymeadows	Greater Horseshoe Bat	y	y	tba		
23 Allow small areas of improved land in corners of fields to revert to rough grassland and scrub	Greater Horseshoe Bat	y	y	tba		
24 Allow woodland edge to develop out into adjoining improved land	Greater Horseshoe Bat	y	y	tba		
26 Fixed rough grass margins on arable land	Greater Horseshoe Bat	y	y	tba		
26B Rotational rough grass margin on arable land	Greater Horseshoe Bat	y	y	tba		
31 Unsprayed spring sown cereals retaining winter stubbles	Greater Horseshoe Bat	y	y	tba		
33 Establish a wildlife cover crop on improved land	Greater Horseshoe Bat	y	y	tba		
35 Create a wildlife pond on enclosed improved land	Greater Horseshoe Bat	y	y	tba		
35B Create a wildlife pond on enclosed improved land – variable size	Greater Horseshoe Bat	y	y	tba		
36 Buffer existing unfenced in-field ponds	Greater Horseshoe Bat	y	y	tba		
42A Hedgerow restoration with fencing	Greater Horseshoe Bat	y	y	tba		
42B Hedgerow restoration without fencing	Greater Horseshoe Bat	y	y	tba		
43A Double fence restored hedge banks with planting	Greater Horseshoe Bat	y	y	tba		
43B Double fence restored hedge banks without planting	Greater Horseshoe Bat	y	y	tba		
45 Maintenance of traditional weatherproof buildings	Greater Horseshoe Bat			tba		
100 Woodland - stock exclusion	Greater Horseshoe Bat		y	tba		
101 Trees and scrub - establishment by planting	Greater Horseshoe Bat	y	y	tba		
102 Trees and scrub - establishment by natural regeneration	Greater Horseshoe Bat	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
103 Scrub - stock exclusion	Greater Horseshoe Bat	y	y	tba		
104 Wood pasture	Greater Horseshoe Bat	y	y	tba		
106 Historic parks and gardens	Greater Horseshoe Bat			tba		
115 Lowland dry heath with less than 50% western gorse	Greater Horseshoe Bat	y	y	tba		
116 Lowland dry heath with more than 50% western gorse	Greater Horseshoe Bat	y	y	tba		
117 Lowland wet heath with less than 60% purple moor-grass	Greater Horseshoe Bat	y	y	tba		
118 Lowland wet heath with more than 60% purple moor-grass	Greater Horseshoe Bat	y	y	tba		
119 Lowland heath habitat expansion - establishment on grassland	Greater Horseshoe Bat	y	y	tba		
120 Lowland unimproved acid grassland	Greater Horseshoe Bat	y	y	tba		
121 Lowland unimproved acid grassland - reversion (pasture)	Greater Horseshoe Bat	y	y	tba		
122 Lowland unimproved acid grassland - reversion (hay cutting)	Greater Horseshoe Bat	y	y	tba		
123 Lowland unimproved neutral grassland - pasture	Greater Horseshoe Bat	y	y	tba		
124 Lowland unimproved neutral grassland - haymeadow	Greater Horseshoe Bat	y	y	tba		
125 Lowland unimproved neutral grassland - reversion (pasture)	Greater Horseshoe Bat	y	y	tba		
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Greater Horseshoe Bat	y	y	tba		
128 Lowland unimproved calcareous grassland	Greater Horseshoe Bat	y	y	tba		
129 Lowland unimproved calcareous grassland - reversion (pasture)	Greater Horseshoe Bat	y	y	tba		
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Greater Horseshoe Bat	y	y	tba		
131 Conversion from arable to grassland (no inputs)	Greater Horseshoe Bat	y	y	tba		
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Greater Horseshoe Bat	y	y	tba		
133 Lowland marshy grassland	Greater Horseshoe Bat	y	y	tba		
134 Lowland marshy grassland - reversion (pasture)	Greater Horseshoe Bat	y	y	tba		
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Greater Horseshoe Bat	y	y	tba		
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Greater Horseshoe Bat	y	y	tba		
141 Lowland bog and other acid mires - restoration (no grazing)	Greater Horseshoe Bat	y	y	tba		
142 Lowland bog and other acid mires - reversion (pasture)	Greater Horseshoe Bat	y	y	tba		
143 Lowland fen	Greater Horseshoe Bat	y	y	tba		
144 Lowland fen - restoration	Greater Horseshoe Bat			tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
(no grazing)						
145 Lowland fen - reversion (pasture)	Greater Horseshoe Bat			tba		
146 Reedbed - stock exclusion	Greater Horseshoe Bat			tba		
147 Reedbed - creation	Greater Horseshoe Bat	y	y	tba		
148 Coastal grassland (maritime cliff and slope)	Greater Horseshoe Bat	y	y	tba		
149 Saltmarsh - restoration (no grazing)	Greater Horseshoe Bat	y	y	tba		
150 Saltmarsh - creation	Greater Horseshoe Bat			tba		
153 Red clover ley	Greater Horseshoe Bat	y	y	tba		
172 Orchard management	Greater Horseshoe Bat			tba		
173 Streamside corridor management	Greater Horseshoe Bat	y	y	tba		
174 Rough grass buffer zone to prevent erosion and run-off from land under arable cropping	Greater Horseshoe Bat	y	y	tba		
175 Management of rough grassland - enclosed land	Greater Horseshoe Bat	y	y	tba		
405 Additional Management Payment - Grazing management for dung invertebrates	Greater Horseshoe Bat	y	y	tba		
15 Grazed permanent pasture with no inputs	Greenland Greater White-fronted Goose	y	y	y		y
15C Grazed permanent pasture with no inputs and mixed grazing	Greenland Greater White-fronted Goose	y	y	y		y
41A Grazing management of open country	Greenland Greater White-fronted Goose	y	y	y		y
41B Grazing management of open country with mixed grazing	Greenland Greater White-fronted Goose	y	y	y		y
159 Grassland managed with no inputs between 15 October and 31 January	Greenland Greater White-fronted Goose	y	y	y		y
7A Create a streamside corridor on improved land on one side of a watercourse	Gwyniad	y	y			
7B Create a streamside corridor on improved land on both sides of a watercourse	Gwyniad	y	y			
8 Continued management of an existing streamside corridor	Gwyniad	y	y			
9A Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Gwyniad	y	y			
9B Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Gwyniad	y	y			
14 Commit to 100% slurry injection	Gwyniad					
14B Commit to 75% slurry injection	Gwyniad					
15 Grazed permanent pasture with no inputs	Gwyniad	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Gwyniad	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
22 Existing haymeadows	Gwyniad	y	y			
26 Fixed rough grass margins on arable land	Gwyniad	y	y			
26B Rotational rough grass margin on arable land	Gwyniad	y	y			
41A Grazing management of open country	Gwyniad	y	y			
41B Grazing management of open country with mixed grazing	Gwyniad	y	y			
101 Trees and scrub - establishment by planting	Gwyniad	y	y			
102 Trees and scrub - establishment by natural regeneration	Gwyniad	y	y			
103 Scrub - stock exclusion	Gwyniad	y	y			
117 Lowland wet heath with less than 60% purple moor-grass	Gwyniad	y	y			
118 Lowland wet heath with more than 60% purple moor-grass	Gwyniad	y	y			
120 Lowland unimproved acid grassland	Gwyniad	y	y			
121 Lowland unimproved acid grassland - reversion (pasture)	Gwyniad	y	y			
122 Lowland unimproved acid grassland - reversion (hay cutting)	Gwyniad	y	y			
123 Lowland unimproved neutral grassland - pasture	Gwyniad	y	y			
124 Lowland unimproved neutral grassland - haymeadow	Gwyniad	y	y			
125 Lowland unimproved neutral grassland - reversion (pasture)	Gwyniad	y	y			
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Gwyniad	y	y			
128 Lowland unimproved calcareous grassland	Gwyniad	y	y			
129 Lowland unimproved calcareous grassland - reversion (pasture)	Gwyniad	y	y			
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Gwyniad	y	y			
131 Conversion from arable to grassland (no inputs)	Gwyniad	y	y			
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Gwyniad	y	y			
133 Lowland marshy grassland	Gwyniad	y	y			
134 Lowland marshy grassland - reversion (pasture)	Gwyniad	y	y			
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Gwyniad	y	y			
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Gwyniad	y	y			
141 Lowland bog and other	Gwyniad	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
acid mires - restoration (no grazing)						
142 Lowland bog and other acid mires - reversion (pasture)	Gwyniad	y	y			
143 Lowland fen	Gwyniad	y	y			
144 Lowland fen - restoration (no grazing)	Gwyniad					
145 Lowland fen - reversion (pasture)	Gwyniad					
146 Reedbed - stock exclusion	Gwyniad					
147 Reedbed - creation	Gwyniad	y	y			
155 Improve nutrient management through planning and soil sampling	Gwyniad					
156 Buffer zones to prevent erosion and run-off from grassland	Gwyniad	y	y			
158 Buffer zones to prevent erosion and run-off from land under arable cropping	Gwyniad	y	y			
159 Grassland managed with no inputs between 15 October and 31 January	Gwyniad	y	y			
173 Streamside corridor management	Gwyniad	y	y			
174 Rough grass buffer zone to prevent erosion and run-off from land under arable cropping	Gwyniad	y	y			
175 Management of rough grassland - enclosed land	Gwyniad	y	y			
16 Upland heath	Heathland plants	y	y	y		
17 Blanket Bog	Heathland plants	y	y	y		
18 Upland grassland	Heathland plants	y	y	y		
20 Management of lowland and coastal heath	Heathland plants	y	y	y		
20B Management of lowland and coastal heath with mixed grazing	Heathland plants	y	y	y		
41A Grazing management of open country	Heathland plants	y	y	y		
41B Grazing management of open country with mixed grazing	Heathland plants	y	y	y		
44 Mechanical bracken control	Heathland plants	y	y	y		
115 Lowland dry heath with less than 50% western gorse	Heathland plants	y	y	y		
116 Lowland dry heath with more than 50% western gorse	Heathland plants	y	y	y		
117 Lowland wet heath with less than 60% purple moor-grass	Heathland plants	y	y	y		
118 Lowland wet heath with more than 60% purple moor-grass	Heathland plants	y	y	y		
119 Lowland heath habitat expansion - establishment on grassland	Heathland plants	y	y	y		
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Heathland plants	y	y	y		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Heathland plants	y	y	y		
141 Lowland bog and other acid mires - restoration (no grazing)	Heathland plants	y	y	y		
142 Lowland bog and other acid mires - reversion (pasture)	Heathland plants	y	y	y		
400 Additional Management Payment - Stock management	Heathland plants	y	y	y		
401 Additional Management Payment - Mixed grazing	Heathland plants	y	y	y		
402 Additional Management Payment - Control burning	Heathland plants	y	y	y		
403 Additional Management Payment - Re-wetting	Heathland plants	y	y	y		
411 Additional Management Payment - Reduce stocking	Heathland plants	y	y	y		
15 Grazed permanent pasture with no inputs	High Brown Fritillary	y	y	y	y	
15C Grazed permanent pasture with no inputs and mixed grazing	High Brown Fritillary	y	y	y	y	
41A Grazing management of open country	High Brown Fritillary	y	y	y	y	
41B Grazing management of open country with mixed grazing	High Brown Fritillary	y	y	y	y	
44 Mechanical bracken control	High Brown Fritillary	y	y	y	y	
103 Scrub - stock exclusion	High Brown Fritillary	y	y	y	y	
120 Lowland unimproved acid grassland	High Brown Fritillary	y	y	y	y	
121 Lowland unimproved acid grassland - reversion (pasture)	High Brown Fritillary	y	y	y	y	
122 Lowland unimproved acid grassland - reversion (hay cutting)	High Brown Fritillary	y	y	y	y	
123 Lowland unimproved neutral grassland - pasture	High Brown Fritillary	y	y	y	y	
124 Lowland unimproved neutral grassland - haymeadow	High Brown Fritillary	y	y	y	y	
125 Lowland unimproved neutral grassland - reversion (pasture)	High Brown Fritillary	y	y	y	y	
126 Lowland unimproved neutral grassland - reversion (hay cutting)	High Brown Fritillary	y	y	y	y	
128 Lowland unimproved calcareous grassland	High Brown Fritillary	y	y	y	y	
129 Lowland unimproved calcareous grassland - reversion (pasture)	High Brown Fritillary	y	y	y	y	
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	High Brown Fritillary	y	y	y	y	
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	High Brown Fritillary	y	y	y	y	
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Historic features and landscape	y	y			
1B Create a 2 metre corridor to include tree and shrub planting	Historic features and landscape	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
on improved land						
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Historic features and landscape	y	y			
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Historic features and landscape	y	y			
6 Double fence gappy hedges	Historic features and landscape	y	y			
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Historic features and landscape	y	y			
10 Convert arable land containing archaeological sites to permanent grassland	Historic features and landscape	y	y			
11 Restore a traditional orchard	Historic features and landscape	y	y			
12 Create a new orchard on improved land	Historic features and landscape	y	y			
13 Plant individual native trees on improved land	Historic features and landscape	y	y			
18 Upland grassland	Historic features and landscape	y	y			
39 Management of scrub, saplings and intrusive vegetation from identified historic features by cutting to ground level and treating roots in situ	Historic features and landscape					
42A Hedgerow restoration with fencing	Historic features and landscape	y	y			
42B Hedgerow restoration without fencing	Historic features and landscape	y	y			
43A Double fence restored hedge banks with planting	Historic features and landscape	y	y			
43B Double fence restored hedge banks without planting	Historic features and landscape	y	y			
44 Mechanical bracken control	Historic features and landscape	y	y			
45 Maintenance of traditional weatherproof buildings	Historic features and landscape					
104 Wood pasture	Historic features and landscape	y	y			
172 Orchard management	Historic features and landscape					
175 Management of rough grassland - enclosed land	Historic features and landscape	y	y			
11 Restore a traditional orchard	Honey bee health	y	y			
12 Create a new orchard on improved land	Honey bee health	y	y			
16 Upland heath	Honey bee health	y	y			
19 Lowland marshy grassland	Honey bee health	y	y			
19B Management of lowland marshy grassland with mixed grazing	Honey bee health	y	y			
20 Management of lowland and coastal heath	Honey bee health	y	y			
20B Management of lowland and coastal heath with mixed	Honey bee health	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
grazing						
22 Existing haymeadows	Honey bee health	y	y			
41A Grazing management of open country	Honey bee health	y	y			
41B Grazing management of open country with mixed grazing	Honey bee health	y	y			
115 Lowland dry heath with less than 50% western gorse	Honey bee health	y	y			
116 Lowland dry heath with more than 50% western gorse	Honey bee health	y	y			
117 Lowland wet heath with less than 60% purple moor-grass	Honey bee health	y	y			
118 Lowland wet heath with more than 60% purple moor-grass	Honey bee health	y	y			
119 Lowland heath habitat expansion - establishment on grassland	Honey bee health	y	y			
120 Lowland unimproved acid grassland	Honey bee health	y	y			
121 Lowland unimproved acid grassland - reversion (pasture)	Honey bee health	y	y			
122 Lowland unimproved acid grassland - reversion (hay cutting)	Honey bee health	y	y			
123 Lowland unimproved neutral grassland - pasture	Honey bee health	y	y			
124 Lowland unimproved neutral grassland - haymeadow	Honey bee health	y	y			
125 Lowland unimproved neutral grassland - reversion (pasture)	Honey bee health	y	y			
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Honey bee health	y	y			
128 Lowland unimproved calcareous grassland	Honey bee health	y	y			
129 Lowland unimproved calcareous grassland - reversion (pasture)	Honey bee health	y	y			
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Honey bee health	y	y			
131 Conversion from arable to grassland (no inputs)	Honey bee health	y	y			
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Honey bee health	y	y			
133 Lowland marshy grassland	Honey bee health	y	y			
134 Lowland marshy grassland - reversion (pasture)	Honey bee health	y	y			
153 Red clover ley	Honey bee health	y	y			
172 Orchard management	Honey bee health					
41A Grazing management of open country	Lapwing	y	y	y		y
41B Grazing management of open country with mixed grazing	Lapwing	y	y	y		y
159 Grassland managed with no inputs between 15 October	Lapwing	y	y	y		y

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
and 31 January						
168 Grassland management for lapwing (nesting & feeding)	Lapwing	y	y	y		y
169 Unsprayed spring sown cereals, oil seed rape, linseed or mustard crop for lapwing (nesting)	Lapwing	y	y	y		y
170 Uncropped fallow plot for lapwing (nesting)	Lapwing	y	y	y		y
400 Additional Management Payment - Stock management	Lapwing	y	y	y		y
401 Additional Management Payment - Mixed grazing	Lapwing	y	y	y		y
403 Additional Management Payment - Re-wetting	Lapwing	y	y	y		y
404 Additional Management Payment - Re-wetting (improved land)	Lapwing	y	y	y		y
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Lesser Horseshoe Bat	y	y	tba		
1B Create a 2 metre corridor to include tree and shrub planting on improved land	Lesser Horseshoe Bat	y	y	tba		
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Lesser Horseshoe Bat	y	y	tba		
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Lesser Horseshoe Bat	y	y	tba		
3 Create a wildlife corridor – Establish wooded strip on improved ground	Lesser Horseshoe Bat	y	y	tba		
5 Enhanced hedgerow management (on both sides)	Lesser Horseshoe Bat	y	y	tba		
6 Double fence gappy hedges	Lesser Horseshoe Bat	y	y	tba		
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Lesser Horseshoe Bat	y	y	tba		
7A Create a streamside corridor on improved land on one side of a watercourse	Lesser Horseshoe Bat	y	y	tba		
7B Create a streamside corridor on improved land on both sides of a watercourse	Lesser Horseshoe Bat	y	y	tba		
8 Continued management of an existing streamside corridor	Lesser Horseshoe Bat	y	y	tba		
9A Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Lesser Horseshoe Bat	y	y	tba		
9B Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Lesser Horseshoe Bat	y	y	tba		
11 Restore a traditional orchard	Lesser Horseshoe Bat	y	y	tba		
12 Create a new orchard on improved land	Lesser Horseshoe Bat	y	y	tba		
13 Plant individual native trees on improved land	Lesser Horseshoe Bat	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
15C Grazed permanent pasture with no inputs and mixed grazing	Lesser Horseshoe Bat	y	y	tba		
19 Lowland marshy grassland	Lesser Horseshoe Bat	y	y	tba		
19B Management of lowland marshy grassland with mixed grazing	Lesser Horseshoe Bat	y	y	tba		
20 Management of lowland and coastal heath	Lesser Horseshoe Bat	y	y	tba		
20B Management of lowland and coastal heath with mixed grazing	Lesser Horseshoe Bat	y	y	tba		
21 Grazed saltmarsh	Lesser Horseshoe Bat			tba		
21B Management of grazed saltmarsh with mixed grazing	Lesser Horseshoe Bat			tba		
22 Existing haymeadows	Lesser Horseshoe Bat	y	y	tba		
23 Allow small areas of improved land in corners of fields to revert to rough grassland and scrub	Lesser Horseshoe Bat	y	y	tba		
24 Allow woodland edge to develop out into adjoining improved land	Lesser Horseshoe Bat	y	y	tba		
26 Fixed rough grass margins on arable land	Lesser Horseshoe Bat	y	y	tba		
26B Rotational rough grass margin on arable land	Lesser Horseshoe Bat	y	y	tba		
31 Unsprayed spring sown cereals retaining winter stubbles	Lesser Horseshoe Bat	y	y	tba		
33 Establish a wildlife cover crop on improved land	Lesser Horseshoe Bat	y	y	tba		
35 Create a wildlife pond on enclosed improved land	Lesser Horseshoe Bat	y	y	tba		
35B Create a wildlife pond on enclosed improved land – variable size	Lesser Horseshoe Bat	y	y	tba		
36 Buffer existing unfenced in-field ponds	Lesser Horseshoe Bat	y	y	tba		
41A Grazing management of open country	Lesser Horseshoe Bat	y	y	tba		
42A Hedgerow restoration with fencing	Lesser Horseshoe Bat	y	y	tba		
42B Hedgerow restoration without fencing	Lesser Horseshoe Bat	y	y	tba		
43A Double fence restored hedge banks with planting	Lesser Horseshoe Bat	y	y	tba		
43B Double fence restored hedge banks without planting	Lesser Horseshoe Bat	y	y	tba		
45 Maintenance of traditional weatherproof buildings	Lesser Horseshoe Bat			tba		
100 Woodland - stock exclusion	Lesser Horseshoe Bat		y	tba		
101 Trees and scrub - establishment by planting	Lesser Horseshoe Bat	y	y	tba		
102 Trees and scrub - establishment by natural regeneration	Lesser Horseshoe Bat	y	y	tba		
103 Scrub - stock exclusion	Lesser Horseshoe Bat	y	y	tba		
104 Wood pasture	Lesser Horseshoe Bat	y	y	tba		
106 Historic parks and gardens	Lesser Horseshoe Bat			tba		
115 Lowland dry heath with	Lesser Horseshoe Bat	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
less than 50% western gorse						
116 Lowland dry heath with more than 50% western gorse	Lesser Horseshoe Bat	y	y	tba		
117 Lowland wet heath with less than 60% purple moor-grass	Lesser Horseshoe Bat	y	y	tba		
118 Lowland wet heath with more than 60% purple moor-grass	Lesser Horseshoe Bat	y	y	tba		
119 Lowland heath habitat expansion - establishment on grassland	Lesser Horseshoe Bat	y	y	tba		
120 Lowland unimproved acid grassland	Lesser Horseshoe Bat	y	y	tba		
121 Lowland unimproved acid grassland - reversion (pasture)	Lesser Horseshoe Bat	y	y	tba		
122 Lowland unimproved acid grassland - reversion (hay cutting)	Lesser Horseshoe Bat	y	y	tba		
123 Lowland unimproved neutral grassland - pasture	Lesser Horseshoe Bat	y	y	tba		
124 Lowland unimproved neutral grassland - haymeadow	Lesser Horseshoe Bat	y	y	tba		
125 Lowland unimproved neutral grassland - reversion (pasture)	Lesser Horseshoe Bat	y	y	tba		
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Lesser Horseshoe Bat	y	y	tba		
128 Lowland unimproved calcareous grassland	Lesser Horseshoe Bat	y	y	tba		
129 Lowland unimproved calcareous grassland - reversion (pasture)	Lesser Horseshoe Bat	y	y	tba		
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Lesser Horseshoe Bat	y	y	tba		
131 Conversion from arable to grassland (no inputs)	Lesser Horseshoe Bat	y	y	tba		
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Lesser Horseshoe Bat	y	y	tba		
133 Lowland marshy grassland	Lesser Horseshoe Bat	y	y	tba		
134 Lowland marshy grassland - reversion (pasture)	Lesser Horseshoe Bat	y	y	tba		
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Lesser Horseshoe Bat	y	y	tba		
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Lesser Horseshoe Bat	y	y	tba		
141 Lowland bog and other acid mires - restoration (no grazing)	Lesser Horseshoe Bat	y	y	tba		
142 Lowland bog and other acid mires - reversion (pasture)	Lesser Horseshoe Bat	y	y	tba		
143 Lowland fen	Lesser Horseshoe Bat	y	y	tba		
145 Lowland fen - reversion (pasture)	Lesser Horseshoe Bat			tba		
146 Reedbed - stock exclusion	Lesser Horseshoe Bat			tba		
147 Reedbed - creation	Lesser Horseshoe Bat	y	y	tba		
149 Saltmarsh - restoration (no	Lesser Horseshoe Bat	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
grazing)						
150 Saltmarsh - creation	Lesser Horseshoe Bat			tba		
153 Red clover ley	Lesser Horseshoe Bat	y	y	tba		
172 Orchard management	Lesser Horseshoe Bat			tba		
173 Streamside corridor management	Lesser Horseshoe Bat	y	y	tba		
174 Rough grass buffer zone to prevent erosion and run-off from land under arable cropping	Lesser Horseshoe Bat	y	y	tba		
175 Management of rough grassland - enclosed land	Lesser Horseshoe Bat	y	y	tba		
405 Additional Management Payment - Grazing management for dung invertebrates	Lesser Horseshoe Bat	y	y	tba		
6 Double fence gappy hedges	Lichens of Old Wayside Trees and Parklands	y	y			
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Lichens of Old Wayside Trees and Parklands	y	y			
11 Restore a traditional orchard	Lichens of Old Wayside Trees and Parklands	y	y			
12 Create a new orchard on improved land	Lichens of Old Wayside Trees and Parklands	y	y			
13 Plant individual native trees on improved land	Lichens of Old Wayside Trees and Parklands	y	y			
14 Commit to 100% slurry injection	Lichens of Old Wayside Trees and Parklands					
14B Commit to 75% slurry injection	Lichens of Old Wayside Trees and Parklands					
15 Grazed permanent pasture with no inputs	Lichens of Old Wayside Trees and Parklands	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Lichens of Old Wayside Trees and Parklands	y	y			
24 Allow woodland edge to develop out into adjoining improved land	Lichens of Old Wayside Trees and Parklands	y	y			
26 Fixed rough grass margins on arable land	Lichens of Old Wayside Trees and Parklands	y	y			
26B Rotational rough grass margin on arable land	Lichens of Old Wayside Trees and Parklands	y	y			
27 Fallow margins	Lichens of Old Wayside Trees and Parklands	y	y			
40 Management of existing fence on stock excluded woodland	Lichens of Old Wayside Trees and Parklands					
42A Hedgerow restoration with fencing	Lichens of Old Wayside Trees and Parklands	y	y			
42B Hedgerow restoration without fencing	Lichens of Old Wayside Trees and Parklands	y	y			
43A Double fence restored hedge banks with planting	Lichens of Old Wayside Trees and Parklands	y	y			
100 Woodland - stock exclusion	Lichens of Old Wayside Trees and Parklands		y			
102 Trees and scrub - establishment by natural regeneration	Lichens of Old Wayside Trees and Parklands	y	y			
104 Wood pasture	Lichens of Old Wayside Trees and Parklands	y	y			
106 Historic parks and gardens	Lichens of Old Wayside					

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
	Trees and Parklands					
172 Orchard management	Lichens of Old Wayside Trees and Parklands					
174 Rough grass buffer zone to prevent erosion and run-off from land under arable cropping	Lichens of Old Wayside Trees and Parklands	y	y			
175 Management of rough grassland - enclosed land	Lichens of Old Wayside Trees and Parklands	y	y			
15 Grazed permanent pasture with no inputs	Lowland Grassland	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Lowland Grassland	y	y			
17 Blanket Bog	Lowland Grassland	y	y			
19 Lowland marshy grassland	Lowland Grassland	y	y			
19B Management of lowland marshy grassland with mixed grazing	Lowland Grassland	y	y			
22 Existing haymeadows	Lowland Grassland	y	y			
41A Grazing management of open country	Lowland Grassland	y	y			
41B Grazing management of open country with mixed grazing	Lowland Grassland	y	y			
109 Calaminarian grassland	Lowland Grassland	y	y			
120 Lowland unimproved acid grassland	Lowland Grassland	y	y			
121 Lowland unimproved acid grassland - reversion (pasture)	Lowland Grassland	y	y			
122 Lowland unimproved acid grassland - reversion (hay cutting)	Lowland Grassland	y	y			
123 Lowland unimproved neutral grassland - pasture	Lowland Grassland	y	y			
124 Lowland unimproved neutral grassland - haymeadow	Lowland Grassland	y	y			
125 Lowland unimproved neutral grassland - reversion (pasture)	Lowland Grassland	y	y			
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Lowland Grassland	y	y			
128 Lowland unimproved calcareous grassland	Lowland Grassland	y	y			
129 Lowland unimproved calcareous grassland - reversion (pasture)	Lowland Grassland	y	y			
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Lowland Grassland	y	y			
131 Conversion from arable to grassland (no inputs)	Lowland Grassland	y	y			
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Lowland Grassland	y	y			
133 Lowland marshy grassland	Lowland Grassland	y	y			
134 Lowland marshy grassland - reversion (pasture)	Lowland Grassland	y	y			
20 Management of lowland and coastal heath	Lowland Heathland	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
20B Management of lowland and coastal heath with mixed grazing	Lowland Heathland	y	y			
41A Grazing management of open country	Lowland Heathland	y	y			
41B Grazing management of open country with mixed grazing	Lowland Heathland	y	y			
115 Lowland dry heath with less than 50% western gorse	Lowland Heathland	y	y			
116 Lowland dry heath with more than 50% western gorse	Lowland Heathland	y	y			
117 Lowland wet heath with less than 60% purple moor-grass	Lowland Heathland	y	y			
118 Lowland wet heath with more than 60% purple moor-grass	Lowland Heathland	y	y			
119 Lowland heath habitat expansion - establishment on grassland	Lowland Heathland	y	y			
175 Management of rough grassland - enclosed land	Lowland Heathland	y	y			
19 Lowland marshy grassland	Marsh Fritillary	y	y	y	y	
19B Management of lowland marshy grassland with mixed grazing	Marsh Fritillary	y	y	y	y	
20 Management of lowland and coastal heath	Marsh Fritillary	y	y	y	y	
20B Management of lowland and coastal heath with mixed grazing	Marsh Fritillary	y	y	y	y	
117 Lowland wet heath with less than 60% purple moor-grass	Marsh Fritillary	y	y	y	y	
118 Lowland wet heath with more than 60% purple moor-grass	Marsh Fritillary	y	y	y	y	
123 Lowland unimproved neutral grassland - pasture	Marsh Fritillary	y	y	y	y	
133 Lowland marshy grassland	Marsh Fritillary	y	y	y	y	
134 Lowland marshy grassland - reversion (pasture)	Marsh Fritillary	y	y	y	y	
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Marsh Fritillary	y	y	y	y	
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Marsh Fritillary	y	y	y	y	
141 Lowland bog and other acid mires - restoration (no grazing)	Marsh Fritillary	y	y	y	y	
143 Lowland fen	Marsh Fritillary	y	y	y	y	
144 Lowland fen - restoration (no grazing)	Marsh Fritillary			y	y	
145 Lowland fen - reversion (pasture)	Marsh Fritillary			y	y	
400 Additional Management Payment - Stock management	Marsh Fritillary	y	y	y	y	
403 Additional Management Payment - Re-wetting	Marsh Fritillary	y	y	y	y	
404 Additional Management	Marsh Fritillary	y	y	y	y	

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
Payment - Re-wetting (improved land)						
16 Upland heath	Montane Heath	y	y			
17 Blanket Bog	Montane Heath	y	y			
18 Upland grassland	Montane Heath	y	y			
41A Grazing management of open country	Montane Heath	y	y			
41B Grazing management of open country with mixed grazing	Montane Heath	y	y			
11 Restore a traditional orchard	Orchard	y	y			
12 Create a new orchard on improved land	Orchard	y	y			
172 Orchard management	Orchard					
13 Plant individual native trees on improved land	Parkland and Wood Pasture	y	y			
15 Grazed permanent pasture with no inputs	Parkland and Wood Pasture	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Parkland and Wood Pasture	y	y			
18 Upland grassland	Parkland and Wood Pasture	y	y			
22 Existing haymeadows	Parkland and Wood Pasture	y	y			
41A Grazing management of open country	Parkland and Wood Pasture	y	y			
41B Grazing management of open country with mixed grazing	Parkland and Wood Pasture	y	y			
101 Trees and scrub - establishment by planting	Parkland and Wood Pasture	y	y			
102 Trees and scrub - establishment by natural regeneration	Parkland and Wood Pasture	y	y			
103 Scrub - stock exclusion	Parkland and Wood Pasture	y	y			
104 Wood pasture	Parkland and Wood Pasture	y	y			
106 Historic parks and gardens	Parkland and Wood Pasture					
120 Lowland unimproved acid grassland	Parkland and Wood Pasture	y	y			
121 Lowland unimproved acid grassland - reversion (pasture)	Parkland and Wood Pasture	y	y			
122 Lowland unimproved acid grassland - reversion (hay cutting)	Parkland and Wood Pasture	y	y			
123 Lowland unimproved neutral grassland - pasture	Parkland and Wood Pasture	y	y			
124 Lowland unimproved neutral grassland - haymeadow	Parkland and Wood Pasture	y	y			
125 Lowland unimproved neutral grassland - reversion (pasture)	Parkland and Wood Pasture	y	y			
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Parkland and Wood Pasture	y	y			
128 Lowland unimproved calcareous grassland	Parkland and Wood Pasture	y	y			
129 Lowland unimproved	Parkland and Wood	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
calcareous grassland - reversion (pasture)	Pasture					
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Parkland and Wood Pasture	y	y			
131 Conversion from arable to grassland (no inputs)	Parkland and Wood Pasture	y	y			
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Parkland and Wood Pasture	y	y			
133 Lowland marshy grassland	Parkland and Wood Pasture	y	y			
134 Lowland marshy grassland - reversion (pasture)	Parkland and Wood Pasture	y	y			
175 Management of rough grassland - enclosed land	Parkland and Wood Pasture	y	y			
6 Double fence gappy hedges	Parks and Gardens	y	y			
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Parks and Gardens	y	y			
10 Convert arable land containing archaeological sites to permanent grassland	Parks and Gardens	y	y			
11 Restore a traditional orchard	Parks and Gardens	y	y			
13 Plant individual native trees on improved land	Parks and Gardens	y	y			
15 Grazed permanent pasture with no inputs	Parks and Gardens	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Parks and Gardens	y	y			
22 Existing haymeadows	Parks and Gardens	y	y			
39 Management of scrub, saplings and intrusive vegetation from identified historic features by cutting to ground level and treating roots in situ	Parks and Gardens					
100 Woodland - stock exclusion	Parks and Gardens		y			
101 Trees and scrub - establishment by planting	Parks and Gardens	y	y			
104 Wood pasture	Parks and Gardens	y	y			
106 Historic parks and gardens	Parks and Gardens					
120 Lowland unimproved acid grassland	Parks and Gardens	y	y			
121 Lowland unimproved acid grassland - reversion (pasture)	Parks and Gardens	y	y			
122 Lowland unimproved acid grassland - reversion (hay cutting)	Parks and Gardens	y	y			
123 Lowland unimproved neutral grassland - pasture	Parks and Gardens	y	y			
124 Lowland unimproved neutral grassland - haymeadow	Parks and Gardens	y	y			
125 Lowland unimproved neutral grassland - reversion (pasture)	Parks and Gardens	y	y			
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Parks and Gardens	y	y			
128 Lowland unimproved	Parks and Gardens	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
calcareous grassland						
129 Lowland unimproved calcareous grassland - reversion (pasture)	Parks and Gardens	y	y			
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Parks and Gardens	y	y			
131 Conversion from arable to grassland (no inputs)	Parks and Gardens	y	y			
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Parks and Gardens	y	y			
146 Reedbed - stock exclusion	Parks and Gardens					
147 Reedbed - creation	Parks and Gardens	y	y			
172 Orchard management	Parks and Gardens					
175 Management of rough grassland - enclosed land	Parks and Gardens	y	y			
15 Grazed permanent pasture with no inputs	Pearl Bordered Fritillary	y	y	y	y	
15C Grazed permanent pasture with no inputs and mixed grazing	Pearl Bordered Fritillary	y	y	y	y	
20 Management of lowland and coastal heath	Pearl Bordered Fritillary	y	y	y	y	
20B Management of lowland and coastal heath with mixed grazing	Pearl Bordered Fritillary	y	y	y	y	
41A Grazing management of open country	Pearl Bordered Fritillary	y	y	y	y	
41B Grazing management of open country with mixed grazing	Pearl Bordered Fritillary	y	y	y	y	
44 Mechanical bracken control	Pearl Bordered Fritillary	y	y	y	y	
103 Scrub - stock exclusion	Pearl Bordered Fritillary	y	y	y	y	
120 Lowland unimproved acid grassland	Pearl Bordered Fritillary	y	y	y	y	
121 Lowland unimproved acid grassland - reversion (pasture)	Pearl Bordered Fritillary	y	y	y	y	
123 Lowland unimproved neutral grassland - pasture	Pearl Bordered Fritillary	y	y	y	y	
125 Lowland unimproved neutral grassland - reversion (pasture)	Pearl Bordered Fritillary	y	y	y	y	
128 Lowland unimproved calcareous grassland	Pearl Bordered Fritillary	y	y	y	y	
148 Coastal grassland (maritime cliff and slope)	Pearl Bordered Fritillary	y	y	y	y	
400 Additional Management Payment - Stock management	Pearl Bordered Fritillary	y	y	y	y	
401 Additional Management Payment - Mixed grazing	Pearl Bordered Fritillary	y	y	y	y	
411 Additional Management Payment - Reduce stocking	Pearl Bordered Fritillary	y	y	y	y	
46A Maintenance of linear permissive access - existing Tir Gofal bridleway	Permissive Access					
46B Maintenance of linear permissive access - existing Tir Gofal footpath	Permissive Access					
46C Maintenance of linear	Permissive Access					

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
permissive access - existing Tir Gofal disabled access						
35 Create a wildlife pond on enclosed improved land	Pond Landscape	y	y			
35B Create a wildlife pond on enclosed improved land – variable size	Pond Landscape	y	y			
36 Buffer existing unfenced in-field ponds	Pond Landscape	y	y			
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Protected Landscape	y	y			
1B Create a 2 metre corridor to include tree and shrub planting on improved land	Protected Landscape	y	y			
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Protected Landscape	y	y			
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Protected Landscape	y	y			
3 Create a wildlife corridor – Establish wooded strip on improved ground	Protected Landscape	y	y			
6 Double fence gappy hedges	Protected Landscape	y	y			
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Protected Landscape	y	y			
13 Plant individual native trees on improved land	Protected Landscape	y	y			
15 Grazed permanent pasture with no inputs	Protected Landscape	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Protected Landscape	y	y			
19 Lowland marshy grassland	Protected Landscape	y	y			
19B Management of lowland marshy grassland with mixed grazing	Protected Landscape	y	y			
22 Existing haymeadows	Protected Landscape	y	y			
24 Allow woodland edge to develop out into adjoining improved land	Protected Landscape	y	y			
40 Management of existing fence on stock excluded woodland	Protected Landscape					
41A Grazing management of open country	Protected Landscape	y	y			
41B Grazing management of open country with mixed grazing	Protected Landscape	y	y			
42A Hedgerow restoration with fencing	Protected Landscape	y	y			
42B Hedgerow restoration without fencing	Protected Landscape	y	y			
43A Double fence restored hedge banks with planting	Protected Landscape	y	y			
43B Double fence restored hedge banks without planting	Protected Landscape	y	y			
44 Mechanical bracken control	Protected Landscape	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
100 Woodland - stock exclusion	Protected Landscape		y			
101 Trees and scrub - establishment by planting	Protected Landscape	y	y			
102 Trees and scrub - establishment by natural regeneration	Protected Landscape	y	y			
103 Scrub - stock exclusion	Protected Landscape	y	y			
104 Wood pasture	Protected Landscape	y	y			
164 Grassland management for curlew (nesting & chick feeding)	Protected Landscape	y	y			
171 Grassland management for ring ouzel (feeding)	Protected Landscape	y	y			
175 Management of rough grassland - enclosed land	Protected Landscape	y	y			
400 Additional Management Payment - Stock management	Protected Landscape	y	y			
401 Additional Management Payment - Mixed grazing	Protected Landscape	y	y			
404 Additional Management Payment - Re-wetting (improved land)	Protected Landscape	y	y			
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Rare Plants	y	y	y		
1B Create a 2 metre corridor to include tree and shrub planting on improved land	Rare Plants	y	y	y		
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Rare Plants	y	y	y		
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Rare Plants	y	y	y		
3 Create a wildlife corridor – Establish wooded strip on improved ground	Rare Plants	y	y	y		
4 Simple hedgerow management (on both sides)	Rare Plants	y	y	y		
4B Hedgerow management of external boundary hedges (on side only)	Rare Plants			y		
6 Double fence gappy hedges	Rare Plants	y	y	y		
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Rare Plants	y	y	y		
15 Grazed permanent pasture with no inputs	Rare Plants	y	y	y		
15C Grazed permanent pasture with no inputs and mixed grazing	Rare Plants	y	y	y		
16 Upland heath	Rare Plants	y	y	y		
17 Blanket Bog	Rare Plants	y	y	y		
18 Upland grassland	Rare Plants	y	y	y		
19 Lowland marshy grassland	Rare Plants	y	y	y		
19B Management of lowland marshy grassland with mixed grazing	Rare Plants	y	y	y		
20B Management of lowland	Rare Plants	y	y	y		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
and coastal heath with mixed grazing						
22 Existing haymeadows	Rare Plants	y	y	y		
41A Grazing management of open country	Rare Plants	y	y	y		
41B Grazing management of open country with mixed grazing	Rare Plants	y	y	y		
42A Hedgerow restoration with fencing	Rare Plants	y	y	y		
42B Hedgerow restoration without fencing	Rare Plants	y	y	y		
43A Double fence restored hedge banks with planting	Rare Plants	y	y	y		
43B Double fence restored hedge banks without planting	Rare Plants	y	y	y		
120 Lowland unimproved acid grassland	Rare Plants	y	y	y		
121 Lowland unimproved acid grassland - reversion (pasture)	Rare Plants	y	y	y		
122 Lowland unimproved acid grassland - reversion (hay cutting)	Rare Plants	y	y	y		
123 Lowland unimproved neutral grassland - pasture	Rare Plants	y	y	y		
124 Lowland unimproved neutral grassland - haymeadow	Rare Plants	y	y	y		
125 Lowland unimproved neutral grassland - reversion (pasture)	Rare Plants	y	y	y		
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Rare Plants	y	y	y		
131 Conversion from arable to grassland (no inputs)	Rare Plants	y	y	y		
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Rare Plants	y	y	y		
133 Lowland marshy grassland	Rare Plants	y	y	y		
134 Lowland marshy grassland - reversion (pasture)	Rare Plants	y	y	y		
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Rare Plants	y	y	y		
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Rare Plants	y	y	y		
141 Lowland bog and other acid mires - restoration (no grazing)	Rare Plants	y	y	y		
142 Lowland bog and other acid mires - reversion (pasture)	Rare Plants	y	y	y		
143 Lowland fen	Rare Plants	y	y	y		
144 Lowland fen - restoration (no grazing)	Rare Plants			y		
145 Lowland fen - reversion (pasture)	Rare Plants			y		
16 Upland heath	Red Grouse	y	y	y		y
17 Blanket Bog	Red Grouse	y	y	y		y
18 Upland grassland	Red Grouse	y	y	y		y
41A Grazing management of	Red Grouse	y	y	y		y

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
open country						
41B Grazing management of open country with mixed grazing	Red Grouse	y	y	y		y
44 Mechanical bracken control	Red Grouse	y	y	y		y
115 Lowland dry heath with less than 50% western gorse	Red Grouse	y	y	y		y
400 Additional Management Payment - Stock management	Red Grouse	y	y	y		y
401 Additional Management Payment - Mixed grazing	Red Grouse	y	y	y		y
402 Additional Management Payment - Control burning	Red Grouse	y	y	y		y
403 Additional Management Payment - Re-wetting	Red Grouse	y	y	y		y
411 Additional Management Payment - Reduce stocking	Red Grouse	y	y	y		y
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Red Squirrel	y	y	tba		
1B Create a 2 metre corridor to include tree and shrub planting on improved land	Red Squirrel	y	y	tba		
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Red Squirrel	y	y	tba		
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Red Squirrel	y	y	tba		
3 Create a wildlife corridor – Establish wooded strip on improved ground	Red Squirrel	y	y	tba		
4 Simple hedgerow management (on both sides)	Red Squirrel	y	y	tba		
4B Hedgerow management of external boundary hedges (on side only)	Red Squirrel			tba		
6 Double fence gappy hedges	Red Squirrel	y	y	tba		
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Red Squirrel	y	y	tba		
24 Allow woodland edge to develop out into adjoining improved land	Red Squirrel	y	y	tba		
40 Management of existing fence on stock excluded woodland	Red Squirrel			tba		
42A Hedgerow restoration with fencing	Red Squirrel	y	y	tba		
42B Hedgerow restoration without fencing	Red Squirrel	y	y	tba		
43A Double fence restored hedge banks with planting	Red Squirrel	y	y	tba		
100 Woodland - stock exclusion	Red Squirrel		y	tba		
16 Upland heath	Ring Ouzel	y	y	y		y
41A Grazing management of open country	Ring Ouzel	y	y	y		y
41B Grazing management of open country with mixed grazing	Ring Ouzel	y	y	y		y

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
161 Grassland management for chough (feeding)	Ring Ouzel	y	y	y		y
171 Grassland management for ring ouzel (feeding)	Ring Ouzel	y	y	y		y
16 Upland heath	Rock ledge and Scree	y	y			
17 Blanket Bog	Rock ledge and Scree	y	y			
18 Upland grassland	Rock ledge and Scree	y	y			
41A Grazing management of open country	Rock ledge and Scree	y	y			
41B Grazing management of open country with mixed grazing	Rock ledge and Scree	y	y			
3 Create a wildlife corridor – Establish wooded strip on improved ground	Sensitive Lakes	y	y			
7A Create a streamside corridor on improved land on one side of a watercourse	Sensitive Lakes	y	y			
7B Create a streamside corridor on improved land on both sides of a watercourse	Sensitive Lakes	y	y			
8 Continued management of an existing streamside corridor	Sensitive Lakes	y	y			
9A Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Sensitive Lakes	y	y			
9B Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Sensitive Lakes	y	y			
14 Commit to 100% slurry injection	Sensitive Lakes					
14B Commit to 75% slurry injection	Sensitive Lakes					
15 Grazed permanent pasture with no inputs	Sensitive Lakes	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Sensitive Lakes	y	y			
19 Lowland marshy grassland	Sensitive Lakes	y	y			
19B Management of lowland marshy grassland with mixed grazing	Sensitive Lakes	y	y			
20 Management of lowland and coastal heath	Sensitive Lakes	y	y			
20B Management of lowland and coastal heath with mixed grazing	Sensitive Lakes	y	y			
22 Existing haymeadows	Sensitive Lakes	y	y			
26 Fixed rough grass margins on arable land	Sensitive Lakes	y	y			
26B Rotational rough grass margin on arable land	Sensitive Lakes	y	y			
28 Retain winter stubbles	Sensitive Lakes					
33 Establish a wildlife cover crop on improved land	Sensitive Lakes	y	y			
34 Unharvested cereal headland	Sensitive Lakes	y	y			
34B Unfertilised and unsprayed cereal headland	Sensitive Lakes	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
41A Grazing management of open country	Sensitive Lakes	y	y			
41B Grazing management of open country with mixed grazing	Sensitive Lakes	y	y			
101 Trees and scrub - establishment by planting	Sensitive Lakes	y	y			
102 Trees and scrub - establishment by natural regeneration	Sensitive Lakes	y	y			
103 Scrub - stock exclusion	Sensitive Lakes	y	y			
117 Lowland wet heath with less than 60% purple moor-grass	Sensitive Lakes	y	y			
118 Lowland wet heath with more than 60% purple moor-grass	Sensitive Lakes	y	y			
119 Lowland heath habitat expansion - establishment on grassland	Sensitive Lakes	y	y			
120 Lowland unimproved acid grassland	Sensitive Lakes	y	y			
121 Lowland unimproved acid grassland - reversion (pasture)	Sensitive Lakes	y	y			
122 Lowland unimproved acid grassland - reversion (hay cutting)	Sensitive Lakes	y	y			
123 Lowland unimproved neutral grassland - pasture	Sensitive Lakes	y	y			
124 Lowland unimproved neutral grassland - haymeadow	Sensitive Lakes	y	y			
125 Lowland unimproved neutral grassland - reversion (pasture)	Sensitive Lakes	y	y			
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Sensitive Lakes	y	y			
128 Lowland unimproved calcareous grassland	Sensitive Lakes	y	y			
129 Lowland unimproved calcareous grassland - reversion (pasture)	Sensitive Lakes	y	y			
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Sensitive Lakes	y	y			
131 Conversion from arable to grassland (no inputs)	Sensitive Lakes	y	y			
133 Lowland marshy grassland	Sensitive Lakes	y	y			
134 Lowland marshy grassland - reversion (pasture)	Sensitive Lakes	y	y			
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Sensitive Lakes	y	y			
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Sensitive Lakes	y	y			
141 Lowland bog and other acid mires - restoration (no grazing)	Sensitive Lakes	y	y			
142 Lowland bog and other acid mires - reversion (pasture)	Sensitive Lakes	y	y			
143 Lowland fen	Sensitive Lakes	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
144 Lowland fen - restoration (no grazing)	Sensitive Lakes					
145 Lowland fen - reversion (pasture)	Sensitive Lakes					
146 Reedbed - stock exclusion	Sensitive Lakes					
147 Reedbed - creation	Sensitive Lakes	y	y			
151 Coastal vegetated shingle and sand dunes - creation	Sensitive Lakes					
155 Improve nutrient management through planning and soil sampling	Sensitive Lakes					
156 Buffer zones to prevent erosion and run-off from grassland	Sensitive Lakes	y	y			
158 Buffer zones to prevent erosion and run-off from land under arable cropping	Sensitive Lakes	y	y			
172 Orchard management	Sensitive Lakes					
173 Streamside corridor management	Sensitive Lakes	y	y			
174 Rough grass buffer zone to prevent erosion and run-off from land under arable cropping	Sensitive Lakes	y	y			
175 Management of rough grassland - enclosed land	Sensitive Lakes	y	y			
3 Create a wildlife corridor – Establish wooded strip on improved ground	Sensitive Rivers	y	y			
7A Create a streamside corridor on improved land on one side of a watercourse	Sensitive Rivers	y	y			
7B Create a streamside corridor on improved land on both sides of a watercourse	Sensitive Rivers	y	y			
8 Continued management of an existing streamside corridor	Sensitive Rivers	y	y			
9A Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Sensitive Rivers	y	y			
9B Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Sensitive Rivers	y	y			
14 Commit to 100% slurry injection	Sensitive Rivers					
14B Commit to 75% slurry injection	Sensitive Rivers					
15 Grazed permanent pasture with no inputs	Sensitive Rivers	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Sensitive Rivers	y	y			
19 Lowland marshy grassland	Sensitive Rivers	y	y			
19B Management of lowland marshy grassland with mixed grazing	Sensitive Rivers	y	y			
20 Management of lowland and coastal heath	Sensitive Rivers	y	y			
20B Management of lowland and coastal heath with mixed	Sensitive Rivers	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
grazing						
22 Existing haymeadows	Sensitive Rivers	y	y			
26 Fixed rough grass margins on arable land	Sensitive Rivers	y	y			
26B Rotational rough grass margin on arable land	Sensitive Rivers	y	y			
28 Retain winter stubbles	Sensitive Rivers					
33 Establish a wildlife cover crop on improved land	Sensitive Rivers	y	y			
34 Unharvested cereal headland	Sensitive Rivers	y	y			
34B Unfertilised and unsprayed cereal headland	Sensitive Rivers	y	y			
36 Buffer existing unfenced in-field ponds	Sensitive Rivers	y	y			
41A Grazing management of open country	Sensitive Rivers	y	y			
41B Grazing management of open country with mixed grazing	Sensitive Rivers	y	y			
101 Trees and scrub - establishment by planting	Sensitive Rivers	y	y			
102 Trees and scrub - establishment by natural regeneration	Sensitive Rivers	y	y			
103 Scrub - stock exclusion	Sensitive Rivers	y	y			
117 Lowland wet heath with less than 60% purple moor-grass	Sensitive Rivers	y	y			
118 Lowland wet heath with more than 60% purple moor-grass	Sensitive Rivers	y	y			
119 Lowland heath habitat expansion - establishment on grassland	Sensitive Rivers	y	y			
120 Lowland unimproved acid grassland	Sensitive Rivers	y	y			
121 Lowland unimproved acid grassland - reversion (pasture)	Sensitive Rivers	y	y			
122 Lowland unimproved acid grassland - reversion (hay cutting)	Sensitive Rivers	y	y			
123 Lowland unimproved neutral grassland - pasture	Sensitive Rivers	y	y			
124 Lowland unimproved neutral grassland - haymeadow	Sensitive Rivers	y	y			
125 Lowland unimproved neutral grassland - reversion (pasture)	Sensitive Rivers	y	y			
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Sensitive Rivers	y	y			
128 Lowland unimproved calcareous grassland	Sensitive Rivers	y	y			
129 Lowland unimproved calcareous grassland - reversion (pasture)	Sensitive Rivers	y	y			
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Sensitive Rivers	y	y			
131 Conversion from arable to grassland (no inputs)	Sensitive Rivers	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
133 Lowland marshy grassland	Sensitive Rivers	y	y			
134 Lowland marshy grassland - reversion (pasture)	Sensitive Rivers	y	y			
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Sensitive Rivers	y	y			
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Sensitive Rivers	y	y			
141 Lowland bog and other acid mires - restoration (no grazing)	Sensitive Rivers	y	y			
142 Lowland bog and other acid mires - reversion (pasture)	Sensitive Rivers	y	y			
143 Lowland fen	Sensitive Rivers	y	y			
144 Lowland fen - restoration (no grazing)	Sensitive Rivers					
145 Lowland fen - reversion (pasture)	Sensitive Rivers					
146 Reedbed - stock exclusion	Sensitive Rivers					
147 Reedbed - creation	Sensitive Rivers	y	y			
155 Improve nutrient management through planning and soil sampling	Sensitive Rivers					
156 Buffer zones to prevent erosion and run-off from grassland	Sensitive Rivers	y	y			
158 Buffer zones to prevent erosion and run-off from land under arable cropping	Sensitive Rivers	y	y			
172 Orchard management	Sensitive Rivers					
173 Streamside corridor management	Sensitive Rivers	y	y			
174 Rough grass buffer zone to prevent erosion and run-off from land under arable cropping	Sensitive Rivers	y	y			
175 Management of rough grassland - enclosed land	Sensitive Rivers	y	y			
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Shrill Carder Bee	y	y	y	y	
1B Create a 2 metre corridor to include tree and shrub planting on improved land	Shrill Carder Bee	y	y	y	y	
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Shrill Carder Bee	y	y	y	y	
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Shrill Carder Bee	y	y	y	y	
4 Simple hedgerow management (on both sides)	Shrill Carder Bee	y	y	y	y	
4B Hedgerow management of external boundary hedges (on side only)	Shrill Carder Bee			y	y	
5 Enhanced hedgerow management (on both sides)	Shrill Carder Bee	y	y	y	y	
6 Double fence gappy hedges	Shrill Carder Bee	y	y	y	y	

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Shrill Carder Bee	y	y	y	y	
15 Grazed permanent pasture with no inputs	Shrill Carder Bee	y	y	y	y	
15C Grazed permanent pasture with no inputs and mixed grazing	Shrill Carder Bee	y	y	y	y	
19 Lowland marshy grassland	Shrill Carder Bee	y	y	y	y	
19B Management of lowland marshy grassland with mixed grazing	Shrill Carder Bee	y	y	y	y	
20 Management of lowland and coastal heath	Shrill Carder Bee	y	y	y	y	
20B Management of lowland and coastal heath with mixed grazing	Shrill Carder Bee	y	y	y	y	
22 Existing haymeadows	Shrill Carder Bee	y	y	y	y	
23 Allow small areas of improved land in corners of fields to revert to rough grassland and scrub	Shrill Carder Bee	y	y	y	y	
25 Management of sand dunes	Shrill Carder Bee			y	y	
25B Management of sand dunes with mixed grazing	Shrill Carder Bee			y	y	
26 Fixed rough grass margins on arable land	Shrill Carder Bee	y	y	y	y	
26B Rotational rough grass margin on arable land	Shrill Carder Bee	y	y	y	y	
27 Fallow margins	Shrill Carder Bee	y	y	y	y	
33 Establish a wildlife cover crop on improved land	Shrill Carder Bee	y	y	y	y	
34 Unharvested cereal headland	Shrill Carder Bee	y	y	y	y	
34B Unfertilised and unsprayed cereal headland	Shrill Carder Bee	y	y	y	y	
41A Grazing management of open country	Shrill Carder Bee	y	y	y	y	
41B Grazing management of open country with mixed grazing	Shrill Carder Bee	y	y	y	y	
42A Hedgerow restoration with fencing	Shrill Carder Bee	y	y	y	y	
42B Hedgerow restoration without fencing	Shrill Carder Bee	y	y	y	y	
43A Double fence restored hedge banks with planting	Shrill Carder Bee	y	y	y	y	
43B Double fence restored hedge banks without planting	Shrill Carder Bee	y	y	y	y	
115 Lowland dry heath with less than 50% western gorse	Shrill Carder Bee	y	y	y	y	
116 Lowland dry heath with more than 50% western gorse	Shrill Carder Bee	y	y	y	y	
117 Lowland wet heath with less than 60% purple moor-grass	Shrill Carder Bee	y	y	y	y	
118 Lowland wet heath with more than 60% purple moor-grass	Shrill Carder Bee	y	y	y	y	
119 Lowland heath habitat expansion - establishment on grassland	Shrill Carder Bee	y	y	y	y	

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
120 Lowland unimproved acid grassland	Shrill Carder Bee	y	y	y	y	
121 Lowland unimproved acid grassland - reversion (pasture)	Shrill Carder Bee	y	y	y	y	
122 Lowland unimproved acid grassland - reversion (hay cutting)	Shrill Carder Bee	y	y	y	y	
123 Lowland unimproved neutral grassland - pasture	Shrill Carder Bee	y	y	y	y	
124 Lowland unimproved neutral grassland - haymeadow	Shrill Carder Bee	y	y	y	y	
125 Lowland unimproved neutral grassland - reversion (pasture)	Shrill Carder Bee	y	y	y	y	
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Shrill Carder Bee	y	y	y	y	
128 Lowland unimproved calcareous grassland	Shrill Carder Bee	y	y	y	y	
129 Lowland unimproved calcareous grassland - reversion (pasture)	Shrill Carder Bee	y	y	y	y	
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Shrill Carder Bee	y	y	y	y	
131 Conversion from arable to grassland (no inputs)	Shrill Carder Bee	y	y	y	y	
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Shrill Carder Bee	y	y	y	y	
133 Lowland marshy grassland	Shrill Carder Bee	y	y	y	y	
134 Lowland marshy grassland - reversion (pasture)	Shrill Carder Bee	y	y	y	y	
148 Coastal grassland (maritime cliff and slope)	Shrill Carder Bee	y	y	y	y	
151 Coastal vegetated shingle and sand dunes - creation	Shrill Carder Bee			y	y	
153 Red clover ley	Shrill Carder Bee	y	y	y	y	
175 Management of rough grassland - enclosed land	Shrill Carder Bee	y	y	y	y	
3 Create a wildlife corridor – Establish wooded strip on improved ground	Turtle Dove	y	y	y		y
23 Allow small areas of improved land in corners of fields to revert to rough grassland and scrub	Turtle Dove	y	y	y		y
27 Fallow margins	Turtle Dove	y	y	y		y
30 Unsprayed spring sown cereals or legumes	Turtle Dove	y	y	y		y
31 Unsprayed spring sown cereals retaining winter stubbles	Turtle Dove	y	y	y		y
32B Plant unsprayed root crops on improved land	Turtle Dove	y	y	y		y
33 Establish a wildlife cover crop on improved land	Turtle Dove	y	y	y		y
34 Unharvested cereal headland	Turtle Dove	y	y	y		y
34B Unfertilised and unsprayed cereal headland	Turtle Dove	y	y	y		y
15 Grazed permanent pasture	Twite	y	y	y		y

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
with no inputs						
15C Grazed permanent pasture with no inputs and mixed grazing	Twite	y	y	y		y
16 Upland heath	Twite	y	y	y		y
17 Blanket Bog	Twite	y	y	y		y
18 Upland grassland	Twite	y	y	y		y
22 Existing haymeadows	Twite	y	y	y		y
26 Fixed rough grass margins on arable land	Twite	y	y	y		y
26B Rotational rough grass margin on arable land	Twite	y	y	y		y
27 Fallow margins	Twite	y	y	y		y
28 Retain winter stubbles	Twite			y		y
30 Unsprayed spring sown cereals or legumes	Twite	y	y	y		y
31 Unsprayed spring sown cereals retaining winter stubbles	Twite	y	y	y		y
32B Plant unsprayed root crops on improved land	Twite	y	y	y		y
33 Establish a wildlife cover crop on improved land	Twite	y	y	y		y
34 Unharvested cereal headland	Twite	y	y	y		y
34B Unfertilised and unsprayed cereal headland	Twite	y	y	y		y
41A Grazing management of open country	Twite	y	y	y		y
41B Grazing management of open country with mixed grazing	Twite	y	y	y		y
120 Lowland unimproved acid grassland	Twite	y	y	y		y
121 Lowland unimproved acid grassland - reversion (pasture)	Twite	y	y	y		y
122 Lowland unimproved acid grassland - reversion (hay cutting)	Twite	y	y	y		y
123 Lowland unimproved neutral grassland - pasture	Twite	y	y	y		y
124 Lowland unimproved neutral grassland - haymeadow	Twite	y	y	y		y
125 Lowland unimproved neutral grassland - reversion (pasture)	Twite	y	y	y		y
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Twite	y	y	y		y
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Twite	y	y	y		y
133 Lowland marshy grassland	Twite	y	y	y		y
134 Lowland marshy grassland - reversion (pasture)	Twite	y	y	y		y
159 Grassland managed with no inputs between 15 October and 31 January	Twite	y	y	y		y
175 Management of rough grassland - enclosed land	Twite	y	y	y		y

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
16 Upland heath	Upland Heath	y	y			
17 Blanket Bog	Upland Heath	y	y			
18 Upland grassland	Upland Heath	y	y			
41A Grazing management of open country	Upland Heath	y	y			
41B Grazing management of open country with mixed grazing	Upland Heath	y	y			
15 Grazed permanent pasture with no inputs	Upland Limestone Grassland	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Upland Limestone Grassland	y	y			
18 Upland grassland	Upland Limestone Grassland	y	y			
22 Existing haymeadows	Upland Limestone Grassland	y	y			
41A Grazing management of open country	Upland Limestone Grassland	y	y			
41B Grazing management of open country with mixed grazing	Upland Limestone Grassland	y	y			
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Upland Limestone Grassland	y	y			
7A Create a streamside corridor on improved land on one side of a watercourse	Water Quality	y	y			
7B Create a streamside corridor on improved land on both sides of a watercourse	Water Quality	y	y			
8 Continued management of an existing streamside corridor	Water Quality	y	y			
9A Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Water Quality	y	y			
9B Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Water Quality	y	y			
14 Commit to 100% slurry injection	Water Quality					
14B Commit to 75% slurry injection	Water Quality					
15 Grazed permanent pasture with no inputs	Water Quality	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Water Quality	y	y			
16 Upland heath	Water Quality	y	y			
17 Blanket Bog	Water Quality	y	y			
18 Upland grassland	Water Quality	y	y			
19 Lowland marshy grassland	Water Quality	y	y			
19B Management of lowland marshy grassland with mixed grazing	Water Quality	y	y			
20 Management of lowland and coastal heath	Water Quality	y	y			
20B Management of lowland and coastal heath with mixed	Water Quality	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
grazing						
22 Existing haymeadows	Water Quality	y	y			
23 Allow small areas of improved land in corners of fields to revert to rough grassland and scrub	Water Quality	y	y			
24 Allow woodland edge to develop out into adjoining improved land	Water Quality	y	y			
26 Fixed rough grass margins on arable land	Water Quality	y	y			
26B Rotational rough grass margin on arable land	Water Quality	y	y			
28 Retain winter stubbles	Water Quality					
29 Undersown spring cereals next to water courses	Water Quality	y	y			
31 Unsprayed spring sown cereals retaining winter stubbles	Water Quality	y	y			
34B Unfertilised and unsprayed cereal headland	Water Quality	y	y			
36 Buffer existing unfenced in-field ponds	Water Quality	y	y			
41A Grazing management of open country	Water Quality	y	y			
41B Grazing management of open country with mixed grazing	Water Quality	y	y			
100 Woodland - stock exclusion	Water Quality		y			
101 Trees and scrub - establishment by planting	Water Quality	y	y			
102 Trees and scrub - establishment by natural regeneration	Water Quality	y	y			
103 Scrub - stock exclusion	Water Quality	y	y			
104 Wood pasture	Water Quality	y	y			
115 Lowland dry heath with less than 50% western gorse	Water Quality	y	y			
116 Lowland dry heath with more than 50% western gorse	Water Quality	y	y			
117 Lowland wet heath with less than 60% purple moor-grass	Water Quality	y	y			
118 Lowland wet heath with more than 60% purple moor-grass	Water Quality	y	y			
119 Lowland heath habitat expansion - establishment on grassland	Water Quality	y	y			
120 Lowland unimproved acid grassland	Water Quality	y	y			
121 Lowland unimproved acid grassland - reversion (pasture)	Water Quality	y	y			
122 Lowland unimproved acid grassland - reversion (hay cutting)	Water Quality	y	y			
123 Lowland unimproved neutral grassland - pasture	Water Quality	y	y			
124 Lowland unimproved neutral grassland - haymeadow	Water Quality	y	y			
125 Lowland unimproved	Water Quality	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
neutral grassland - reversion (pasture)						
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Water Quality	y	y			
128 Lowland unimproved calcareous grassland	Water Quality	y	y			
129 Lowland unimproved calcareous grassland - reversion (pasture)	Water Quality	y	y			
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Water Quality	y	y			
131 Conversion from arable to grassland (no inputs)	Water Quality	y	y			
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Water Quality	y	y			
133 Lowland marshy grassland	Water Quality	y	y			
134 Lowland marshy grassland - reversion (pasture)	Water Quality	y	y			
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Water Quality	y	y			
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Water Quality	y	y			
141 Lowland bog and other acid mires - restoration (no grazing)	Water Quality	y	y			
142 Lowland bog and other acid mires - reversion (pasture)	Water Quality	y	y			
143 Lowland fen	Water Quality	y	y			
144 Lowland fen - restoration (no grazing)	Water Quality					
145 Lowland fen - reversion (pasture)	Water Quality					
146 Reedbed - stock exclusion	Water Quality					
147 Reedbed - creation	Water Quality	y	y			
155 Improve nutrient management through planning and soil sampling	Water Quality					
156 Buffer zones to prevent erosion and run-off from grassland	Water Quality	y	y			
157 Buffer zones to prevent erosion and run-off from grassland - ditch landscapes	Water Quality	y	y			
158 Buffer zones to prevent erosion and run-off from land under arable cropping	Water Quality	y	y			
159 Grassland managed with no inputs between 15 October and 31 January	Water Quality	y	y			
173 Streamside corridor management	Water Quality	y	y			
174 Rough grass buffer zone to prevent erosion and run-off from land under arable cropping	Water Quality	y	y			
175 Management of rough grassland - enclosed land	Water Quality	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
403 Additional Management Payment - Re-wetting	Water Quality	y	y			
404 Additional Management Payment - Re-wetting (improved land)	Water Quality	y	y			
7A Create a streamside corridor on improved land on one side of a watercourse	Water Quality Priority Area	y	y			
7B Create a streamside corridor on improved land on both sides of a watercourse	Water Quality Priority Area	y	y			
8 Continued management of an existing streamside corridor	Water Quality Priority Area	y	y			
9A Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Water Quality Priority Area	y	y			
9B Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Water Quality Priority Area	y	y			
14 Commit to 100% slurry injection	Water Quality Priority Area					
14B Commit to 75% slurry injection	Water Quality Priority Area					
15 Grazed permanent pasture with no inputs	Water Quality Priority Area	y	y			
15C Grazed permanent pasture with no inputs and mixed grazing	Water Quality Priority Area	y	y			
16 Upland heath	Water Quality Priority Area	y	y			
17 Blanket Bog	Water Quality Priority Area	y	y			
18 Upland grassland	Water Quality Priority Area	y	y			
19 Lowland marshy grassland	Water Quality Priority Area	y	y			
19B Management of lowland marshy grassland with mixed grazing	Water Quality Priority Area	y	y			
20 Management of lowland and coastal heath	Water Quality Priority Area	y	y			
20B Management of lowland and coastal heath with mixed grazing	Water Quality Priority Area	y	y			
22 Existing haymeadows	Water Quality Priority Area	y	y			
23 Allow small areas of improved land in corners of fields to revert to rough grassland and scrub	Water Quality Priority Area	y	y			
24 Allow woodland edge to develop out into adjoining improved land	Water Quality Priority Area	y	y			
26 Fixed rough grass margins on arable land	Water Quality Priority Area	y	y			
26B Rotational rough grass margin on arable land	Water Quality Priority Area	y	y			
28 Retain winter stubbles	Water Quality Priority Area					
29 Undersown spring cereals next to water courses	Water Quality Priority Area	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
31 Unsprayed spring sown cereals retaining winter stubbles	Water Quality Priority Area	y	y			
34B Unfertilised and unsprayed cereal headland	Water Quality Priority Area	y	y			
36 Buffer existing unfenced in-field ponds	Water Quality Priority Area	y	y			
41A Grazing management of open country	Water Quality Priority Area	y	y			
41B Grazing management of open country with mixed grazing	Water Quality Priority Area	y	y			
100 Woodland - stock exclusion	Water Quality Priority Area		y			
101 Trees and scrub - establishment by planting	Water Quality Priority Area	y	y			
102 Trees and scrub - establishment by natural regeneration	Water Quality Priority Area	y	y			
103 Scrub - stock exclusion	Water Quality Priority Area	y	y			
104 Wood pasture	Water Quality Priority Area	y	y			
115 Lowland dry heath with less than 50% western gorse	Water Quality Priority Area	y	y			
116 Lowland dry heath with more than 50% western gorse	Water Quality Priority Area	y	y			
117 Lowland wet heath with less than 60% purple moor-grass	Water Quality Priority Area	y	y			
118 Lowland wet heath with more than 60% purple moor-grass	Water Quality Priority Area	y	y			
119 Lowland heath habitat expansion - establishment on grassland	Water Quality Priority Area	y	y			
120 Lowland unimproved acid grassland	Water Quality Priority Area	y	y			
121 Lowland unimproved acid grassland - reversion (pasture)	Water Quality Priority Area	y	y			
122 Lowland unimproved acid grassland - reversion (hay cutting)	Water Quality Priority Area	y	y			
123 Lowland unimproved neutral grassland - pasture	Water Quality Priority Area	y	y			
124 Lowland unimproved neutral grassland - haymeadow	Water Quality Priority Area	y	y			
125 Lowland unimproved neutral grassland - reversion (pasture)	Water Quality Priority Area	y	y			
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Water Quality Priority Area	y	y			
128 Lowland unimproved calcareous grassland	Water Quality Priority Area	y	y			
129 Lowland unimproved calcareous grassland - reversion (pasture)	Water Quality Priority Area	y	y			
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Water Quality Priority Area	y	y			
131 Conversion from arable to grassland (no inputs)	Water Quality Priority Area	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Water Quality Priority Area	y	y			
133 Lowland marshy grassland	Water Quality Priority Area	y	y			
134 Lowland marshy grassland - reversion (pasture)	Water Quality Priority Area	y	y			
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Water Quality Priority Area	y	y			
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Water Quality Priority Area	y	y			
141 Lowland bog and other acid mires - restoration (no grazing)	Water Quality Priority Area	y	y			
142 Lowland bog and other acid mires - reversion (pasture)	Water Quality Priority Area	y	y			
143 Lowland fen	Water Quality Priority Area	y	y			
144 Lowland fen - restoration (no grazing)	Water Quality Priority Area					
145 Lowland fen - reversion (pasture)	Water Quality Priority Area					
146 Reedbed - stock exclusion	Water Quality Priority Area					
147 Reedbed - creation	Water Quality Priority Area	y	y			
155 Improve nutrient management through planning and soil sampling	Water Quality Priority Area					
156 Buffer zones to prevent erosion and run-off from grassland	Water Quality Priority Area	y	y			
157 Buffer zones to prevent erosion and run-off from grassland - ditch landscapes	Water Quality Priority Area	y	y			
158 Buffer zones to prevent erosion and run-off from land under arable cropping	Water Quality Priority Area	y	y			
159 Grassland managed with no inputs between 15 October and 31 January	Water Quality Priority Area	y	y			
173 Streamside corridor management	Water Quality Priority Area	y	y			
174 Rough grass buffer zone to prevent erosion and run-off from land under arable cropping	Water Quality Priority Area	y	y			
175 Management of rough grassland - enclosed land	Water Quality Priority Area	y	y			
403 Additional Management Payment - Re-wetting	Water Quality Priority Area	y	y			
404 Additional Management Payment - Re-wetting (improved land)	Water Quality Priority Area	y	y			
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Water Quantity	y	y			
1B Create a 2 metre corridor to include tree and shrub planting on improved land	Water Quantity	y	y			
2 Create a 3 metre corridor to	Water Quantity	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
include earth bank and tree and shrub planting on improved land						
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Water Quantity	y	y			
3 Create a wildlife corridor – Establish wooded strip on improved ground	Water Quantity	y	y			
7A Create a streamside corridor on improved land on one side of a watercourse	Water Quantity	y	y			
7B Create a streamside corridor on improved land on both sides of a watercourse	Water Quantity	y	y			
8 Continued management of an existing streamside corridor	Water Quantity	y	y			
9A Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Water Quantity	y	y			
9B Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Water Quantity	y	y			
15 Grazed permanent pasture with no inputs	Water Quantity	y	y			
15C Grazed permanent pasture with no inputs & mixed grazing	Water Quantity	y	y			
16 Upland heath	Water Quantity	y	y			
17 Blanket Bog	Water Quantity	y	y			
18 Upland grassland	Water Quantity	y	y			
19 Lowland marshy grassland	Water Quantity	y	y			
19B Management of lowland marshy grassland with mixed grazing	Water Quantity	y	y			
20 Management of lowland and coastal heath	Water Quantity	y	y			
20B Management of lowland & coastal heath with mixed grazing	Water Quantity	y	y			
22 Existing haymeadows	Water Quantity	y	y			
23 Allow small areas of improved land in corners of fields to revert to rough grassland and scrub	Water Quantity	y	y			
24 Allow woodland edge to develop out into adjoining improved land	Water Quantity	y	y			
26 Fixed rough grass margins on arable land	Water Quantity	y	y			
26B Rotational rough grass margin on arable land	Water Quantity	y	y			
36 Buffer existing unfenced in-field ponds	Water Quantity	y	y			
41A Grazing management of open country	Water Quantity	y	y			
41B Grazing management of open country with mixed grazing	Water Quantity	y	y			
100 Woodland - stock exclusion	Water Quantity		y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
101 Trees and scrub - establishment by planting	Water Quantity	y	y			
102 Trees and scrub - establishment by natural regeneration	Water Quantity	y	y			
104 Wood pasture	Water Quantity	y	y			
117 Lowland wet heath with less than 60% purple moor-grass	Water Quantity	y	y			
118 Lowland wet heath with more than 60% purple moor-grass	Water Quantity	y	y			
119 Lowland heath habitat expansion - establishment on grassland	Water Quantity	y	y			
120 Lowland unimproved acid grassland	Water Quantity	y	y			
121 Lowland unimproved acid grassland - reversion (pasture)	Water Quantity	y	y			
122 Lowland unimproved acid grassland - reversion (hay cutting)	Water Quantity	y	y			
123 Lowland unimproved neutral grassland - pasture	Water Quantity	y	y			
124 Lowland unimproved neutral grassland - haymeadow	Water Quantity	y	y			
125 Lowland unimproved neutral grassland - reversion (pasture)	Water Quantity	y	y			
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Water Quantity	y	y			
128 Lowland unimproved calcareous grassland	Water Quantity	y	y			
129 Lowland unimproved calcareous grassland - reversion (pasture)	Water Quantity	y	y			
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Water Quantity	y	y			
131 Conversion from arable to grassland (no inputs)	Water Quantity	y	y			
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Water Quantity	y	y			
133 Lowland marshy grassland	Water Quantity	y	y			
134 Lowland marshy grassland - reversion (pasture)	Water Quantity	y	y			
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Water Quantity	y	y			
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Water Quantity	y	y			
141 Lowland bog and other acid mires - restoration (no grazing)	Water Quantity	y	y			
142 Lowland bog and other acid mires - reversion (pasture)	Water Quantity	y	y			
143 Lowland fen	Water Quantity	y	y			
144 Lowland fen - restoration (no grazing)	Water Quantity					

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
145 Lowland fen - reversion (pasture)	Water Quantity					
146 Reedbed - stock exclusion	Water Quantity					
147 Reedbed - creation	Water Quantity	y	y			
149 Saltmarsh - restoration (no grazing)	Water Quantity	y	y			
150 Saltmarsh - creation	Water Quantity					
151 Coastal vegetated shingle and sand dunes - creation	Water Quantity					
156 Buffer zones to prevent erosion and run-off from grassland	Water Quantity	y	y			
157 Buffer zones to prevent erosion and run-off from grassland - ditch landscapes	Water Quantity	y	y			
158 Buffer zones to prevent erosion and run-off from land under arable cropping	Water Quantity	y	y			
173 Streamside corridor management	Water Quantity	y	y			
174 Rough grass buffer zone to prevent erosion & run-off from land under arable cropping	Water Quantity	y	y			
175 Management of rough grassland - enclosed land	Water Quantity	y	y			
7A Create a streamside corridor on improved land on one side of a watercourse	Water Vole	y	y	tba		
7B Create a streamside corridor on improved land on both sides of a watercourse	Water Vole	y	y	tba		
8 Continued management of an existing streamside corridor	Water Vole	y	y	tba		
14 Commit to 100% slurry injection	Water Vole			tba		
14B Commit to 75% slurry injection	Water Vole			tba		
15 Grazed permanent pasture with no inputs	Water Vole	y	y	tba		
15C Grazed permanent pasture with no inputs and mixed grazing	Water Vole	y	y	tba		
16 Upland heath	Water Vole	y	y	tba		
17 Blanket Bog	Water Vole	y	y	tba		
18 Upland grassland	Water Vole	y	y	tba		
19 Lowland marshy grassland	Water Vole	y	y	tba		
19B Management of lowland marshy grassland with mixed grazing	Water Vole	y	y	tba		
20 Management of lowland and coastal heath	Water Vole	y	y	tba		
20B Management of lowland & coastal heath with mixed grazing	Water Vole	y	y	tba		
22 Existing haymeadows	Water Vole	y	y	tba		
26 Fixed rough grass margins on arable land	Water Vole	y	y	tba		
26B Rotational rough grass margin on arable land	Water Vole	y	y	tba		
35 Create a wildlife pond on enclosed improved land	Water Vole	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
35B Create a wildlife pond on enclosed improved land – variable size	Water Vole	y	y	tba		
36 Buffer existing unfenced in-field ponds	Water Vole	y	y	tba		
41A Grazing management of open country	Water Vole	y	y	tba		
41B Grazing management of open country with mixed grazing	Water Vole	y	y	tba		
104 Wood pasture	Water Vole	y	y	tba		
106 Historic parks and gardens	Water Vole			tba		
117 Lowland wet heath with less than 60% purple moor-grass	Water Vole	y	y	tba		
118 Lowland wet heath with more than 60% purple moor-grass	Water Vole	y	y	tba		
119 Lowland heath habitat expansion - establishment on grassland	Water Vole	y	y	tba		
120 Lowland unimproved acid grassland	Water Vole	y	y	tba		
121 Lowland unimproved acid grassland - reversion (pasture)	Water Vole	y	y	tba		
122 Lowland unimproved acid grassland - reversion (hay cutting)	Water Vole	y	y	tba		
123 Lowland unimproved neutral grassland - pasture	Water Vole	y	y	tba		
124 Lowland unimproved neutral grassland - haymeadow	Water Vole	y	y	tba		
125 Lowland unimproved neutral grassland - reversion (pasture)	Water Vole	y	y	tba		
126 Lowland unimproved neutral grassland - reversion (hay cutting)	Water Vole	y	y	tba		
128 Lowland unimproved calcareous grassland	Water Vole	y	y	tba		
129 Lowland unimproved calcareous grassland - reversion (pasture)	Water Vole	y	y	tba		
130 Lowland unimproved calcareous grassland - reversion (hay cutting)	Water Vole	y	y	tba		
131 Conversion from arable to grassland (no inputs)	Water Vole	y	y	tba		
132 Conversion from improved grassland to semi- improved grassland (hay cutting)	Water Vole	y	y	tba		
133 Lowland marshy grassland	Water Vole	y	y	tba		
134 Lowland marshy grassland - reversion (pasture)	Water Vole	y	y	tba		
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Water Vole	y	y	tba		
140 Lowland bog and other acid mires with more than 50% purple moor-grass	Water Vole	y	y	tba		
141 Lowland bog and other acid mires - restoration (no grazing)	Water Vole	y	y	tba		

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
142 Lowland bog and other acid mires - reversion (pasture)	Water Vole	y	y	tba		
143 Lowland fen	Water Vole	y	y	tba		
144 Lowland fen - restoration (no grazing)	Water Vole			tba		
145 Lowland fen - reversion (pasture)	Water Vole			tba		
146 Reedbed - stock exclusion	Water Vole			tba		
147 Reedbed - creation	Water Vole	y	y	tba		
155 Improve nutrient management through planning and soil sampling	Water Vole			tba		
156 Buffer zones to prevent erosion and run-off from grassland	Water Vole	y	y	tba		
157 Buffer zones to prevent erosion and run-off from grassland - ditch landscapes	Water Vole	y	y	tba		
158 Buffer zones to prevent erosion and run-off from land under arable cropping	Water Vole	y	y	tba		
173 Streamside corridor management	Water Vole	y	y	tba		
174 Rough grass buffer zone to prevent erosion & run-off from land under arable cropping	Water Vole	y	y	tba		
175 Management of rough grassland - enclosed land	Water Vole	y	y	tba		
13 Plant individual native trees on improved land	Welsh Clearwing	y	y	y		
101 Trees and scrub - establishment by planting	Welsh Clearwing	y	y	y		
102 Trees and scrub - establishment by natural regeneration	Welsh Clearwing	y	y	y		
103 Scrub - stock exclusion	Welsh Clearwing	y	y	y		
104 Wood pasture	Welsh Clearwing	y	y	y		
16 Upland heath	Wetland (Upland and Lowland Bog and Fen)	y	y			
17 Blanket Bog	Wetland (Upland & Lowland Bog & Fen)	y	y			
18 Upland grassland	Wetland (Upland & Lowland Bog & Fen)	y	y			
19 Lowland marshy grassland	Wetland (Upland & Lowland Bog & Fen)	y	y			
19B Management of lowland marshy grassland with mixed grazing	Wetland (Upland & Lowland Bog & Fen)	y	y			
41A Grazing management of open country	Wetland (Upland & Lowland Bog & Fen)	y	y			
41B Grazing management of open country with mixed grazing	Wetland (Upland & Lowland Bog & Fen)	y	y			
133 Lowland marshy grassland	Wetland (Upland & Lowland Bog & Fen)	y	y			
134 Lowland marshy grassland - reversion (pasture)	Wetland (Upland & Lowland Bog & Fen)	y	y			
139 Lowland bog and other acid mires with less than 50% purple moor-grass	Wetland (Upland & Lowland Bog & Fen)	y	y			
140 Lowland bog and other acid mires with more than 50%	Wetland (Upland & Lowland Bog & Fen)	y	y			

MANAGEMENT OPTIONS AND ADDITIONAL MANAGEMENT PAYMENTS	Target objective	GMEP Habitat Survey (inc. RHS, Ponds & macroinverts)	GMEP Vegetation sampling plots	BRC/ Record-ing Societies	GMEP Invert-ebrate survey	GMEP Bird Survey
purple moor-grass						
141 Lowland bog and other acid mires - restoration (no grazing)	Wetland (Upland & Lowland Bog & Fen)	y	y			
142 Lowland bog and other acid mires - reversion (pasture)	Wetland (Upland & Lowland Bog & Fen)	y	y			
143 Lowland fen	Wetland (Upland & Lowland Bog & Fen)	y	y			
144 Lowland fen - restoration (no grazing)	Wetland (Upland & Lowland Bog & Fen)					
145 Lowland fen - reversion (pasture)	Wetland (Upland & Lowland Bog & Fen)					
146 Reedbed - stock exclusion	Wetland (Upland & Lowland Bog & Fen)					
147 Reedbed - creation	Wetland (Upland & Lowland Bog & Fen)	y	y			
3 Create a wildlife corridor – Establish wooded strip on improved ground	Woodland	y	y			
24 Allow woodland edge to develop out into adjoining improved land	Woodland	y	y			
40 Management of existing fence on stock excluded woodland	Woodland					
100 Woodland - stock exclusion	Woodland		y			
101 Trees and scrub - establishment by planting	Woodland	y	y			
102 Trees and scrub - establishment by natural regeneration	Woodland	y	y			
103 Scrub - stock exclusion	Woodland	y	y			
104 Wood pasture	Woodland	y	y			

Appendix 4.5b: Look-up table linking target objectives and Glastir capital works (from Target checker) to GMEP survey datasets.

Columns containing a 'y' indicate that the respective component of GMEP will record the impact of the Glastir intervention on habitat extent, condition, other relevant ecosystem attributes and on the biodiversity target objective listed in the second column. Only capital works listed in bold in target checker are included i.e. 'those more likely to deliver in a wider range of situations'.

CAPITAL WORKS	Target objective	GMEP Field Survey (inc. RHS, Ponds & macro-inverts)	GMEP Vegetation sampling plots
595 Post & Wire Fencing with Stock Netting	Barbastelle Bat	y	
608 Tree Shelter [60cm with stake]	Barbastelle Bat	y	
611 Trees & Shrubs – transplants	Barbastelle Bat		
612 Trees & Shrubs – Whips	Barbastelle Bat		
613 Basic Re-stocking: <5ha coupe size – over 350m altitude	Barbastelle Bat	y	y
614 Basic Re-stocking: >5 to 20ha coupe size – over 350m altitude	Barbastelle Bat	y	y
615 Basic Re-stocking: >20ha coupe size – over 350m altitude	Barbastelle Bat	y	y
616 Basic Re-stocking: <5ha coupe size – between 250 & 350m altitude	Barbastelle Bat	y	y
617 Re-stocking: >5 to 20ha coupe size – between 250 & 350m altitude	Barbastelle Bat	y	y
618 Basic Re-stocking: >20ha coupe size – between 250 & 350m altitude	Barbastelle Bat	y	y
619 Basic Re-stocking: <5ha coupe size – below 250m altitude	Barbastelle Bat	y	y
620 Basic Re-stocking: >5 to 20ha coupe size – below 250m altitude	Barbastelle Bat	y	y
621 Basic Re-stocking: >20ha coupe size – below 250m altitude	Barbastelle Bat	y	y
622 Enhanced Re-stocking: <5ha coupe size – over 350m altitude	Barbastelle Bat	y	y
623 Enhanced Re-stocking: >5 to 20ha coupe size – over 350m altitude	Barbastelle Bat	y	y
624 Enhanced Re-stocking: >20ha coupe size – over 350m altitude	Barbastelle Bat	y	y
625 Enhanced Re-stocking: <5ha coupe size – between 250 & 350m altitude	Barbastelle Bat	y	y
626 Enhanced Re-stocking: >5 to 20ha coupe size – between 250 & 350m altitude	Barbastelle Bat	y	y
627 Enhanced Re-stocking: >20ha coupe size – between 250 & 350m altitude	Barbastelle Bat	y	y
628 Enhanced Re-stocking: <5ha coupe size – below 250m altitude	Barbastelle Bat	y	y
629 Enhanced Re-stocking: >5 to 20ha coupe size – below 250m altitude	Barbastelle Bat	y	y
630 Enhanced Re-stocking: >20ha coupe size – below 250m altitude	Barbastelle Bat	y	y
595 Post & Wire Fencing with Stock Netting	Bechstein's Bat	y	
608 Tree Shelter [60cm with stake]	Bechstein's Bat	y	
611 Trees & Shrubs – transplants	Bechstein's Bat		
612 Trees & Shrubs – Whips	Bechstein's Bat		
613 Basic Re-stocking: <5ha coupe size – over 350m altitude	Bechstein's Bat	y	y
614 Basic Re-stocking: >5 to 20ha coupe size – over 350m altitude	Bechstein's Bat	y	y

CAPITAL WORKS	Target objective	GMEP Field Survey (inc. RHS, Ponds & macro-inverts)	GMEP Vegetation sampling plots
615 Basic Re-stocking: >20ha coupe size – over 350m altitude	Bechstein's Bat	y	y
616 Basic Re-stocking: <5ha coupe size – between 250 & 350m altitude	Bechstein's Bat	y	y
617 Re-stocking: >5 to 20ha coupe size – between 250 & 350m altitude	Bechstein's Bat	y	y
618 Basic Re-stocking: >20ha coupe size – between 250 & 350m altitude	Bechstein's Bat	y	y
619 Basic Re-stocking: <5ha coupe size – below 250m altitude	Bechstein's Bat	y	y
620 Basic Re-stocking: >5 to 20ha coupe size – below 250m altitude	Bechstein's Bat	y	y
621 Basic Re-stocking: >20ha coupe size – below 250m altitude	Bechstein's Bat	y	y
622 Enhanced Re-stocking: <5ha coupe size – over 350m altitude	Bechstein's Bat	y	y
623 Enhanced Re-stocking: >5 to 20ha coupe size – over 350m altitude	Bechstein's Bat	y	y
624 Enhanced Re-stocking: >20ha coupe size – over 350m altitude	Bechstein's Bat	y	y
625 Enhanced Re-stocking: <5ha coupe size – between 250 & 350m altitude	Bechstein's Bat	y	y
626 Enhanced Re-stocking: >5 to 20ha coupe size – between 250 & 350m altitude	Bechstein's Bat	y	y
627 Enhanced Re-stocking: >20ha coupe size – between 250 & 350m altitude	Bechstein's Bat	y	y
628 Enhanced Re-stocking: <5ha coupe size – below 250m altitude	Bechstein's Bat	y	y
629 Enhanced Re-stocking: >5 to 20ha coupe size – below 250m altitude	Bechstein's Bat	y	y
630 Enhanced Re-stocking: >20ha coupe size – below 250m altitude	Bechstein's Bat	y	y
559 Grip Blocking	Black Grouse		y
656 Heather management by burning	Black Grouse	y	y
657 Heather management by cutting	Black Grouse		
658 Heather Restoration	Black Grouse	y	y
683 Heather cutting & removal	Black Grouse		
551 Establish Red Clover Lay	Brown Banded Carder Bee	y	y
589 Hedge Planting/Coppicing	Brown Banded Carder Bee	y	y
667 Sward Enhancement Using Native Seed	Brown Banded Carder Bee		y
673 Green Hay	Brown Banded Carder Bee		
553 Breaking up field drains	Chough		
559 Grip Blocking	Chough		y
586 Earth Bank Restoration	Chough	y	y
659 Planting Marram Grass	Coastal habitats		y
675 Dune remobilisation	Coastal habitats		
546 Supplementary Bird Feed	Curlew		
553 Breaking up field drains	Curlew		
566 Scrapes	Curlew	y	y
664 Rush / Molinia Management – mechanical control	Curlew	y	y
543 Species Control - Maintenance of Trap (Grey Squirrel/Mink/Rabbit)	Ditch landscape		
544 Species Control – Mink trap payment	Ditch landscape		
555 Ditch Casting	Ditch landscape	y	y

CAPITAL WORKS	Target objective	GMEP Field Survey (inc. RHS, Ponds & macro-inverts)	GMEP Vegetation sampling plots
548 Dormouse nest box	Dormouse		
588 Hedge Laying	Dormouse	y	y
589 Hedge Planting/Coppicing	Dormouse	y	y
613 Basic Re-stocking: <5ha coupe size – over 350m altitude	Dormouse	y	y
614 Basic Re-stocking: >5 to 20ha coupe size – over 350m altitude	Dormouse	y	y
615 Basic Re-stocking: >20ha coupe size – over 350m altitude	Dormouse	y	y
616 Basic Re-stocking: <5ha coupe size – between 250 & 350m altitude	Dormouse	y	y
617 Re-stocking: >5 to 20ha coupe size – between 250 & 350m altitude	Dormouse	y	y
618 Basic Re-stocking: >20ha coupe size – between 250 & 350m altitude	Dormouse	y	y
619 Basic Re-stocking: <5ha coupe size – below 250m altitude	Dormouse	y	y
620 Basic Re-stocking: >5 to 20ha coupe size – below 250m altitude	Dormouse	y	y
621 Basic Re-stocking: >20ha coupe size – below 250m altitude	Dormouse	y	y
622 Enhanced Re-stocking: <5ha coupe size – over 350m altitude	Dormouse	y	y
623 Enhanced Re-stocking: >5 to 20ha coupe size – over 350m altitude	Dormouse	y	y
624 Enhanced Re-stocking: >20ha coupe size – over 350m altitude	Dormouse	y	y
625 Enhanced Re-stocking: <5ha coupe size – between 250 & 350m altitude	Dormouse	y	y
626 Enhanced Re-stocking: >5 to 20ha coupe size – between 250 & 350m altitude	Dormouse	y	y
627 Enhanced Re-stocking: >20ha coupe size – between 250 & 350m altitude	Dormouse	y	y
628 Enhanced Re-stocking: <5ha coupe size – below 250m altitude	Dormouse	y	y
629 Enhanced Re-stocking: >5 to 20ha coupe size – below 250m altitude	Dormouse	y	y
630 Enhanced Re-stocking: >20ha coupe size – below 250m altitude	Dormouse	y	y
556 Enhanced In Ditch Wetland	Freshwater pearl mussel		y
558 Grazing Marsh Bridge	Freshwater pearl mussel		
560 In Ditch Wetland	Freshwater pearl mussel		y
567 Sediment Traps	Freshwater pearl mussel		
569 Sleeping Policemen	Freshwater pearl mussel		
570 Soft Engineering to Reduce River Bank Erosion	Freshwater pearl mussel		
582 Soil Sampling	Freshwater pearl mussel		
656 Heather management by burning	Golden Plover	y	y
657 Heather management by cutting	Golden Plover		
652 Bracken Control - Mechanical Two Cuts/Yr	Grassland fungi	y	y
654 Bramble / Scrub Control - H& Knapsack Spraying	Grassland fungi	y	y
665 Scrub Clearance – h&	Grassland fungi	y	y
666 Scrub Clearance – mechanical	Grassland fungi	y	y
564 Pond Creation	Great Crested Newt	y	y
565 Pond Restoration	Great Crested Newt		y
566 Scrapes	Great Crested Newt	y	y

CAPITAL WORKS	Target objective	GMEP Field Survey (inc. RHS, Ponds & macro-inverts)	GMEP Vegetation sampling plots
580 Removal of coarse fish	Great Crested Newt		
535 Bat Boxes – with lid	Greater Horseshoe Bat		
537 Bat entrance & roosting improvements	Greater Horseshoe Bat		
538 Bat Grilles	Greater Horseshoe Bat		
539 Bat Survey	Greater Horseshoe Bat		
564 Pond Creation	Greater Horseshoe Bat	y	y
565 Pond Restoration	Greater Horseshoe Bat		y
588 Hedge Laying	Greater Horseshoe Bat	y	y
589 Hedge Planting/Coppicing	Greater Horseshoe Bat	y	y
608 Tree Shelter [60cm with stake]	Greater Horseshoe Bat	y	
611 Trees & Shrubs – transplants	Greater Horseshoe Bat		
612 Trees & Shrubs – Whips	Greater Horseshoe Bat		
613 Basic Re-stocking: <5ha coupe size – over 350m altitude	Greater Horseshoe Bat	y	y
614 Basic Re-stocking: >5 to 20ha coupe size – over 350m altitude	Greater Horseshoe Bat	y	y
615 Basic Re-stocking: >20ha coupe size – over 350m altitude	Greater Horseshoe Bat	y	y
616 Basic Re-stocking: <5ha coupe size – between 250 & 350m altitude	Greater Horseshoe Bat	y	y
617 Re-stocking: >5 to 20ha coupe size – between 250 & 350m altitude	Greater Horseshoe Bat	y	y
618 Basic Re-stocking: >20ha coupe size – between 250 & 350m altitude	Greater Horseshoe Bat	y	y
619 Basic Re-stocking: <5ha coupe size – below 250m altitude	Greater Horseshoe Bat	y	y
620 Basic Re-stocking: >5 to 20ha coupe size – below 250m altitude	Greater Horseshoe Bat	y	y
621 Basic Re-stocking: >20ha coupe size – below 250m altitude	Greater Horseshoe Bat	y	y
622 Enhanced Re-stocking: <5ha coupe size – over 350m altitude	Greater Horseshoe Bat	y	y
623 Enhanced Re-stocking: >5 to 20ha coupe size – over 350m altitude	Greater Horseshoe Bat	y	y
624 Enhanced Re-stocking: >20ha coupe size – over 350m altitude	Greater Horseshoe Bat	y	y
625 Enhanced Re-stocking: <5ha coupe size – between 250 & 350m altitude	Greater Horseshoe Bat	y	y
626 Enhanced Re-stocking: >5 to 20ha coupe size – between 250 & 350m altitude	Greater Horseshoe Bat	y	y
627 Enhanced Re-stocking: >20ha coupe size – between 250 & 350m altitude	Greater Horseshoe Bat	y	y
628 Enhanced Re-stocking: <5ha coupe size – below 250m altitude	Greater Horseshoe Bat	y	y
629 Enhanced Re-stocking: >5 to 20ha coupe size – below 250m altitude	Greater Horseshoe Bat	y	y
630 Enhanced Re-stocking: >20ha coupe size – below 250m altitude	Greater Horseshoe Bat	y	y
556 Enhanced In Ditch Wetland	Gwyniad		y
570 Soft Engineering to Reduce River Bank Erosion	Gwyniad		
559 Grip Blocking	Heathland Plants		y
605 Removal of Conifers	Heathland Plants		
656 Heather management by burning	Heathland Plants	y	y
657 Heather management by cutting	Heathland Plants		
658 Heather Restoration	Heathland Plants	y	y

CAPITAL WORKS	Target objective	GMEP Field Survey (inc. RHS, Ponds & macro-inverts)	GMEP Vegetation sampling plots
683 Heather cutting & removal	Heathland Plants		
551 Establish Red Clover Lay	Honey Bee Health	y	y
588 Hedge Laying	Honey Bee Health	y	y
589 Hedge Planting/Coppicing	Honey Bee Health	y	y
667 Sward Enhancement Using Native Seed	Honey Bee Health		y
673 Green Hay	Honey Bee Health		
553 Breaking up field drains	Lapwing		
564 Pond Creation	Lapwing	y	y
566 Scrapes	Lapwing	y	y
664 Rush / Molinia Management – mechanical control	Lapwing	y	y
535 Bat Boxes – with lid	Lesser Horseshoe Bat		
537 Bat entrance & roosting improvements	Lesser Horseshoe Bat		
538 Bat Grilles	Lesser Horseshoe Bat		
539 Bat Survey	Lesser Horseshoe Bat		
564 Pond Creation	Lesser Horseshoe Bat	y	y
565 Pond Restoration	Lesser Horseshoe Bat		y
588 Hedge Laying	Lesser Horseshoe Bat	y	y
589 Hedge Planting/Coppicing	Lesser Horseshoe Bat	y	y
608 Tree Shelter [60cm with stake]	Lesser Horseshoe Bat	y	
611 Trees & Shrubs – transplants	Lesser Horseshoe Bat		
612 Trees & Shrubs – Whips	Lesser Horseshoe Bat		
613 Basic Re-stocking: <5ha coupe size – over 350m altitude	Lesser Horseshoe Bat	y	y
614 Basic Re-stocking: >5 to 20ha coupe size – over 350m altitude	Lesser Horseshoe Bat	y	y
615 Basic Re-stocking: >20ha coupe size – over 350m altitude	Lesser Horseshoe Bat	y	y
616 Basic Re-stocking: <5ha coupe size – between 250 & 350m altitude	Lesser Horseshoe Bat	y	y
617 Re-stocking: >5 to 20ha coupe size – between 250 & 350m altitude	Lesser Horseshoe Bat	y	y
618 Basic Re-stocking: >20ha coupe size – between 250 & 350m altitude	Lesser Horseshoe Bat	y	y
619 Basic Re-stocking: <5ha coupe size – below 250m altitude	Lesser Horseshoe Bat	y	y
620 Basic Re-stocking: >5 to 20ha coupe size – below 250m altitude	Lesser Horseshoe Bat	y	y
621 Basic Re-stocking: >20ha coupe size – below 250m altitude	Lesser Horseshoe Bat	y	y
622 Enhanced Re-stocking: <5ha coupe size – over 350m altitude	Lesser Horseshoe Bat	y	y
623 Enhanced Re-stocking: >5 to 20ha coupe size – over 350m altitude	Lesser Horseshoe Bat	y	y
624 Enhanced Re-stocking: >20ha coupe size – over 350m altitude	Lesser Horseshoe Bat	y	y
625 Enhanced Re-stocking: <5ha coupe size – between 250 & 350m altitude	Lesser Horseshoe Bat	y	y
626 Enhanced Re-stocking: >5 to 20ha coupe size – between 250 & 350m altitude	Lesser Horseshoe Bat	y	y
627 Enhanced Re-stocking: >20ha coupe size – between 250 & 350m altitude	Lesser Horseshoe Bat	y	y
628 Enhanced Re-stocking: <5ha coupe size – below 250m altitude	Lesser Horseshoe Bat	y	y

CAPITAL WORKS	Target objective	GMEP Field Survey (inc. RHS, Ponds & macro-inverts)	GMEP Vegetation sampling plots
629 Enhanced Re-stocking: >5 to 20ha coupe size – below 250m altitude	Lesser Horseshoe Bat	y	y
630 Enhanced Re-stocking: >20ha coupe size – below 250m altitude	Lesser Horseshoe Bat	y	y
606 Restoration Pruning of Orchard Trees	Lichens of Old Wayside Trees and Parklands		
610 Trees – Standards	Lichens of Old Wayside Trees and Parklands		
610 Trees – Standards	Lichens of Old Wayside Trees and Parklands		
652 Bracken Control - Mechanical Two Cuts/Yr	Lowland Grassland	y	y
654 Bramble / Scrub Control - H& Knapsack Spraying	Lowland Grassland	y	y
665 Scrub Clearance – h&	Lowland Grassland	y	y
666 Scrub Clearance – mechanical	Lowland Grassland	y	y
667 Sward Enhancement Using Native Seed	Lowland Grassland		y
673 Green Hay	Lowland Grassland		
652 Bracken Control - Mechanical Two Cuts/Yr	Lowland Heathland	y	y
654 Bramble / Scrub Control - H& Knapsack Spraying	Lowland Heathland	y	y
656 Heather management by burning	Lowland Heathland	y	y
657 Heather management by cutting	Lowland Heathland		
658 Heather Restoration	Lowland Heathland	y	y
683 Heather cutting & removal	Lowland Heathland		
664 Rush / Molinia Management – mechanical control	Marsh Fritillary	y	y
603 Grafting & Budding	Orchard		
606 Restoration Pruning of Orchard Trees	Orchard		
645 M25 & MM111 Orchard Trees plus guard & Stake	Orchard		
608 Tree Shelter [60cm with stake]	Parkland and Wood Pasture	y	
610 Trees – Standards	Parkland and Wood Pasture		
611 Trees & Shrubs – transplants	Parkland and Wood Pasture		
612 Trees & Shrubs – Whips	Parkland and Wood Pasture		
565 Pond Restoration	Parks and Gardens		y
591 Parkland Fencing [iron railings]	Parks and Gardens	y	
592 Parkland Iron Gates	Parks and Gardens		
604 Parkland Tree Stock Guards	Parks and Gardens		
607 Tree Pollarding	Parks and Gardens		
608 Tree Shelter [60cm with stake]	Parks and Gardens	y	
609 Tree Surgery [per day]	Parks and Gardens		
610 Trees – Standards	Parks and Gardens		
611 Trees & Shrubs – transplants	Parks and Gardens		
500 Access - footpaths	Permissive Access	y	
501 Access - footpaths (no dogs)	Permissive Access	y	
502 Access - bridlepath/cyclepath/disabled	Permissive Access	y	
503 Access - bridlepath/cyclepath/disabled (no dogs)	Permissive Access	y	
504 Access - dedicate new public rights of way	Permissive Access		
505 Access - permissive access areas	Permissive Access		
506 Access Bridges	Permissive Access		
507 Access Gates for Disabled People	Permissive Access		

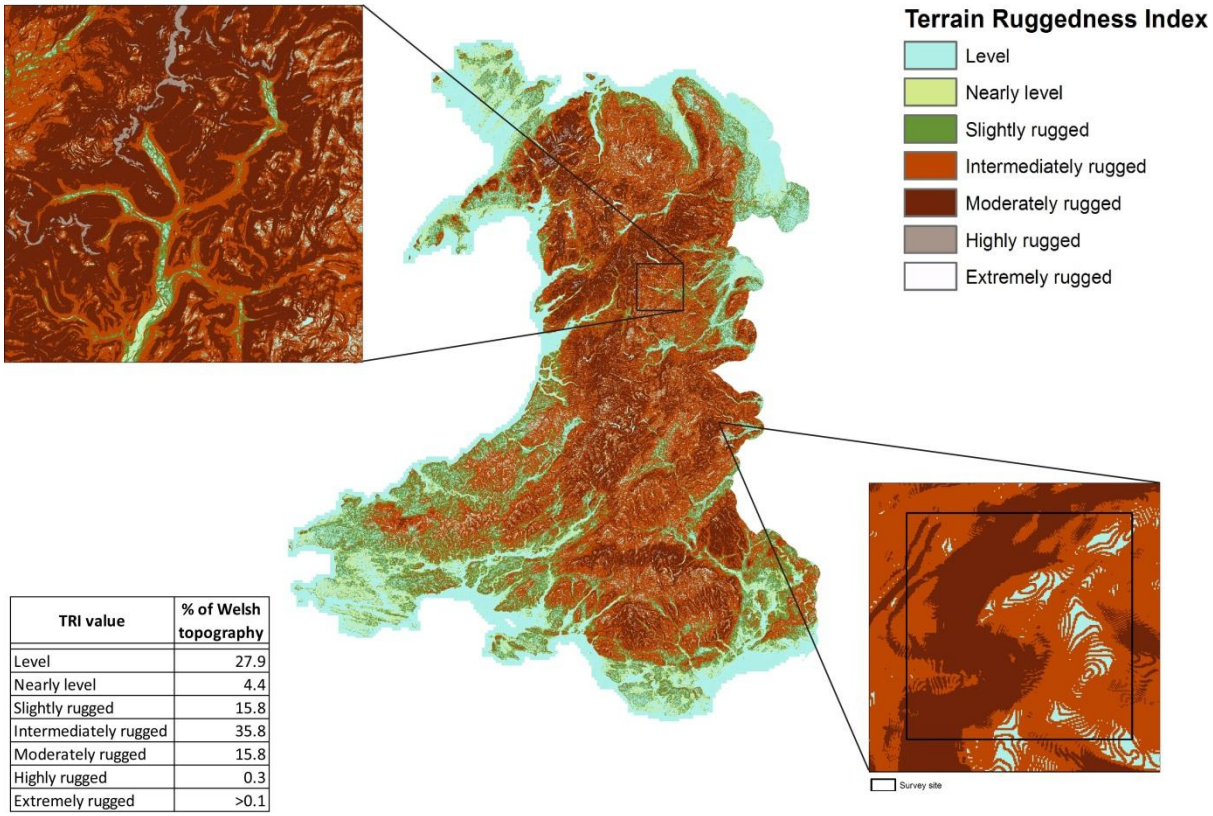
CAPITAL WORKS	Target objective	GMEP Field Survey (inc. RHS, Ponds & macro-inverts)	GMEP Vegetation sampling plots
508 Boardwalks	Permissive Access		
509 Boardwalks – hand rail supplement	Permissive Access		
510 Dog Gate	Permissive Access		
512 Hard Surfacing Footpaths	Permissive Access		
513 Infrastructure for educational access	Permissive Access		
514 Ladder Stile	Permissive Access		
515 Step Stile	Permissive Access		
516 Timber Bridle Gate & Posts	Permissive Access		
517 Timber Kissing Gate & Posts	Permissive Access		
532 Posts for Signs, Waymarks & Boards	Permissive Access		
564 Pond Creation	Pond Landscape	y	y
565 Pond Restoration	Pond Landscape		y
580 Removal of coarse fish	Pond Landscape		
584 Dry Stone Wall - importing stone [additional]	Protected Landscape		
585 Dry Stone Wall Restoration	Protected Landscape	y	
586 Earth Bank Restoration	Protected Landscape	y	y
588 Hedge Laying	Protected Landscape	y	y
589 Hedge Planting/Coppicing	Protected Landscape	y	y
597 Slate Fencing - Restorations	Protected Landscape	y	
598 Stone Faced Earth Banks – repairing & restoring	Protected Landscape	y	
611 Trees & Shrubs – transplants	Protected Landscape		
612 Trees & Shrubs – Whips	Protected Landscape		
652 Bracken Control - Mechanical Two Cuts/Yr	Protected Landscape	y	y
654 Bramble / Scrub Control - H& Knapsack Spraying	Protected Landscape	y	y
680 Restoration of traditional farm buildings	Protected Landscape		
559 Grip Blocking	Rare Plants		y
588 Hedge Laying	Rare Plants	y	y
589 Hedge Planting/Coppicing	Rare Plants	y	y
605 Removal of Conifers	Rare Plants		
652 Bracken Control - Mechanical Two Cuts/Yr	Rare Plants	y	y
664 Rush / Molinia Management – mechanical control	Rare Plants	y	y
656 Heather management by burning	Red Grouse	y	y
657 Heather management by cutting	Red Grouse		
658 Heather Restoration	Red Grouse	y	y
683 Heather cutting & removal	Red Grouse		
542 Species Control - Grey Squirrel Trap payment	Red Squirrel		
543 Species Control - Maintenance of Trap (Grey Squirrel/Mink/Rabbit)	Red Squirrel		
595 Post & Wire Fencing with Stock Netting	Red Squirrel	y	
540 Otter Holts	Sensitive Lakes		
543 Species Control - Maintenance of Trap (Grey Squirrel/Mink/Rabbit)	Sensitive Lakes		
544 Species Control – Mink trap payment	Sensitive Lakes		
580 Removal of coarse fish	Sensitive Lakes		
540 Otter Holts	Sensitive Rivers		

CAPITAL WORKS	Target objective	GMEP Field Survey (inc. RHS, Ponds & macro-inverts)	GMEP Vegetation sampling plots
543 Species Control - Maintenance of Trap (Grey Squirrel/Mink/Rabbit)	Sensitive Rivers		
544 Species Control – Mink trap payment	Sensitive Rivers		
570 Soft Engineering to Reduce River Bank Erosion	Sensitive Rivers		
551 Establish Red Clover Lay	Shrill Carder Bee	y	y
589 Hedge Planting/Coppicing	Shrill Carder Bee	y	y
667 Sward Enhancement Using Native Seed	Shrill Carder Bee		y
673 Green Hay	Shrill Carder Bee		
546 Supplementary Bird Feed	Turtle Dove		
546 Supplementary Bird Feed	Twite		
559 Grip Blocking	Upland Heath		y
605 Removal of Conifers	Upland Heath		
656 Heather management by burning	Upland Heath	y	y
657 Heather management by cutting	Upland Heath		
658 Heather Restoration	Upland Heath	y	y
665 Scrub Clearance – h&	Upland Limestone Grassland	y	y
666 Scrub Clearance – mechanical	Upland Limestone Grassland	y	y
553 Breaking up field drains	Water Quality		
556 Enhanced In Ditch Wetland	Water Quality		y
559 Grip Blocking	Water Quality		y
561 Kerbing	Water Quality		
569 Sleeping Policemen	Water Quality		
570 Soft Engineering to Reduce River Bank Erosion	Water Quality		
582 Soil Sampling	Water Quality		
689 Provision of rainwater goods - guttering	Water Quality		
690 Provision of rainwater goods – down pipe	Water Quality		
691 Relocation of sheep dips including any holding pens to a better site	Water Quality		
553 Breaking up field drains	Water Quality Priority Area		
556 Enhanced In Ditch Wetland	Water Quality Priority Area		y
559 Grip Blocking	Water Quality Priority Area		y
561 Kerbing	Water Quality Priority Area		
569 Sleeping Policemen	Water Quality Priority Area		
570 Soft Engineering to Reduce River Bank Erosion	Water Quality Priority Area		
582 Soil Sampling	Water Quality Priority Area		
689 Provision of rainwater goods - guttering	Water Quality Priority Area		
690 Provision of rainwater goods – down pipe	Water Quality Priority Area		
691 Relocation of sheep dips including any holding pens to a better site	Water Quality Priority Area		
553 Breaking up field drains	Water Quantity		
556 Enhanced In Ditch Wetland	Water Quantity		y
559 Grip Blocking	Water Quantity		y
561 Kerbing	Water Quantity		
569 Sleeping Policemen	Water Quantity		
582 Soil Sampling	Water Quantity		
689 Provision of rainwater goods - guttering	Water Quantity		

CAPITAL WORKS	Target objective	GMEP Field Survey (inc. RHS, Ponds & macro-inverts)	GMEP Vegetation sampling plots
690 Provision of rainwater goods – down pipe	Water Quantity		
543 Species Control - Maintenance of Trap (Grey Squirrel/Mink/Rabbit)	Water Vole		
544 Species Control – Mink trap payment	Water Vole		
555 Ditch Casting	Water Vole	y	y
556 Enhanced In Ditch Wetland	Water Vole		y
564 Pond Creation	Water Vole	y	y
565 Pond Restoration	Water Vole		y
669 Invasive Plant Species control	Water Vole	y	y
608 Tree Shelter [60cm with stake]	Welsh Clearwing	y	
609 Tree Surgery [per day]	Welsh Clearwing		
610 Trees – Standards	Welsh Clearwing		
611 Trees & Shrubs – transplants	Welsh Clearwing		
612 Trees & Shrubs – Whips	Welsh Clearwing		
647 Spiral Rabbit Guards	Welsh Clearwing		
665 Scrub Clearance – h&	Welsh Clearwing	y	y
543 Species Control - Maintenance of Trap (Grey Squirrel/Mink/Rabbit)	Wetland (Upland & Lowland Bog and Fen)		
544 Species Control – Mink trap payment	Wetland (Upland & Lowland Bog and Fen)		
559 Grip Blocking	Wetland (Upland & Lowland Bog and Fen)		y
661 Reed Planting – Bought in seed	Wetland (Upland & Lowland Bog and Fen)	y	y
662 Reed Planting – Seed from existing stands	Wetland (Upland & Lowland Bog and Fen)	y	y
526 Track - New basic - no stone	Woodland	y	
527 Track - New – stone bought in	Woodland	y	
595 Post & Wire Fencing with Stock Netting	Woodland	y	
608 Tree Shelter [60cm with stake]	Woodland	y	
611 Trees & Shrubs – transplants	Woodland		
631 Re-stocking: Broadleaves - PAWS, ASNW & Core & Focal networks	Woodland	y	y
636 Re-spacing natural regeneration to favour native broadleaved species or mixed woodland	Woodland		
637 Scarification to encourage natural regeneration of trees from seed	Woodland		
684 Thin predominantly broadleaf woodland - extract	Woodland		y
685 Thin predominantly broadleaf woodland - waste	Woodland		y
686 Thin predominantly conifer woodland - extract	Woodland	y	y
687 Thin predominantly conifer woodland - waste	Woodland		y

Appendix 6.1 The output Terrain Ruggedness Indicator for Wales modified from Riley et al., 1999.

The TRI value is used as a quantifiable measure of landscape heterogeneity and feeds in to the VQI.

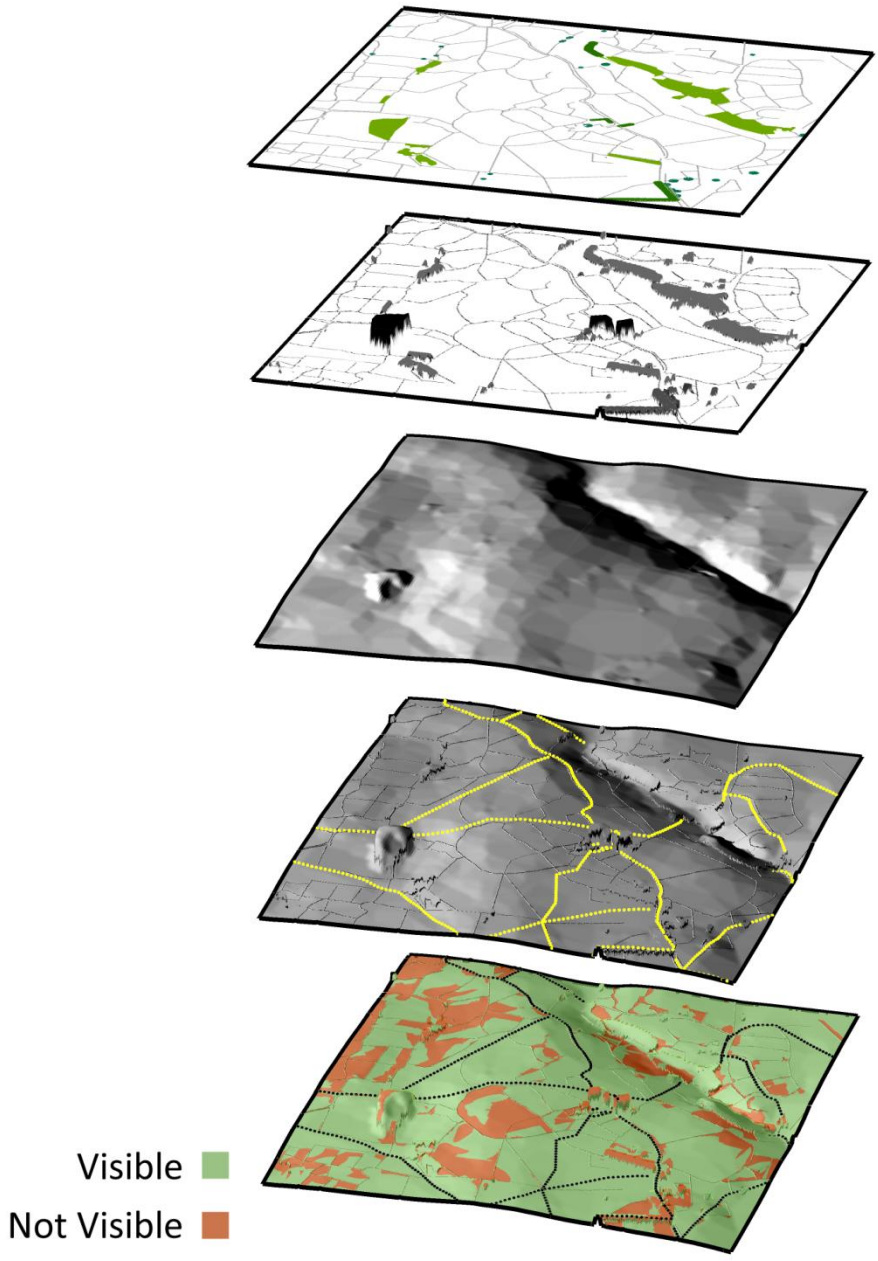


TRI value	% of Welsh topography
Level	27.9
Nearly level	4.4
Slightly rugged	15.8
Intermediately rugged	35.8
Moderately rugged	15.8
Highly rugged	0.3
Extremely rugged	>0.1

Appendix 6.2 The five stages involved in the calculation of the detailed 1km scale viewsheds.

The top diagram shows the baseline mapping with all the elements from the field survey (woodlands, buildings, linear features of height) added. The second map shows these components with their height component added. These values are then added to the third map which shows the baseline digital terrain data (5m resolution) giving a refined output in the fourth map where the detailed structures are apparent. This shows the public footpath network in yellow.

The fifth map shows the output viewshed where the green areas are those that are visible from some point on the public rights of way network and the red are hidden from view. This particular example is calculated for a pedestrian, car drivers would have a much more restricted view as road access is minimal to this site. Parts of the site are obscured behind roadside hedgerows which restrict views whilst other areas can be seen from a number of locations.



Appendix 6.3 The detailed GIS methodology to derive the viewshed datasets. This method has been coded for use within ArcGIS v10

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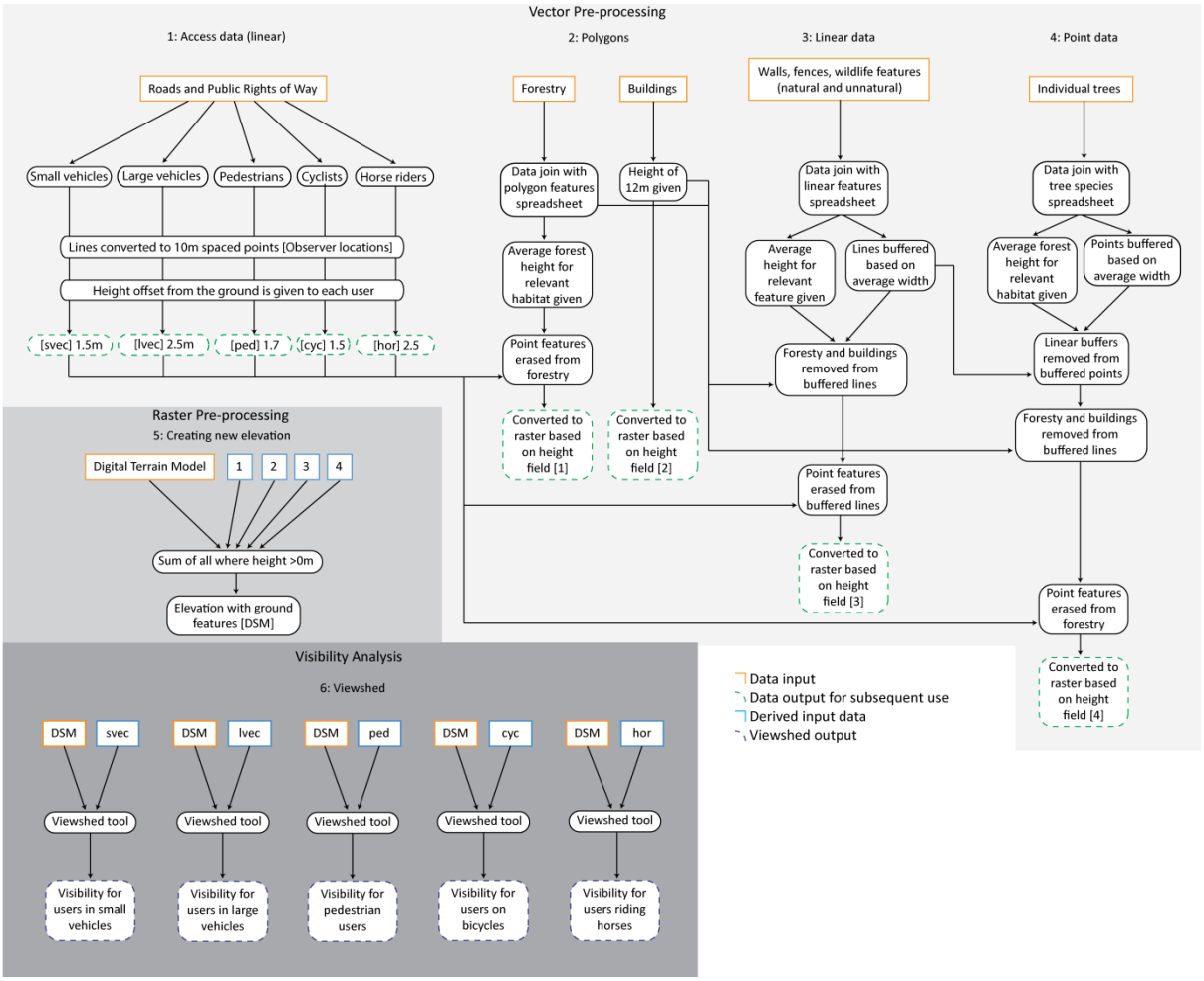


Appendix 6.4 The full range of landscape parameters considered by the Visual Quality Index.

All values are supported by a range of literature sources and have been chosen because they can be quantified objectively. Notes *1 = The method for calculating the TRI is derived from Riley et al., 1991; *2 = The number of species in the parameter classes have not yet been finalised, consultation with ecologists underway; *3 = Unnatural defines land uses defined by human dominated uses, particularly the built environment and includes roads, buildings, industrial units; *4 = Relative classification scheme still being refined; *5 = All historic / cultural elements are currently assumed to be of equal value and judged on presence alone.

Category	Parameter	Classified by….	Possible values	
Terrain	Terrain Ruggedness Index (TRI) *[1]	Dominant level of ruggedness	1	Level
			2	Nearly level
			3	Slightly rugged
			4	Intermediately rugged
			5	Moderately rugged
			6	Highly rugged
			7	Extremely rugged
Blue space	Presence of water	Absent/present	0	Absent
			5	Present
	Extent of water	Standing water area	1	0-20% of square area contains water
			2	21-40%
			3	41-60%
			4	61-80%
			5	81-100%
		Flowing water total length	1	< 100 m
			2	100-500 m
			3	501 m - 1 km
			4	1-2 km
			5	2-3 km
			6	> 3 km
Green space	Diversity of land cover	No. of habitat types represented	1	< 2 land cover types
			2	2-4 land cover types
			3	5-7 land cover types
			4	8-10 land cover types
			5	> 10 land cover types
	Diversity of vegetation species	No. of species present *[2]	1	< 10 species
			2	11-25 species
			3	26-50 species
			4	51-75 species
			5	> 75 species

Category	Parameter	Classified by….	Possible values	
	Colour diversity	No. of contrasting colours present	1	No contrasting colours
			2	2 colours
			3	4 colours
			4	6 colours
			5	> 6 colours
	Presence of livestock	Absent/present	0	Absent
			5	Present
Built	Dominant land use	Area of square covered by human influenced land use	1	81-100% unconverted *[3]
			2	61-80%
			3	41-60%
			4	21-40%
			5	0-20%
			10	Complete absence of built or converted land use types
	"Spot" utilities e.g. pylons, turbines	No. of occurrences within square	0	No occurrences
			2	1-5 occurrences
			5	>5 occurrences
	Buildings/infrastructure	Area of square covered by buildings/infrastructure	TBC	TBC *[4]
	Roads	Total length of road segments	1	< 1 km
			2	1-3 km
			3	3-5 km
			4	5-7 km
			5	7-9 km
			6	> 9 km
Historic/ cultural	Scheduled ancient monuments	Presence/absence	5	Presence within square *[5]
			2	Presence within 3x3 km surround
	Parks/gardens	Presence/absence	5	Presence within square
			2	Presence within 3x3 km surround
	Listed buildings	Presence/absence	2	Individual within square
			2	Individual within 3x3 km surround
			5	Associated with park/garden
	Landscape of outstanding historic beauty	Presence/absence	5	Square falls within
			2	Portion of square or 3x3 km surround falls within

Appendix 6.5: Target Objectives mapped against Glastir management options with the landscape / historic implications outlined.

GLASTIR TARGET	Glastir Management Option	Impact on landscape / historic
Ditch Landscapes	7a, 7b, 8, 173	Management of ditch banks – maintains the "view" of reflective, linear water features.
	10	Conversion of arable - reducing N, P, K runoff and maintaining water quality (clear water ... no algal blooms)
	14, 14b	Slurry injection - reduces surface run-off of NPK fertilisers into ditches (algal blooms)
	22	Maintenance of hay meadows - flowering plants adding colour / biodiversity
	26, 26b, 27, 28, 33,34,34b	Grass & fallow margins / winter stubbles / wildlife crop cover / cereal headlands on arable land. Diversity in the landscape (vegetated strips). Colour. Maintenance of ditch clear water.
	41a, 41b	Maintenance of grazing management in open country - appropriate stocking levels
	120 - 134	Appropriate management of valued lowland acid, neutral and calcareous grassland. Maintenance of grassland biodiversity (flowering plants / associated insects / birds - adding to enjoyment of space)
	146, 147	Management or creation of new reedbeds. Maintains heterogeneity of wetland habitat. Associated biodiversity (water-birds, mammals, invertebrates *etc.*.) "Visible" fauna.
	155-8	Nutrient management - maintains clear ditches (blue space / light / reflections)
Historic Features & Landscapes	1, 1b, 2,2b, 6, 6b	Restoration of hedgerows and wooded wildlife corridors. Hedged boundaries are often very old and significant markers (parish boundaries *etc...*) in addition to acting as species reservoirs for valued plants. These features add structural complexity to a landscape and define field patterns *etc...* Wooded components of the landscape valued for their visual aesthetic.
	10	Cessation of arable farming around archaeological sites and replacing it with grass pasture provides protection for features of historical interest. There is also potential for improved access on grass (rather than field crops).
	11, 12	Orchards are scarce features in the rural landscape, adding colour (from blossom) and interest to the farmed environment. Many valued species of flora and fauna thrive.
	13	Planting of individual native trees - the repopulating of wooded pasture with specimen trees can recreate vistas lost through intensification. Providing vertical structure and habitat.
	39	Management of scrub - removal of invasive growth on historical features. This can have significant landscape benefits, allowing these landscape components to be seen from further afield.
	42a, 42b, 43a, 43b	Restoration of hedgerows and wooded wildlife corridors. Hedged boundaries are often very old and significant markers (parish boundaries *etc.*.) in addition to acting as species reservoirs for valued plants. These features add structural complexity to a land
	104	Wood pasture - maintenance of vertical structure provides heterogeneity in the view. Species diversity tends to be higher than other normal grazed pasture, so the visual complexity of the sites is usually higher.
	173, 175	Streamside corridor management - maintenance of open views of riverine corridors in the landscape is important as such features are valued by landscape users.
Orchards	11, 12, 172	Options relating to orchard management and preservation are important to preserve these rare features of the farmed landscape. Orchards provide blossom (therefore colour changes throughout the season) and are associated with higher levels of flora and fauna.
Parkland & Wood Pasture	13	Planting of native trees - restoring wooded component of these farmed landscapes.
	15, 15c	
	18	
	22	Maintenance of haymeadows - flowering plants adding colour / biodiversity
	41a, 41b	Maintenance of grazing management in open country - appropriate stocking levels
	101, 102, 103, 104, 106	Planting and husbandry of trees and scrub to increase the wooded component of the landscape. Contributes valued "green structure" to the rural scene. Deciduous woodland valued highly in landscape studies.
	120 - 134	Appropriate management of valued lowland acid, neutral and calcareous grassland. Maintenance of grassland biodiversity (flowering plants / associated insects / birds - adding to enjoyment of space)
	146, 147	Management of reedbeds, creation of new reedbeds. Interest and variety of wetland habitat. Associated biodiversity

GLASTIR TARGET	Glastir Management Option	Impact on landscape / historic
	174	Maintenance of unpolluted water habitats within the context of a parkland landscape will contribute to the quality of the view.
Parks & Gardens	6, 6b	Restoration of gappy hedges contributes to landscape cohesiveness and a sense of a managed landscape in a parks & gardens setting.
	10	Cessation of arable farming around archaeological sites and replacing it with grass pasture, provides protection for features of historical interest. There is also potential for improved access on grass (rather than field crops).
	11,	Options relating to orchard management and preservation are important to preserve these rare features of the farmed landscape. Orchards provide blossom (therefore colour changes throughout the season) and are associated with higher levels of flora and fauna.
	13	Planting of native trees - restoring wooded component of these farmed landscapes.
	15, 15c	Grazed PP with low or no inputs. Maintenance of low input grazing - livestock on open areas.
	22	Maintenance of haymeadows - flowering plants adding colour / biodiversity
	39	Management of scrub - removal of invasive growth on historical features. This can have significant landscape benefits, allowing these components to be seen from further afield.
	100	Stock exclusion in woodlands allows native vegetation to regenerate and can protect vulnerable trees from over-browsing or bark damage. Good quality woodlands contribute significantly to landscape quality ratings
	104, 106	Planting and husbandry of trees and scrub to increase the wooded component of the landscape. Contributes valued "green structure" to the rural scene. Deciduous woodland valued highly in landscape studied
	120-132	Appropriate management of valued lowland acid, neutral and calcareous grassland. Maintenance of grassland biodiversity (flowering plants / associated insects / birds - adding to enjoyment of space)
	146, 147	Management of reedbeds, creation of new reedbeds. Interest and variety of wetland habitat. Associated biodiversity
	173	Streamside corridor management - maintenance of open views of riverine corridors in the landscape is important as such features are valued by landscape users.
	400	Stock management options - livestock (rare breeds included) are associated with parkland landscapes. Appropriate use of grazing livestock to maintain the open grasslands of these areas is valued.
Permissive Access	46a-c	Maintenance of access - the PROW network is key to public access and enjoyment of any landscape.
Pond Landscap	35, 35b, 36	Increase in the distribution and number of ponds contributes to the colour, light, reflectivity and preference rating given to most landscapes. Water also acts as an attractor to wildlife which in itself is a valued component of a rural environment. Management of farm ponds is particularly important to ensure they are kept open and clear of rubbish and scrub and free of pollution from farm run-off which can cause algal growth and a "greening" of the water which reduces its attractiveness to viewers.
Protected Landscapes	1, 1b, 2,2b, 6, 6b	Restoration of hedgerows and wooded wildlife corridors. Hedged boundaries are often very old and significant markers (parish boundaries *etc...*) in addition to acting as species reservoirs for valued plants. These features add structural complexity to a landscape and define field patterns *etc...* Wooded components of the landscape valued for their visual aesthetic.
	13	Planting of native trees - restoring wooded component of these farmed landscapes.
	15, 15c	Grazed PP with low or no inputs. Maintenance of grazing landscape - livestock on open areas.
	19, 19b	Lowland marsh is an open landscape with wider views and more distant horizons. It should contain elements of water and vegetation which define its sense of place. Restoration and management can provide opportunities for flat access and recreational enjoyment of such habitats with close contact to many valued components of biodiversity (insects such as dragonflies, butterflies, birds, small mammals)
	22	Maintenance of haymeadows - flowering plants adding colour / biodiversity
	24	Allowing woodland edges to expand out onto improved land will have medium to long term

GLASTIR TARGET	Glastir Management Option	Impact on landscape / historic
		impacts on landscape. Wooded structure has a significant impact on the length of view and the quality of that view.
	40, 100	Stock exclusion in woodlands allows native vegetation to regenerate and can protect vulnerable trees from over-browsing or bark damage. Good quality woodlands contribute significantly to landscape quality ratings
	41a, 41b	Grazed PP with low or no inputs. Maintenance of grazing landscape - livestock on open areas to maintain open, landscape character. Important in semi-improved landscapes where stock removal can lead to damaging scrub / bracken / bramble invasion which can hide geological features and archaeological features of value.
	42a, 42b, 43a, 43b,	Restoration of hedgerows and wooded wildlife corridors. Hedged boundaries are often very old and significant markers (parish boundaries *etc.*.) in addition to acting as species reservoirs for valued plants. These features add structural complexity to a land
	44	Bracken control can be of significant importance for the landscape context of historic features - many earthworks can be totally hidden by such growth, significantly degrading landscape character. In addition, bracken invasion can impede public rights of way and reduce access.
	101,102, 103, 104,	Planting and husbandry of trees and scrub to increase the wooded component of the landscape. Contributes valued "green structure" to the rural scene. Deciduous woodland valued highly in landscape studied
	164, 171, 175	Grassland management for bird species - notable species are valued, mobile components of grassland landscapes
	400, 401	Stock management options - livestock (rare breeds included) are associated with parkland landscapes. Appropriate use of grazing livestock to maintain the open grasslands of these areas is valued.
	404	Re-wetting of improved land usually designed to improve floral biodiversity. Can lead to greater diversity of plants and increased heterogeneity of the landscape.
Woodland	3	Creation of a wooded wildlife corridor on improved land can increase the vertical structure present in an open landscape, so improving the heterogeneity / complexity of the view.
	24	Allowing woodland edges to expand out onto improved land will have medium to long term impacts on landscape. Wooded structure has a significant impact on the length of view and the quality of that view.
	40	Stock exclusion in woodlands allows native vegetation to regenerate and can protect vulnerable trees from over-browsing or bark damage. Good quality woodlands contribute significantly to landscape quality ratings
	101, 102, 103, 104	Planting and husbandry of trees and scrub to increase the wooded component of the landscape. Contributes valued "green structure" to the rural scene. Deciduous woodland valued highly in landscape studied

Appendix 7.1. Developing framework for integrated analysis of Biodiversity and environmental responses with Glastir options

Glastir measure	Glastir Targets and proxies	GMEP approach for reporting
1 Create a 3 metre corridor to include tree and shrub planting on improved land	Barbastelle Bat, Bechstein's Bat, Brown Banded Carder Bee, Dormouse, Great Crested Newt, Greater Horseshoe Bat, Historic features and landscape, Lesser Horseshoe Bat, Protected Landscape, rare plants, Red squirrel, Shrill Carder bee, Water quantity	GMEP survey will map tree planting on improved land and identify dominant species. Extent and condition data can be used in analysis of contribution to landscape and historic features (but not permitted on a SAM). Rare plants may be recorded in GMEP vegetation plots and woody species diversity recorded in D plots, Water quantity recorded through GMEP survey (e.g. soil moisture of adjacent field) can be combined with external information from the EA or flood risk maps to analyse impacts. Presence of Bat boxes is recorded in GMEP survey. Invertebrate pollinators sampled. Other species data could be incorporated from BRC.
1B Create a 2 metre corridor to include tree & shrub planting on improved land	Barbastelle Bat, Bechstein's Bat, Brown Banded Carder Bee, Dormouse, Great Crested Newt, Greater Horseshoe Bat, Historic features and landscape, Lesser Horseshoe Bat, Protected Landscape, rare plants, Red squirrel, Shrill Carder bee, Water quantity	as above
2 Create a 3 metre corridor to include earth bank and tree and shrub planting on improved land	Barbastelle Bat, Bechstein's Bat, Brown Banded Carder Bee, Dormouse, Freshwater pearl mussel, Great Crested Newt, Greater Horseshoe Bat, Historic features and landscape, Lesser Horseshoe Bat, Protected Landscape, rare plants, Red squirrel, Shrill Carder bee, Water quantity	GMEP survey records earth banks and tree planting (as woody linear features) on improved land, can be used in analysis of contribution to landscape and historic features (not on SAM). Rare plants may be recorded in GMEP vegetation plots and diversity of woody species in D plots, Water quantity recorded through GMEP survey (e.g. soil moisture of adjacent field) can be combined with external information from the EA or flood risk maps to analyse impacts. Presence of Bat boxes is recorded in GMEP survey. Invertebrate pollinators sampled. Other species data incorporated from BRC.
2B Create a 2 metre corridor to include earth bank and tree and shrub planting on improved land	Barbastelle Bat, Bechstein's Bat, Brown Banded Carder Bee, Dormouse, Freshwater pearl mussel, Great Crested Newt, Greater Horseshoe Bat, Historic features and landscape, Lesser Horseshoe Bat, Protected Landscape, rare plants, Red squirrel, Shrill Carder bee, Water quantity	as above
3 Create a wildlife corridor – Establish wooded strip on improved ground	Barbastelle Bat, Bechstein's Bat, Ditch landscape, Dormouse, Freshwater pearl mussel, Great Crested Newt, Greater Horseshoe Bat, Lesser Horseshoe Bat, Protected Landscape, rare plants, Red squirrel, Sensitive lakes, Sensitive rivers, Turtle dove, Water quantity, Woodland	GMEP maps the wildlife corridor strip as an area, dominant species and use data recorded. Will contribute to calculation of woodland extent. Linear features surrounding corridor will also be recorded. GMEP vegetation plots may record rare plants and GMEP plant data contributes to Woodland condition measures. Water quality of rivers measured by GMEP freshwater survey, complemented by EA data for rivers and lakes. Water quantity recorded through GMEP survey (e.g. soil moisture of adjacent field) can be combined with external information from the EA or flood risk maps to analyse impacts. Invertebrate pollinators sampled. Presence of Bat boxes is recorded in GMEP survey. Other species data incorporated from BRC and specific recording schemes.

Glastir measure	Glastir Targets and proxies	GMEP approach for reporting
4 Simple hedgerow management (on both sides)	Brown Banded Carder Bee, rare plants, Red squirrel, Shrill Carder bee	GMEP survey records detailed information on hedgerows, management type, species composition. Invertebrate pollinators sampled. GMEP vegetation plots may record rare plants. Other species data incorporated from BRC and specific recording schemes.
4B Hedgerow management of external boundary hedges (on side only)	Brown Banded Carder Bee, rare plants, Red squirrel, Shrill Carder bee	as above
5 Enhanced hedgerow management (on both sides)	Barbastelle Bat, Bechstein's Bat, Brown Banded Carder Bee, Dormouse, Greater Horseshoe Bat, Lesser Horseshoe Bat, Shrill Carder bee	GMEP survey records detailed information on hedgerows, management type, species composition. Invertebrate pollinators sampled. Presence of bat boxes recorded. GMEP vegetation plots may record rare plants. Other species data incorporated from BRC and specific recording schemes.
6 Double fence gappy hedges	Barbastelle Bat, Bechstein's Bat, Brown Banded Carder Bee, Dormouse, Great crested newt, Greater Horseshoe Bat, Historic features and landscape, Lesser Horseshoe Bat, Lichens of Old Wayside trees and parklands, Parks and gardens, Protected Landscape, Rare plants, Red squirrel, Shrill Carder bee	GMEP survey records detailed information on hedgerows, management type, species composition. Invertebrate pollinators sampled. Presence of bat boxes recorded. GMEP vegetation plots may record rare plants. Other species data incorporated from BRC and specific recording schemes.
6B Double fence gappy hedgerows at a 2 metre width (1 metre from centre)	Barbastelle Bat, Bechstein's Bat, Brown Banded Carder Bee, Dormouse, Great crested newt, Greater Horseshoe Bat, Historic features and landscape, Lesser Horseshoe Bat, Lichens of Old Wayside trees and parklands, Parks and gardens, Protected Landscape, Rare plants, Red squirrel, Shrill Carder bee	as above
7A Create a streamside corridor on improved land on one side of a watercourse	Barbastelle Bat, Bechstein's Bat, Ditch landscape, Freshwater pearl mussel, Great crested newt, Greater Horseshoe Bat, Gwyniad, Lesser Horseshoe Bat, Sensitive lakes, Sensitive rivers, Water Quality, Water Quality Priority Area, Water quantity, Water vole	GMEP maps the stream and any fencing as linear features, adjacent land mapped as area with dominant species and use data recorded. GMEP vegetation SW, P and boundary plots may record rare plants. Water quality of streams measured by GMEP freshwater survey, complemented by EA data for rivers and lakes, River Habitats Survey records detail on streamside corridor. Water quantity recorded through GMEP survey (e.g. soil moisture) can be combined with external information such as flood risk maps to analyse impacts. Invertebrate pollinators sampled. Other species data incorporated from BRC and specific recording schemes.
7B Create a streamside corridor on improved land on both sides of a watercourse	Barbastelle Bat, Bechstein's Bat, Ditch landscape, Freshwater pearl mussel, Great crested newt, Greater Horseshoe Bat, Gwyniad, Lesser Horseshoe Bat, Sensitive lakes, Sensitive rivers, Water Quality, Water Quality Priority Area, Water quantity, Water vole	as above
8 Continued management of an existing streamside corridor	Barbastelle Bat, Bechstein's Bat, Ditch landscape, Freshwater pearl mussel, Great crested newt, Greater Horseshoe Bat, Gwyniad, Lesser Horseshoe Bat, Sensitive lakes, Sensitive rivers, Water Quality, Water Quality Priority Area, Water quantity, Water vole	as above

Glastir measure	Glastir Targets and proxies	GMEP approach for reporting
9A Create a new streamside corridor on improved land with tree planting on one side of a watercourse	Barbastelle Bat, Bechstein's Bat, Freshwater pearl mussel, Greater Horseshoe Bat, Gwyniad, Lesser Horseshoe Bat, Sensitive lakes, Sensitive rivers, Water Quality, Water Quality Priority Area, Water quantity, Water vole	GMEP maps the stream and any fencing as linear features, adjacent land mapped as area with dominant species and use data recorded. Tree species planted recorded as point, linear or area features according to patch size. GMEP vegetation SW, P and boundary plots may record rare plants. Water quality of streams measured by GMEP freshwater survey, complemented by EA data for rivers and lakes, River Habitats Survey records detail on streamside corridor. Water quantity recorded through GMEP survey (e.g. soil moisture of adjacent field) can be combined with external information from the EA or flood risk maps to analyse impacts. Invertebrate pollinators sampled. Other species data incorporated from BRC and specific recording schemes.
9B Create a new streamside corridor on improved land with tree planting on both sides of a watercourse	Barbastelle Bat, Bechstein's Bat, Freshwater pearl mussel, Greater Horseshoe Bat, Gwyniad, Lesser Horseshoe Bat, Sensitive lakes, Sensitive rivers, Water Quality, Water Quality Priority Area, Water quantity, Water vole	as above
11 Restore a traditional orchard	Barbastelle Bat, Bechstein's Bat, Grassland fungi, Greater Horseshoe Bat, Historic Features and Landscape, Honey Bee Health, Lesser Horseshoe Bat, Lichens of Old Wayside Trees and Parklands, orchard, Parks and gardens	GMEP maps orchard as a priority habitat, records information on dominant species and management. There may be GMEP X or Y plots in the orchard. Bird and bat boxes are recorded. GMEP pollinator survey samples bees and other pollinators. Other species data incorporated from BRC and specific recording schemes.
12 Create a new orchard on improved land	Barbastelle Bat, Bechstein's Bat, Grassland fungi, Greater Horseshoe Bat, Historic Features and Landscape, Honey Bee Health, Lesser Horseshoe Bat, Lichens of Old Wayside Trees and Parklands, orchard,	GMEP survey can record the progression of the orchard from tree planting on improved land to mature orchard. GMEP mapping will map orchard extent and record dominant species. There may be GMEP X or Y plots in the orchard. Bird and bat boxes are recorded. GMEP pollinator survey samples bees and other pollinators. Other species data incorporated from BRC and specific recording schemes.
13 Plant individual native trees on improved land	Barbastelle Bat, Bechstein's Bat, Greater Horseshoe Bat, Historic Features and Landscape, Lesser Horseshoe Bat, Lichens of Old Wayside Trees and Parklands, Parkland and Wood Pasture, Parks and gardens, Protected Landscape, Welsh Clearwing	GMEP maps planted trees on improved land and later when they reach a certain height individual trees. GMEP vegetation plots may sample the underlying land and detect changes in rare species. Other species data incorporated from BRC and specific recording schemes.
24 Allow woodland edge to develop out into adjoining improved land	Barbastelle Bat, Bechstein's Bat, Dormouse, Great crested newt, Greater Horseshoe Bat, Lesser Horseshoe Bat, Lichens of Old Wayside Trees and Parklands, Protected Landscapes, Red squirrel, Water Quality, Water Quality Priority Area, Water quantity, Woodland	GMEP maps area of woodland and records dominant species from canopy and ground flora, along with attributes describing management or use e.g. tree protectors, deer grazing, presence of bat boxes. GMEP X or Y plots may be recorded. In the plots, vegetation height, plant species composition and other plant traits can be recorded/calculated. Water quality of streams measured by GMEP freshwater survey, complemented by EA data for rivers and lakes. Water quantity recorded through GMEP survey (e.g. soil moisture of adjacent field) can be combined with external information from the EA or flood risk maps to analyse impacts. Other species data incorporated from BRC and specific recording schemes.

Glastir measure	Glastir Targets and proxies	GMEP approach for reporting
40 Management of existing fence on stock excluded woodland	Dormouse, Great crested newt, Lichens of Old Wayside Trees and Parklands, Protected Landscape, Red squirrel, Woodland	This has to be a large woodland patch identified by NFI >0.5 ha. Area and dominant species are mapped along with attributes describing management or use (see above), the fence will be mapped as a linear feature. GMEP X or Y plots may be recorded. In the plots, vegetation height, plant species composition and other plant traits can be recorded/calculated. Other species data incorporated from BRC and specific recording schemes.
42A Hedgerow restoration with fencing	Barbastelle Bat, Bechstein's Bat, brown banded carder bee, Dormouse, Great crested newt, Greater Horseshoe Bat, Historic Features and Landscape, Lesser Horseshoe Bat, Lichens of Old Wayside Trees and Parklands, Protected Landscape, Rare plants, Red squirrel, Shrill Carder Bee	GMEP survey records detailed information on hedgerows, management type, species composition in mapping system. Fences will be recorded as linear features. Invertebrate pollinators sampled. GMEP B, H and D vegetation plots may record rare plants as well as overall diversity. Other species data incorporated from BRC and specific recording schemes. Mapping data will be analysed to look at hedgerows within the landscape.
42B Hedgerow restoration without fencing	Barbastelle Bat, Bechstein's Bat, brown banded carder bee, Dormouse, Great crested newt, Greater Horseshoe Bat, Historic Features and Landscape, Lesser Horseshoe Bat, Lichens of Old Wayside Trees and Parklands, Protected Landscape, Rare plants, Red squirrel, Shrill Carder Bee	GMEP survey records detailed information on hedgerows, management type, species composition etc. in mapping system. Invertebrate pollinators sampled. GMEP B, H and D vegetation plots may record rare plants as well as overall diversity. Other species data incorporated from BRC and specific recording schemes. Mapping data will be analysed to look at hedgerows within the landscape.
43A Double fence restored hedge banks with planting	Barbastelle Bat, Bechstein's Bat, brown banded carder bee, Dormouse, Freshwater Pearl Mussel, Great crested newt, Greater Horseshoe Bat, Historic Features and Landscape, Lesser Horseshoe Bat, Lichens of Old Wayside Trees and Parklands, Protected Landscape, Rare plants, Red squirrel, Shrill Carder Bee	GMEP survey records detailed information on hedgerows and associated earth banks, management type, species composition etc. in mapping system. Fences will be recorded as linear features. Planted trees will be recorded and tree growth detected over time. Invertebrate pollinators sampled. GMEP B, H and D vegetation plots may record rare plants as well as overall diversity. Other species data incorporated from BRC and specific recording schemes. Mapping data will be analysed to look at hedgerows within the landscape.
43B Double fence restored hedge banks without planting	Barbastelle Bat, Bechstein's Bat, brown banded carder bee, Dormouse, Freshwater Pearl Mussel, Greater Horseshoe Bat, Historic Features and Landscape, Lesser Horseshoe Bat, Protected Landscape, Rare plants, Red squirrel, Shrill Carder Bee	GMEP survey records detailed information on hedgerows and associated earth banks, management type, species composition etc. in mapping system. Fences will be recorded as linear features. Invertebrate pollinators sampled. GMEP B, H and D vegetation plots may record rare plants as well as overall diversity. Other species data incorporated from BRC and specific recording schemes. Mapping data will be analysed to look at hedgerows within the landscape.
46A Maintenance of linear permissive access - existing Tir Gofal bridleway	Permissive access	Footpaths are mapped as linear features in the mapping software, may need to add fields for collecting additional information e.g. Ease of access, nature of obstruction. GMEP bird surveyors have collected information on the status of footpaths within squares.
46B Maintenance of linear permissive access - existing Tir Gofal footpath	Permissive access	Footpaths are mapped as linear features in the mapping software, may need to add fields for collecting additional information e.g. Ease of access, nature of obstruction. GMEP bird surveyors have collected information on the status of footpaths within squares.

Glastir measure	Glastir Targets and proxies	GMEP approach for reporting
46C Maintenance of linear permissive access - existing Tir Gofal disabled access	Permissive access	Footpaths are mapped as linear features in the mapping software, may need to add fields for collecting additional information e.g. Ease of access, nature of obstruction. GMEP bird surveyors have collected information on the status of footpaths within squares.
100 Woodland - stock exclusion	Barbastelle Bat, Bechstein's Bat, Dormouse, Greater Horseshoe Bat, Lesser Horseshoe bat, Lichens of Old Wayside Trees and Parklands, Parks and gardens Protected Landscape, Red squirrel, Water Quality, Water Quality Priority Area, Water quantity, Woodland	Area and dominant species are mapped along with attributes describing management or use, the fence will be mapped as a linear feature. GMEP X or Y plots may be recorded. In the plots, vegetation height, plant species composition and other plant traits can be recorded/calculated. Other species data incorporated from BRC and specific recording schemes. The impact on change in woodland condition on water quality and quantity can be measured using GMEP and EA water quality data, additional products assessing flood risks, soil data.
101 Trees and scrub - establishment by planting	Barbastelle Bat, Bechstein's Bat, Dormouse, Great crested newt, Greater Horseshoe Bat, Gwyniad, Lesser Horseshoe bat, Parks and gardens, Protected Landscape, Sensitive Lakes, Sensitive rivers, Water Quality, Water Quality Priority Area, Water quantity, Welsh Clearwing, Woodland	Area and dominant species are mapped along with attributes describing management or use and whether regeneration natural or planted. GMEP X or Y plots may be recorded. In the plots, vegetation height, plant species composition and other plant traits can be recorded/calculated. Other species data incorporated from BRC and specific recording schemes. The impact on change in woodland condition on water quality and quantity can be measured using GMEP and EA water quality data, additional products assessing flood risks, soil data.
102 Trees and scrub - establishment by natural regeneration	Barbastelle Bat, Bechstein's Bat, Dormouse, Great crested newt, Greater Horseshoe Bat, Gwyniad, Lesser Horseshoe bat, Lichens of Old Wayside Trees and Parklands, Parkland and Wood Pasture, Protected Landscape, Sensitive Lakes, Sensitive rivers, Water Quality, Water Quality Priority Area, Water quantity, Welsh Clearwing, Woodland	as above
103 Scrub - stock exclusion	Barbastelle Bat, Bechstein's Bat, Dormouse, Great crested newt, Greater Horseshoe Bat, Gwyniad, High brown Fritillary, Lesser Horseshoe bat, Lichens of Old Wayside Trees and Parklands, Pearl bordered Fritillary, Protected Landscape, Sensitive Lakes, Sensitive rivers, Water Quality, Water Quality Priority Area, Welsh Clearwing, Woodland	Area and dominant species are mapped along with attributes describing management or use, the fence will be mapped as a linear feature. GMEP X or Y plots may be recorded. In the plots, vegetation height, plant species composition and other plant traits can be recorded/calculated. Other species data incorporated from BRC and specific recording schemes. The impact on change in woodland condition on water quality and quantity can be measured using GMEP and EA water quality data, additional products assessing flood risks, soil data.
104 Wood pasture	Barbastelle Bat, Bechstein's Bat, Grassland fungi, Great crested newt, Greater Horseshoe Bat, Historic features and landscape, Lesser Horseshoe bat, Lichens of Old Wayside Trees and Parklands, Parkland and Wood Pasture, Parks and Gardens, Protected Landscape, Water Quality, Water Quality Priority Area, Water quantity, Water vole, Welsh Clearwing, Woodland	Area and dominant species are mapped along with attributes describing management or use, including sward height and degree of tussockiness. GMEP X or Y plots may be recorded. In the plots, vegetation height, plant species composition and other plant traits can be recorded/calculated. Other species data incorporated from BRC and specific recording schemes. The impact on change in woodland condition on water quality and quantity can be measured using GMEP and EA water quality data, additional products assessing flood risks, soil data.

Glastir measure	Glastir Targets and proxies	GMEP approach for reporting
172 Orchard management	Barbastelle Bat, Bechstein's Bat, Grassland fungi, Greater Horseshoe Bat, Historic features and landscape, Honey Bee health, Lesser Horseshoe bat, Lichens of Old Wayside Trees and Parklands, Orchard, Parks and gardens, Sensitive Lakes, Sensitive rivers	GMEP maps orchard as a priority habitat, records information on dominant species and management. There may be GMEP X or Y plots in the orchard. Bird and bat boxes are recorded. GMEP pollinator survey samples bees and other pollinators. Other species data incorporated from BRC and specific recording schemes. The impact of orchard management on water quality and quantity will be analysed using GMEP freshwater data and EA data.
173 Streamside corridor management	Barbastelle Bat, Bechstein's Bat, Ditch landscape, Freshwater pearl mussel, Great crested newt, Greater Horseshoe Bat, Gwyniad, Lesser Horseshoe bat, Sensitive Lakes, Sensitive rivers, Water Quality, Water Quality priority area, Water quantity, Water vole	GMEP maps the stream and any fencing as linear features, adjacent land mapped as area with dominant species and use data recorded. Tree species planted recorded as point, linear or area features according to patch size. GMEP vegetation SW, P and boundary plots may record rare plants. Water quality of streams measured by GMEP freshwater survey, complemented by EA data for rivers and lakes, River Habitats Survey records detail on streamside corridor. Water quantity recorded through GMEP survey (e.g. soil moisture of adjacent field) can be combined with external information from the EA or flood risk maps to analyse impacts. Invertebrate pollinators sampled. Other species data incorporated from BRC and specific recording schemes.

Appendix 7.2 Definitions of woodlands used in recent surveys taken from Quine et al. 2011

Table 8.1 Definitions of woodland used in recent surveys.

UK BAP Broad Habitats*	Countryside Survey 2007	National Inventory of Woodlands and Trees†	Food and Agriculture Organization 2005	Native Woodland Survey of Scotland	Ancient Woodland Inventories (AWI)
Definition of woodland					
Vegetation dominated by trees >5 m in height when mature; >20% canopy cover.	Trees and shrubs >1 m in height (from vegetation key 2007) with >25% canopy cover; felled or recently planted woodland not included. Minimum area of woodland 400 m^2, minimum width 5 m.	A minimum area of 0.5 ha; and a minimum width of 20 m; tree crown cover ≥20% or the potential to achieve it; a minimum height of 2 m, or the potential to achieve it.	Trees >5 m in height in areas >0.5 ha; canopy cover >10%; minimum width 20 m or able to make these thresholds *in situ*. Does not include agro-forestry or parks and gardens.	Wooded polygons larger than 0.5 ha with a canopy cover of ≥20% of which ≥40% is native species.	Areas ≥2 ha marked as woodland on 1920s base maps and supporting woodland since at least 1600 in England and Wales, 1750 in Scotland, 1830 in Northern Ireland¶ (date under review in Wales). Woods less than 2 ha were considered in the Northern Ireland inventory and in more recent revisions to the inventory in south-east England and Wales.
Definition of woodland types					
Coniferous woodland >80% of canopy comprising conifer species; includes areas temporarily cleared of woodland. **Broadleaved, mixed and yew woodland** >20% canopy to be dominated by broadleaved species or yew; woody scrub <5 m tall included in some circumstances.	Divided by UK BAP woodland broad habitats; coniferous woodland and broadleaved woodland.	Indicative forest types interpreted from aerial photographs: broadleaved, conifer, mixed conifer, mixed broadleaved, young trees, scrub, felled.	**Other wooded land** Land not classified as forest, spanning >0.5 ha; with trees >5 m tall and a canopy cover of 5–10%, or trees able to reach these thresholds *in situ*; or with a combined cover of shrubs, bushes and trees above 10%. It does not include land that is predominantly under agricultural or urban land use. **Other land with tree cover** Agricultural land, meadows and pastures, built-up areas, barren land, with groups of trees >0.5 ha; canopy cover >10% of trees capable of >5 m height at maturity.	Polygons are ascribed to HAP and NVC‡ types.	Ancient semi-natural woodland—no recent evidence of planting. Ancient replanted woodland Long-established woodland category in Scotland and Northern Ireland used for sites wooded since the middle of the 19th Century.

* From Jackson (2000).
† Based on Patenaude *et al.* (2005).
‡ HAP = Habitat Action Plan; NVC = National Vegetation Classification (Rodwell 1991).
¶ The Northern Ireland AWI was undertaken separately to the GB AWI and included areas 0.5 ha and more; where the origin of woodland in Scotland and Northern Ireland is unknown, but presence can be verified in 1750 or 1830 respectively the woodland is termed "long-established".

Appendix 8.1 Soil Biological Diversity

Soil biological diversity is hard to measure, but advances in instrumentation are rapidly developing our ability to determine the soil biodiversity, and in time, its function. Not only does the soil act as a gene pool, but it supplies organisms that are used in medicine such as antibiotics and drug delivery systems to fight cancer. Moreover, without the constant action of the soil biological community recycling and transforming waste into nutrients, we'd be over our heads in waste products. Therefore a major aim is to measure soil biodiversity across Wales. To ensure complementarity with past CS surveys we will firstly use terminal restriction fragment length polymorphism (TRFLP) which provides information on the relative abundance of different bacterial and fungal species but provides no actual species identification. While being high throughput and relatively low cost, it provides little functional information that can be linked back to specific ecosystem services. Therefore in parallel we use the latest technology, namely MiSeq (Illumina) platform, to undertake phylogenetic analysis of the soil microbial community to provide genus-level information which can be related back to soil processes.

Briefly, TRFLP analysis is an automated and sensitive fingerprinting method which uses fluorescently labelled primers for PCR, followed by restriction digestion and analysis of terminal fragments with a DNA sequencer (Singh et al., 2006). The sequencer recognizes only the fluorescently labelled terminal fragments, and therefore, in principle each fragment represents a unique operational taxonomic unit (OTU) in the sample. Biodiversity measures (e.g. evenness, number of species) within the population can then be determined, since the fluorescence intensity of each peak is proportional to the amount of genomic DNA present for each OTU in the sample. TRFLP analysis has been widely used to study the structural and functional diversity of microbial communities and was until recently the most appropriate molecular method for large-scale soil monitoring (Singh et al., 2006).

The MiSeq (Illumina) is a benchtop high-throughput instrument, based on the Solexa sequencing-by-synthesis chemistry (Bentley et al., 2008). While other sequencing platforms are available (e.g. Roche 454®, Ion Torrent®), this project chose to use the MiSeq platform because a recent performance comparative study showed that the MiSeq had the highest throughput per run and more importantly the lowest error rates (Loman et al., 2012). It is capable of multi-million read level outputs of high quality for downstream analysis pipelines such as QIIME and as such is ideally suited to multiplexed analysis of soil microbial populations where it can provide phylogenetic information to genus level comparable with other next generation sequencing platforms (Whiteley et al., 2012).
To validate the community profiling methods, a test experiment has been initiated. Cores from a diverse range of soil types (differing in pH and organic matter content) have been sampled using a 20 mm gauge auger. These included: Henfaes reference site (high fertility Eutric Cambisol, mineral soil), Abergwyngregyn (low fertility Eutric Cambisol, restored meadow), Deganwy Obelisk (Rendzinic grassland) and Clocaenog Climoor CEH experimental site (Oligotrophic Peat, heather moorland). For the Climoor site, three plots were sampled: plots that had undergone long-term warming, drought or maintained as a non-warning/drought control. Four different DNA extraction methods will be compared: i) PowerLyzer PowerSoil® DNA Isolation Kit (MO-BIO); ii) Pre-treatment with 1 M CaCO3 followed by PowerLyzer PowerSoil® DNA Isolation Kit (MO-BIO); iii) Phenol-chloroform based method (Griffiths et al., 2000); iv) Pre-treatment with 1 M CaCO3 followed by phenol-chloroform based method (Griffiths et al., 2000). Three independent replicates and a pooled DNA will be analysed per soil and per extraction method, leading to 96 samples (4 samples x 6 types of soil x 4 methods). These 96 samples will be analysed by T-RFLP to assess the consistency of the biological replicates and the efficiency of each DNA extraction method to recover bacterial and fungal diversity. Also, these samples will be sequenced on a MiSeq platform, using four different primer pairs, amplifying bacteria and Archaea, fungi, Protists and mesofauna.

Appendix 8.2. Peat surface elevation

A total of 67 satellite SAR images acquired by the European Space Agency (ESA) were made available to The British Geological Survey via the ESA Category-1 project id.13543:

- ERS-1/2 SAR scenes in descending mode **(1993-2000)**
- **ENVISAT ASAR** IS2 scenes in descending mode **(2003-2008)**

Our analyses focussed on the ERS-1/2 scenes (1993-2000). The Satellite altitude was 790 km with an Orbital inclination (α) of 14°. The repeat cycle for scenes was 35 days and the scene coverage was 100 by 100km. The image ground resolution was 30m and the radar frequency was 5.3 GHz with an incidence angle of 23°. The scenes were processed using the Intermittent Small Baseline Subset (ISBAS) technique (Cigna et al., 2013). The SBAS technique for the region studied gave a density of only 6 reflector points per square kilometre, whilst the ISBAS technique gave 150 points per square kilometre.

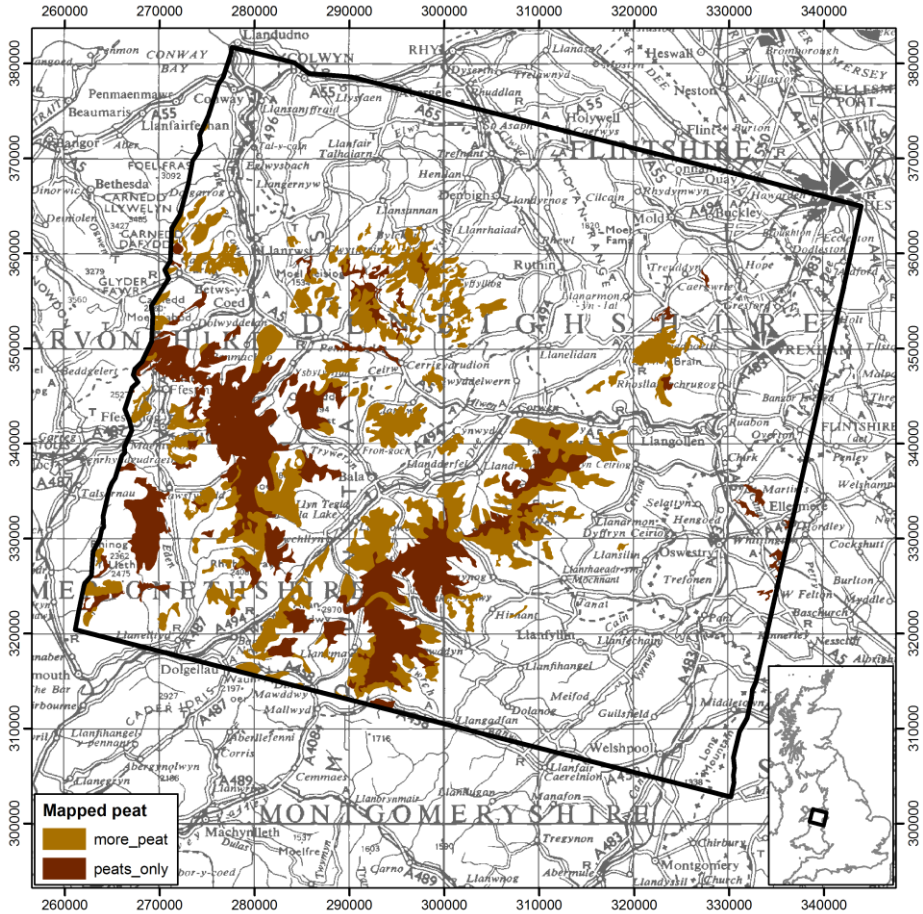


Figure Appendix 8.2.1 The spatial distribution of peat (organic soils) in the study region based on 1:250 000 soil map from the Soil Survey of England and Wales (Cranfield University). "Peats only" refers to organic soils (area 335.6 km2) whilst "more peat" (area 415.1 km2) refers to soils with a thick surface organic layer but the total thickness of the organic material is less than the other class of peat.

The spatial distribution of organic soils/ peats in the study area is shown in Figure Appendix 8.2.1

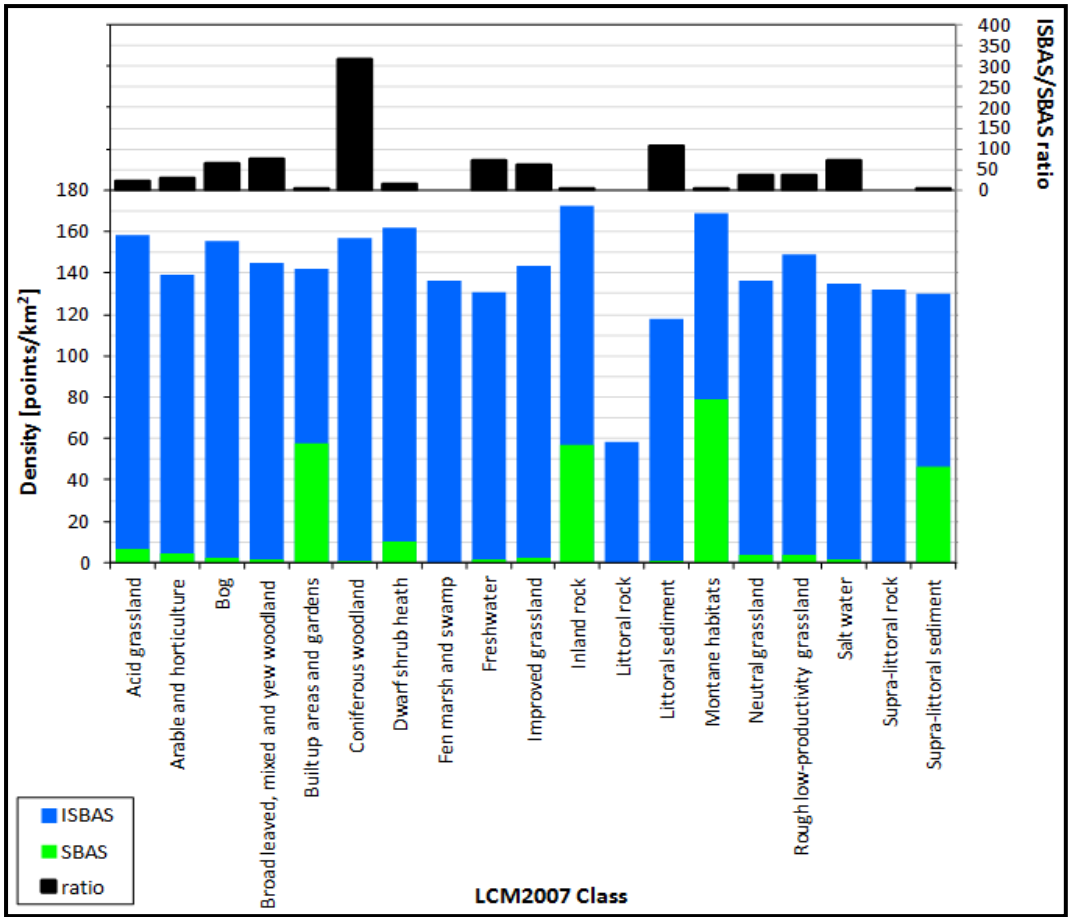


Figure Appendix 8.2.2 – The density of persistent scattering reflectors classified by land cover type for the study area in north Wales. The blue bars highlight the greater density of scatterers based on the ISBAS technique.

Figure Appendix 8.2.2 – shows that reflectors were identified across a range of land cover types (including peat bogs) and so it would be possible to detect changes in surface elevation for a range of different habitats and soil types.

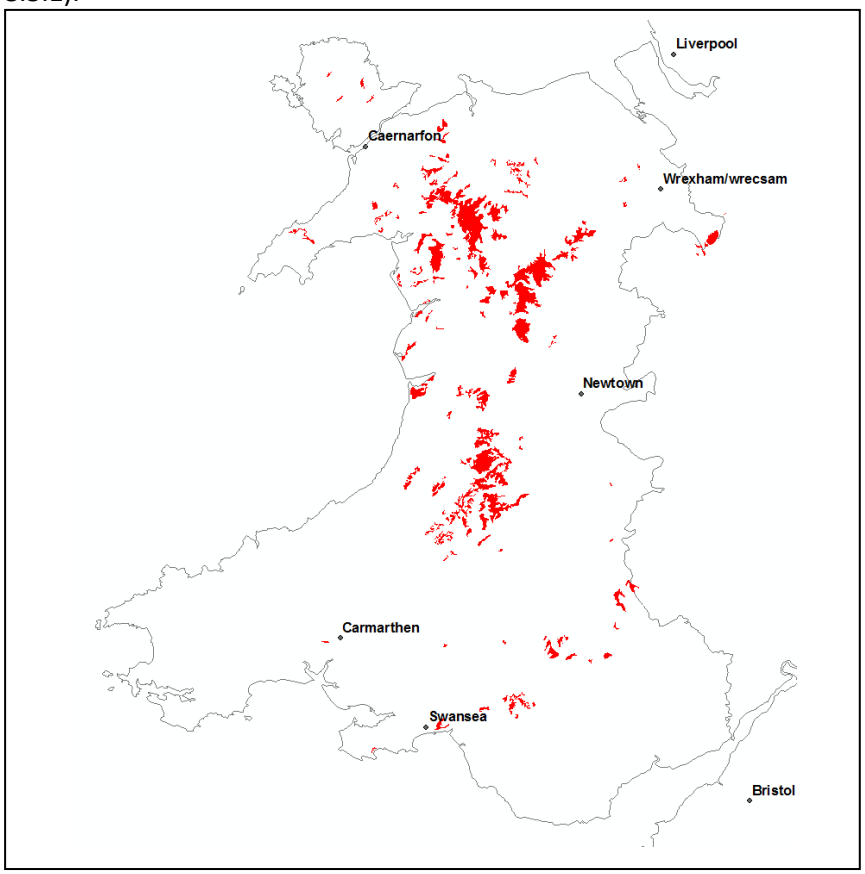
Appendix 8. 3. Bare peat mapping

The distribution of bare peat across Wales was mapped as proof of concept in order to help determine the extent of the organic soil erosion risk to help place intervention locations in context with current status and trends. The approach taken to undertake this mapping comprised four main stages, which are discussed below:

- Delineation of organic soils across Wales;
- Algorithm development;
- Algorithm validation;
- Application to all areas of organic soils across Wales.

Delineation of organic soils across Wales

Since bare peat only occurs where organic soils are present, the extent of the mapping area can be greatly reduced by delineating organic soils. This was achieved by extracting a polygon defining the extent of organic soils across Wales from a 1:250,000-scale soil map produced by Cranfield University. The total area covered by this polygon was approximately 710 km2 (Figure Appendix 8.3.1).



Appendix Figure 8.3.1 Map showing distribution of organic soils across Wales.

Algorithm development

Traditional field-based mapping can be costly and time-consuming when undertaken over vast areas. Remote sensing can be used to overcome these limitations because such data can provide detailed continuous coverage over large areas, and can be used in conjunction with image classifications routines to rapidly map large areas for a fraction of the time and cost of field-based surveys. Accordingly, a remote sensing-based methodology was developed for the purpose of mapping bare peat across Wales.

Remotely sensed data available at national scale comprised either satellite imagery or aerial photographs (both true colour and colour infrared). The spatial resolution (i.e., pixel size) of free or affordable satellite imagery is typically ~30 m, which is too coarse to resolve small eroded channels within the peat hags. For this reason, the mapping methodology utilised the high-resolution aerial photographs with a spatial resolution of 0.25–0.5 m and 1 km x 1 km coverage. The two sets of aerial photographs provide information on the spectral reflectance characteristics of surface materials. For example, true colour photographs measure reflectance in the red, blue and green wavelength regions of the electromagnetic spectrum. Similarly, colour infrared aerial photographs measure reflectance in the infrared, red and blue wavelength regions. If bare peat has reflectance characteristics that are distinct from other surface materials, then bare peat can be identified and mapped by recognising its reflectance characteristics in the aerial photographs. If bare peat has similar reflectance characteristics to other surface materials in the wavelength regions covered by the aerial photographs, then additional information may be required to aid discrimination. For this purpose, four textural parameters including homogeneity and entropy were derived from the aerial photographs.

A small test site (Migneint in Wales) known contain bare peat was identified to help develop a number of different mapping algorithms. The general approach implemented by these algorithms is outlined in Figure Appendix 8.3.2. It involves utilising different combinations of the reflectance and textural input bands in conjunctions with two different image classification routines. Image classification is supervised by defining regions of 'bare peat' and 'no bare peat' training pixels in the input bands so that the routine can 'learn' the characteristics of each class before attempting to classify all pixels in the entire scene. A total of eight different algorithms were applied to the Migneint test site. Initial qualitative observations revealed that all algorithms produced reasonable mapping results, although classification of the infrared, red, blue and green bands using the neural network routine appeared to map bare peat most effectively.

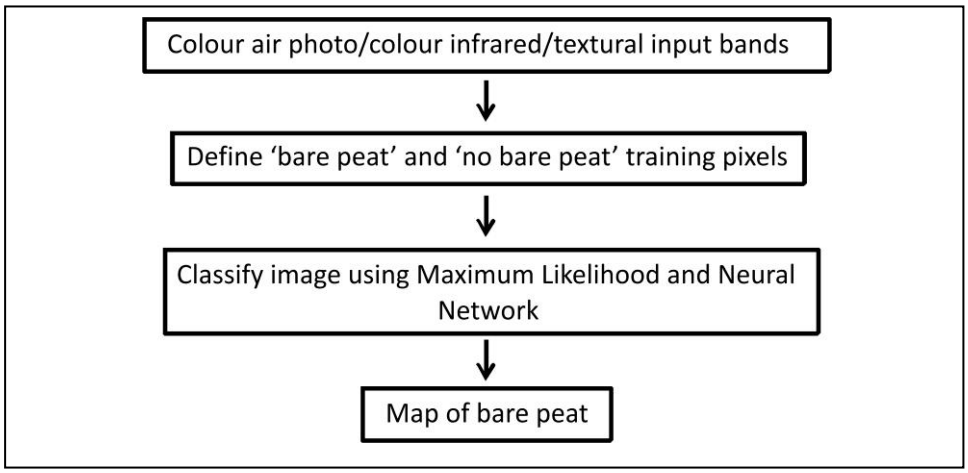


Figure Appendix 8.3.2. General approach utilised by the different mapping algorithms.

Algorithm validation

Following the qualitative assessment of the eight different mapping algorithms, it was decided to robustly and quantitatively validate their mapping capabilities by applying them to an independent site in the Peak District with known peat hags. The mapping performance was evaluated by first randomly selecting a sample of validation pixels with known class identifies from within the scene to represent the 'bare peat' and 'no bare peat' classes (5027 and 4802 pixels, respectively) — these pixels are independent of those used for supervising image classification. Next, the known class identities of the validation pixels are compared to the class assigned through classification, with the proportion of all validation pixels correctly classified providing a measure of the overall mapping accuracy of each algorithm. The Kappa coefficient provides a 'chance-adjusted' estimate of the

overall accuracy. Additionally, the producer's and user's accuracies are associated with omission and commission errors of each class, respectively. Specifically, the producer's accuracy indicates the proportion of validation pixels correctly classified for each class, whereas the user's accuracy indicates the proportion of correctly classified validation pixels in a class from the total number of validation pixels assigned to that class.

Algorithm	Overall accuracy (%)	Kappa coefficient	Peat producer's accuracy (%)	Peat user's accuracy (%)
Maximum likelihood				
R-G-B	81.6	0.69	87.6	100.0
IR-R-G	85.2	0.74	91.5	99.6
IR-R-G-B	87.9	0.78	93.6	100.0
IR-R-G-B + texture	90.1	0.82	92.6	100.0
Neural Network				
R-G-B	94.8	0.90	95.5	100.0
IR-R-G	92.5	0.86	90.0	99.8
IR-R-G-B	98.2	0.96	96.9	100.0
IR-R-G-B + texture	97.4	0.95	96.3	100.0

Table Appendix 8.3.1 Accuracy assessment of the eight mapping algorithms. R – red band, G – green; B – blue; IR – infrared; texture – four textural bands.

The mapping results for the validation site are summarised in Table Appendix 8.3.1 Overall accuracies of >81% in all cases suggest that all eight algorithms are capable of accurately discriminating and mapping bare peat. Algorithms based on classification using the neural network routine outperformed all attempts made using the popular parametric Maximum Likelihood classifier. The highest overall accuracy and Kappa coefficient was achieved using the four band combination of infrared, red, green and blue bands in conjunction with the neural network classifier, thus confirming the initial observations made during product development. Furthermore, this algorithm also results in the highest producer's and user's accuracies, with associated omission and commission errors of 3.1% and 0%, respectively. Consequently, this algorithm was selected as the optimum for mapping bare peat across Wales.

Application to all areas of organic soils across Wales

All true colour and colour infrared aerial photographs coinciding with the organic soil polygon for Wales were extracted from a UK-wide database. In total, more than 1800 photographs were extracted. In an attempt to reduce the processing effort, individual 1 km x 1 km photographs were mosaicked to produced 50 larger mosaic images, each with a spatial resolution of 0.5 m. Bare peat across Wales was mapped by applying the optimum algorithm to each image mosaic. Supervised image classification was performed using the 'bare peat' and 'no bare peat' training pixels defined

for the Migneint development site along with any additional training pixels from within mosaic that were required to fully characterise the scene with respect to these two classes.

Upon commencing peat mapping across Wales, it quickly became apparent that most image mosaics were more complex in terms of the Migneint and Peak District sites in terms of land cover. Specifically, the spectral similarity between bare peat and shadows, and also water bodies to a lesser extent, resulted in considerable classification confusion. In order to reduce this, masks were generated for each image mosaic by transforming the true colour aerial photographs into Hue-Saturation-Value (HSV) colour space and then applying an appropriate threshold to the normalised difference index (NDI) map derived using:

$$NDI = \frac{S - V}{S + V}$$

where S and V are the Saturation and Value pixel values, respectively. In general, the resulting masks were effective in identifying and excluding shadows and water bodies from the classification process (Figure Appendix 8.3.3).

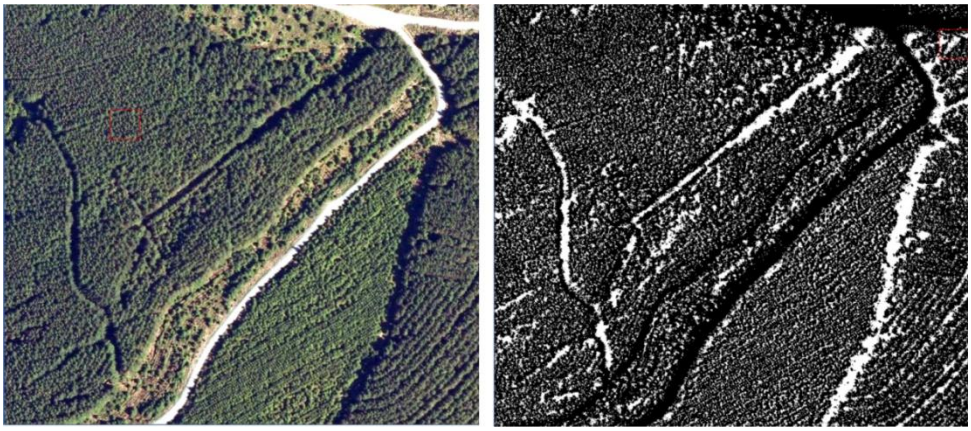


Figure Appendix 8.3.3. Aerial photograph showing shadows and derived mask used to identify and excluded shadows from image classification

Application of the optimum mapping algorithm across Wales was found to be a largely iterative process because the classification results were somewhat dependent on the number and locations of training pixels, in addition to some of the neural network parameters. Given the high-spatial resolution and large extent of each image mosaic, each classification iteration required approximately an hour of processing time, with some mosaics requiring several iterations. As a consequence, there were insufficient resources to map bare peat in all mosaics. Therefore, mapping was focussed on mosaics corresponding to the three largest continuous areas of organic soil, which comprised the majority of the entire organic soil extent and covered an area of 473 km2. Pixels classified as bare peat were extracted from all processed mosaics and merged into a single polygon in the form of a Shapefile.

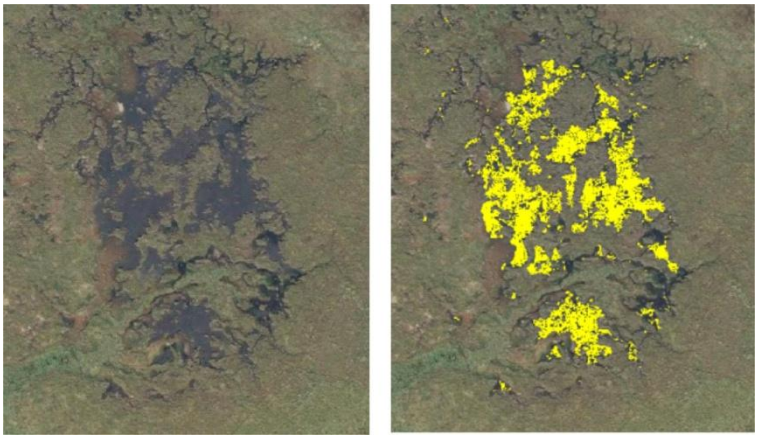


Figure Appendix 8.3.4. Example of the bare peat mapping results. Left: Aerial photograph showing bare peat. Right: Mapped bare peat (yellow).

Although requiring a significant amount of processing time, the mapping algorithm was found to be capable of accurately highlighting areas of bare peat on a national scale (Figure Appendix 8.3.4). The application of masks was essential to the success of this mapping algorithm because they led to a significant reduction in the misclassification of shadow and water as bare peat. However, in some cases the masks led to difficulty in mapping bare peat exposed on relatively steep shaded slopes. While misclassification errors associated with shadows and water were minor, some confusion was observed between some type of vegetation and bare peat (Figure Appendix 8.3.5). Nevertheless, the algorithm excluded boggy peat, which is actually correct since it is not strictly bare peat. A total of 0.63 km2 was mapped as bare peat from an organic soil areal extent of 473 km2.

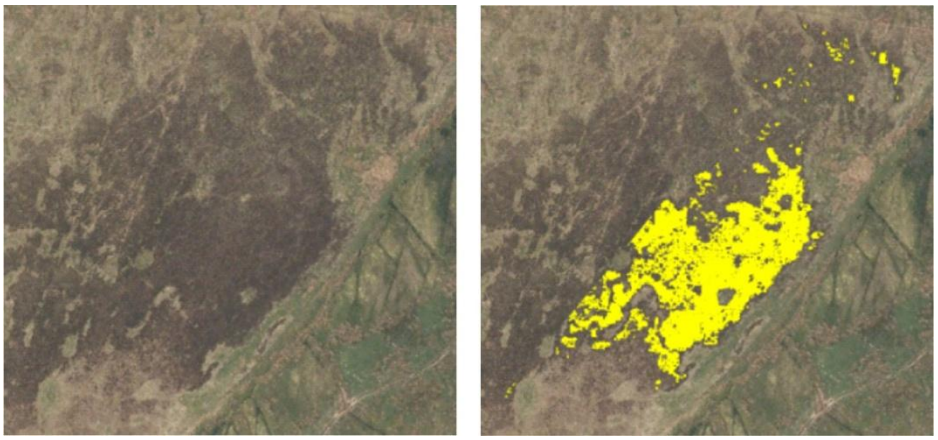


Figure Appendix 8.3.5 Misclassification of specific vegetation types. Left: Aerial photograph showing vegetation. Right: Vegetation incorrectly mapped as bare peat (yellow).

In summary, the results of this study demonstrate the ability to accurately identify and map bare peat across Wales through classification based on aerial photographs. The mapping results provide information on the organic soil erosion risk which can subsequently be used to highlight areas for further investigation or restoration. If applied on data acquire for different time periods, the algorithm present here represents an effective tool for monitoring the erosion risk through time.

Climate change mitigation – Vulnerable peatlands

CEH in collaboration with UCL and University of Southampton will estimate recent rates of peat accumulation on short (0.5 m) peat cores, using a range of radioisotopes (210Pb, 137Cs, 241Am) to date horizons within the peat profile, and measuring carbon accumulation rates between these dated horizons. The method will provide estimates of peat accumulation at a high time resolution

during the last 150 years. For the pilot study, cores will be taken from comparable blanket bog locations within existing flux measurement sites, and from contrasting locations across Wales, to represent a range of peat condition, management and vegetation cover. The method offers the additional potential to measure changes in peat accumulation in relation to documented changes in management, or vegetation changes observed directly from plant remains within the core itself. Since relatively few such data exist for the UK as a whole, this dataset would greatly enhance our capacity to relate peat formation (and thus carbon sequestration) rates to peat condition.

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