Section A: Project details:
Technical Progress Report No.: 3
Reporting Period: 1 July 2006 31 December 2006
Project Reference Number: 2044-CD-P1-M2
Project Title: BOGLAND: A Protocol for Sustainable Peatland Management
Start Date: May 2005  Projected Completion Date: Dec 2008
Lead Organisation: University College Dublin
Project Co-ordinator: Prof. Jim Curry
Project website: www.ucd.ie/bogland

Section B: Research team details for the reporting period

<table>
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Section C: Technical Report

1. **Outline description of progress and results to date**

- During the reported period, the project was promoted through publications, presentations at conferences, workshops and the maintenance and extension of the website (almost 1000 hits at the beginning of January 2007).
- A second ‘sampling season’ was carried out within the ‘Biodiversity’ sub-project work-packages.
- Sampling was also on-going in different work-packages belonging to the ‘Physical peat resource’ sub-project.
- In the ‘Cultural, socio-economic and policy issues’ sub-project, a new working plan has been drawn to clarify the outputs of the various work-packages.

2. **Detailed description of progress and results for period under review**

**Sub-project 1: Management**
Leaders: Jim Curry and Florence Renou

A Data Management Plan (DMP) covering objectives, data collection policies, data standards, sourcing of data management and data dissemination for the BOGLAND project, has been designed and can be seen in Appendix 1.

A workshop was organised on 21 November 2006 in order to agree precise definitions for the terms ‘peat’ and ‘peatland’ in the context of the BOGLAND project. The definitions can be found in Appendix 2 and will be used across all work-packages within the project.

Florence Renou presented the BOGLAND project to Drs Rebekka Artz and Stephen Chapman of the RECIPE Project in Aberdeen in September 2006. This project aims to provide information to assist both conservationists and managers of peat extraction with options to restore peat accumulation and carbon sequestration in peatland that has either been abandoned or designated for restoration, see their website at: (http://www.macaulay.ac.uk/RECIPE/description.htm).

Communication with members of the RECIPE project is encouraged from all, especially students working in the BOGLAND project as similar studies have been carried out there (e.g. microbial studies).

Discussion and ideas have been exchanged on the sustainable use of peatlands at several meetings which have been attended by the project manager: 1) the 5th conference on ecological restoration in Greifswald (http://www.ucd.ie/bogland/Wilson_Renou_2006.pdf), 2) the annual meeting of the Institute of ecology and environmental management (Dublin) and 3) the first seminar of the Irish Peatland Society (see Appendix 3)
Milestones for next six months

- A second steering committee meeting will be held in January 2007
- Meetings at sub-project level will be held regularly, especially for the co-ordination of field work and collaboration for writing papers

Sub-project 2: Biodiversity
Leaders: Tom Bolger and Florence Renou

WP2.1 Biodiversity database
Florence Renou

Main objectives and outputs/deliverables
- To gather relevant information on all aspects of peatland biodiversity in Ireland

Description of progress and results to date
The 12 ‘biodiversity’ sites have been visited: peat depth measured where possible and water table wells established where possible. Peat samples were taken and pH was measured. pH values varied between peatland types ranging from 3.5 (mountain blanket bog in Kippure, Co. Wicklow) to 4.7 (Atlantic blanket bog in Ballygasheen, Co. Kerry).

Milestones for next six months
- Nutrient analysis to be carried out on peat samples
- Database to be initiated

WP2.2 Vegetation studies
Florence Renou, Catherine Farrell

Main objectives and outputs/deliverables:
- To examine the vegetation on the twelve core sites and integrate the data with existing information in order to identify appropriate vegetation indicators of sustainability

Description of progress and results to date
Discussions took place in collaboration with the NPWS and experts met at several conferences in order to establish the best assessment protocol.

Milestones for next six months
- Field visits are due to start in summer 2006; each site will be assessed in order to ascertain its status in terms of the presence of ‘natural’ or ‘intact’ and ‘damaged’ areas as well as identifying ‘restoration’ processes.

WP2.3 Soil microbial diversity
Louise Deering (supervisors: Nick Clipson, Fiona Doohan)

Main objectives and outputs/deliverables
- Analysis of methanogen and methanotrophic communities via molecular methods in order to produce a fingerprint of the microbial communities present in Irish peatlands
- Compare and contrast different characteristics of individual peatland types
- Compare and contrast individual microbial populations in peatlands
- PhD thesis and peer-reviewed articles

Description of progress and results to date:
2nd seasonal sampling August 2006 and subsequent DNA extractions carried out.
- Optimisation of two new PCR protocols using general archaeal and methanogen specific primers
- Bacterial PCR of the majority of DNA peat samples from May and August 2006
- General bacterial primers have also successfully amplified approx 100 out of 160 DNA samples since May which are now ready to be profiled using T-RFLP
Louise attended the following conferences/courses:
- September 2006 - British Mycological Society (BMS) Birmingham
- School of Biology and Environmental Postgraduate Seminar day December 2006
- Postgraduate statistical course

Milestones for next six months:
- Generation of general bacterial, archaeal and specific methanogen population profiles using T-RFLP.
- Identifying the effect of varying parameters on the different microbial populations and their response to those parameters via ANOVA and Canoco.
- Cloning to identify microbial communities.

WP2.4 Terrestrial invertebrates
Rachel Wisdom (supervisor: Tom Bolger)
Main objectives and outputs/deliverables
- Study surface dwelling and soil dwelling invertebrates on Irish peatlands
- Compare and contrast different characteristics of individual peatland types
- Quantify and assess the significance of peatlands for the conservation of invertebrate biodiversity and identify possible indicator species that will aid the overall sustainability of peatlands
- PhD thesis and peer-reviewed articles

Description of progress and results to date
Sampling for the autumn period was completed in August 2006. The fauna gathered from these sampling expeditions is currently being sorted and then identified to the lowest possible taxonomic level to prepare it for statistical analysis in the future. It has been decided that this study will focus on four taxa, mites (Acari), spiders (Arachnida), beetles (Coleoptera) and enchytraeids. It is already apparent that there is a large diversity of oribatid mites in the peatland soil samples. The Arachnida are widely varied also, and the coleopterans found are quite typical for the habitats in question.
Rachel attended the following conferences/courses:
- School of Biology and Environmental Postgraduate Seminar day December 2006
- Postgraduate statistical course

Milestones for next six months
- Identification of species and sorting of the data will continue and should be completed early in 2007 to provide data for statistical analysis and to be available for comparison with data gathered in the second year. The data gathered will be analysed statistically using CANOCO and possible indicator species may be identified using Binary Discriminate analysis and Species Indicator Analysis.
- It is proposed that the data gathered from the first year will be compared to areas of cutaway peatlands and thus indicator species can be determined. This will entail the selection of further sampling sites in order to provide a suitable comparison. This site
selection will take place in early February 2007. Specialised training will be undertaken to identify enchytraeids early in 2007. The second yearly sampling will take place in March/April 2007 and, as already mentioned, these data will then be compared to the intact areas sampled in the first year.

WP2.5 Bird diversity
Fintan Bracken and John Whelan

Main objectives and outputs/deliverables
- To fill the knowledge gap in regards to the bird communities of the main peatland habitat types in Ireland
- Peer-reviewed paper

Description of progress and results to date
The first season of bird surveys in the twelve study sites has been completed and the results analysed. A report including a full literature review has been prepared and from this report a paper has been drafted. Both these documents are in the process of being edited for final submission.

Milestones for next six months
- Finalise the report and submit a paper to a peer reviewed publication by early January 07.

WP2.6 Aquatic invertebrates
Edel Hannigan (supervisor: Mary Kelly-Quinn)

Main objectives and outputs/deliverables
- Identify the open water habitats that may be present in peatlands
- Describe the macro-invertebrate and micro-crustacean communities of the open water bodies identified
- Examine the relationships between invertebrate community composition and habitat characteristics and identify potential indicator species
- PhD thesis and peer-reviewed papers

Description of progress and results to date
Second sampling season took place in August 2006. The macro-invertebrates collected are currently being identified to the lowest possible taxonomic level. The water samples are being tested for nutrients (nitrate, phosphate and ammonia), alkalinity, conductivity, cations (calcium, magnesium, potassium and sodium), and anions (chloride, nitrate, fluoride and phosphate). To date the results indicate that Scragh bog has higher species richness than the other study sites. This may be related to the fact that it has a near neutral pH, high conductivity and the alkalinity in the range of 105 mg CaCO₃/L to 162.5 mg CaCO₃/L. This site also displayed much higher levels of calcium than any of the other sites studied. There were no detectable levels of nitrite present in any of the pools indicating they are free from pollution. Water from both the raised and blanket bogs has a pH of between 4 and 5 as well as low alkalinity (-0.403 to 0.079 mg CaCO₃/L measured using the GRAN method). The conductivity values obtained were slightly higher in the Atlantic blanket bogs (71 µs/cm to 137 µs/cm) than those collected in the raised bogs (55 µs/cm to 76 µs/cm).

Milestones for next six months
- The hydrochemical results will be presented at Environ 2007.
• Sorting and identification of samples will continue. It is envisaged that sorting and identification of the macro-invertebrates from the two sampling seasons will be completed by summer 2007.
• Sampling will be carried out again in April 2007.

Sub-project 3: The peatland resource
Leaders: Shane Ward and Florence Renou

WP3.1 Peatland mapping and WP3.2 Climate change scenario
John Connolly and Nick Holden
Main objectives and outputs/deliverables
- Produce a mapping base of the peatland resource (3-D) including peat depth, carbon content
- Map results from other work packages
- Examine the impact of climate change scenarios on the stability of the peatland carbon resource, using medium (<50 years) and long (>100 years) timescales
- Integrate the outputs of the others WPs into climate change scenarios analyses
- Identify physical aspects of peatlands that will be susceptible to anthropogenic and climate change over the next 100 years

Description of progress and results to date
During the last six months John Connolly passed his PhD-viva with minor revisions. The CORINE 2000 land cover map has been acquired, as has the National Soil Data base. Both John and Prof. Holden have been working on the development of rules to form the basis of a model to estimate peat volume and carbon content for the various peatland types present in Ireland. John has been conducting a literature review on various methods of sampling peatlands and how to determine carbon content and peat depth, this work is ongoing. He is also developing a GIS database of peatland depth values from various sources including: Bord na Mona, Airtricity, UCD’s School of Archaeology, the Geological Survey of Ireland, Shell and data from his thesis. To date the Shell has provided Bord na Mona digitised paper depth maps of the Bellanaboy site and these have been sampled at 100 m intervals yielding over 600 depth values. These have been interpolated to produce a 3D map of the depth of peat at that site. A database of peat depth has been acquired from the Irish Archaeological Wetland Unit in UCD’s School of Archaeology. This database provides depth data for over 3000 points throughout BNM land holding, although only about 450 points have full profiles associated with them. Most of the other 2500+ points recorded the depth as being at least 1 or 2 metres. There is a dearth of depth data for blanket bogs in Ireland, however Airtricity have depth data for seven upland blanket bog sites. This data will be acquired and fed into the GIS database. This depth data will be used to inform the peat depth model.

John Connolly gave a presentation at the Irish Peatland Society seminar in Dublin, October 2006: Using GIS and remote sensing to study the Irish peatland resource. John gave also a presentation to Bord na Mona’s Civil Engineering and Survey groups in Boora in November 2006. The presentation reviewed John’s work using GIS as a tool to integrate multisource data and the development of the Derived Irish Peat Map. The presentation led to a discussion about the use of GIS in mapping peatland resources and to the acquisition of BNM peat depth and carbon content data for the present project.

Milestones for next six months
- Complete literature review on volume and carbon content of bogs
- Develop the peatland volume and carbon content model
- Peat depth model: conduct a number of transects on raised and blanket bogs to acquire data to inform the model
- Peat carbon content: Acquire sample cores from various peatland types. Determine the best and most efficient method to test for carbon content.
- Update the Derived Irish Peat Map to include industrial peatlands

WP3.3 Use and after-use of peatlands
Sub-task 1: Enda Kennedy (supervisors: Kevin McDonnell and Shane Ward)

Main objectives and outputs/deliverables
- Present a framework for a national bioenergy strategy based on peatlands as the base area for biomass growth
- Energy input versus energy output and the economics of energy crops on cutaway peatlands in Ireland
- Master’s thesis

Description of progress and results to date
The initial Energy Ratio and Energy Requirement results for willow, elephant grass and reed canary grass were calculated. These results are based on estimated crop yields on cutaway peatlands, fuel consumption for the production chain, transport of the crop and the application of activated sewage sludge on the crops rather than inorganic fertiliser. Detailed excel spreadsheets have been formulated for each crop documenting energy inputs, energy outputs, energy requirements and energy ratios. Also the same has been created for the economics of each crop. From these excel spreadsheets different scenarios can be composed e.g. required yields to make the crop feasible, cost and energy input into fertiliser applications and how grants and sludge application will affect the overall economic outcome.

Milestones for next six months
- Submit Master’s thesis

Sub-task 2: Shane Ryan (supervisors: Kevin McDonnell and Shane Ward)

Main objectives and outputs/deliverables
- Document peat industry worldwide and in Ireland
- Environmental impact of peat harvesting and implications of future development
- Master’s thesis

Description of progress and results to date
- Detailed report on the peat industry in Ireland covering history of bog usage in Ireland, harvesting methods, Bord na Móna production area, outputs and sales.
- Peat usage in Europe (Finland, Sweden, Estonia etc.)
- Assessment of environmental impact of peat mining
- Possible future use of cutaway peatland studied.

Shane Ryan attended the following events:
- Edenderry power plant: presentation on co-fueling peat with biomass grown on cutaway bog and by farmers in the local area.
- West Offaly power plant: demonstration of state-of-the-art technology for burning peat to create electricity.

Milestones for next six months
- Submit Master’s thesis
WP3.4 Slope stability and slippage
Noel Boylan (supervisor: Mike Long)

Main objectives and outputs/deliverables

- Geotechnical assessment of landslide susceptibility
- Identification and basic characterisation of a number of landslides in Ireland to define parameters for further research.
- Assessment of innovative full flow penetrometers to characterise the humification and strength properties of peat.
- PhD thesis and peer-reviewed papers

Description of progress and results to date
During the period under review, work has concentrated on the development of innovative direct simple shear apparatus (DSS). Several revisions have been made to the apparatus to tailor it for testing soft peat. Tests have been conducted to calibrate the deformation analysis and develop test procedures. Minor issues with the apparatus are being addressed at the moment to enhance results.

Noel Boylan gave a presentation at the 4th International Conference on Soft Soil Engineering and the Bridge & Infrastructure Research in Ireland Symposium. Noel was also invited to present at the Developments in Ground Investigation in Ireland.

Milestones for next six months
- Fundamental testing to of peat in UCD-DSS to understand the effect of rate and specimen size.
- Laboratory testing of peat from test sites to define strength properties and study deformation during shear.

WP3.5 Carbon gas fluxes in Irish peatlands
David Wilson and Ted Farrell

Main objectives and outputs/deliverables

- To provide baseline data of C gas exchange for a range of peatlands through either published sources (where available) and/or field measurements
- To investigate the effect of small-scale peat harvesting on C gas exchange
- To investigate whether restoration of a peatland formerly harvested results in C gas exchange dynamics similar to those of an intact peatland

Description of progress and results to date
Weekly to bi-weekly measurements of C gas fluxes have been carried out using the static chamber method since March 2006. In July, a clipping experiment was undertaken in a number of the sample plots to assess the contribution of autotrophic processes to C fluxes.


Milestones for next six months
- Continuation of the field measurements. Investigation of the relationships between environmental variables and C gas fluxes leading to the construction of CO₂ and CH₄ models.
- Study finishing June 2007
WP3.6 Sheep grazing

Sub-task 1: Briony Williams, Michael Walsh, Mike Gormally

Main objectives and outputs/deliverables

- Monitoring the use of hill and mountain resource by Scottish Blackface hill sheep using satellite geo-referencing and behavioural assessment under free-range grazing [Teagasc contribution to WP3].

Description of progress and results to date

Seasonally-based data have been compiled in relation to (a) flock observations – 5 seasons, (b) frequently occupied area observations – 5 seasons and (c) GPS collar tracking – 8 seasons. Habitat assessment of the Teagasc hill sheep farm, Leenaun, has also been completed. Processing of the various databanks is ongoing. Areas of grazing and territorial preference have been quantified and thus the database for site selection on the Teagasc farm in relation to sub-tasks (2) & (3) is now available.

Milestones for next six months:

- Completion date of PhD by January 2007

Sub-task 2: A.N.Other, Michael Walsh, Rogier Schulte and Tamara Hochstrasser

Main objectives and outputs/deliverables

- Mechanism underlying preferential grazing areas and development of sustainable grazing management strategies

Description of progress and results to date

In response to the reviewers’ comments, two field sites in addition to the Teagasc Hill Sheep Farm were located, i.e. an intensively grazed commonage that is adjacent to the Teagasc Hill Farm and the very lightly grazed Connemara National Park. Activities and a work-plan have been outlined (see below).

Three interview sessions were held (June 26 & 29 and July 6). A Walsh Fellowship was offered to two applicants in turn both of whom declined. The position was re-advertised including the internet but without success.

Milestones for next six months

- Re-advertising of position and interviewing of suitable candidates (Master’s student to start in July 2007 thus finishing in June 2009).

Sub-task 3: Ger Lynch, Michael Walsh, Rogier Schulte and Richard Moles

Main objectives and outputs/deliverables

- Physical and ecological impact of preferential grazing areas

Description of progress and results to date

To-date Ger Lynch has completed (a) an extensive review and selection of field methods to quantify micro-erosion, (b) a random selection of study sites on the Teagasc Hill Sheep Farm based on degree of occupation by sheep and (c) a preliminary study of an intensively grazed area in a commonage and of a lightly grazed area in the Connemara National Park.

Milestones for next six months

- Field studies based in three sites – Teagasc Hill Sheep Farm, Leenaun, a commonage area and Connemara National Park.
- The rate of erosion will be related to sheep activity through two complementary methods: collection of sediment (rainfall detachment trays) from replicated, isolated micro-plots that will be located in the preferential grazing areas, the resting areas, the movement corridors and in the areas of low activity, and measurement of changes in peat height by insertion of replicated reference marker sticks in the same areas.
• Samples will be analysed for SS (Suspended Solids), DOC (Dissolved Organic Carbon) and DON (Dissolved Organic Nitrogen)

WP3.7 Study of peatland hydrology in the context
Paul Johnston, Con Cunnane and Aisling Molloy

Main objectives and outputs/deliverables

➢ Water balance measurement and calculation for a raised bog in the Shannon basin and integration with the outcomes of other known studies
➢ Identify key hydrological indicators and mitigation measures to enable ecological regeneration and sustainable development of peatlands
➢ Develop guidelines for hydrological studies of other peatland areas and guidelines for their future conservation

Description of progress and results to date

Preliminary fieldwork has been undertaken with a view to prepare for a field measurement campaign during the coming months. This has been delayed owing to injury suffered by a Senior Technician on a field trip to a different project. The researcher employed on the project has also been writing literature review material and acquiring data from Met Eireann and OPW.

Attended the National Hydrology Seminar, Tullamore, November 2006

Milestones for next six months

• Complete one week’s intensive monitoring at Garryduff Bog over the next two months. This will involve preliminary fieldwork for one or two days per week for four weeks prior to the intensive monitoring period.

Report from Paul Johnston (in addendum)

Following comments from the steering group following the initial start-up meeting of the project, the direction of this component changed in favour of a more broad-based study rather than focussing on one or two particular sites. The limited resources also meant that the scope for specific field work was limited. By definition, peatlands are, hydrologically, wetlands. The sustainability of peatlands, therefore, which we originally took to include the broad categories of raised bogs, Atlantic and mountain blanket bogs, fens and a minor group of turloughs, depends fundamentally on the hydrological drivers. The relationship between the ambient hydrology and the peatland ecology is basic to the long term management and, where appropriate, restoration, of peatlands. While the companion ‘work package’ at NUIG is focussed on the management options for cutaway raised bogs, the work package at TCD has concentrated on what is known about the overall hydrological processes that sustain the various categories of peatland and to devise hydrological indicators which might be used as measures of the state or condition of the wetland. Two specific sites have been included (one a blanket bog at Glencullen, north Co. Mayo, and one a raised bog at Raheenmore, Co. Offaly) where specific investigations have been carried out to identify the relevant hydrological indicators. In the latter case, specific works were carried out in past years to arrest the deterioration of the bog through cutaway drainage and thus to restore the hydrological dynamics of the bog and its associated ecology.

Work completed, 2006

In association with another initiative under the Water Framework Directive concerning Groundwater Dependent Terrestrial Ecosystems (GWDTE), involving the Geological Survey
of Ireland and NPWS of the Dept of the Environment, the work package addressed the original objective of identifying the hydrological mechanisms at work in the various categories of peatland, based on existing, available information. This work formed the basis of a classification and typing of such wetlands based on measures of hydrological interaction. A scheme for such classification, based on water supply mechanisms, was started by English Nature in the UK (Wheeler and Shaw, 2000) but concentrated on small scale wetlands associated with groundwater discharges from the Chalk. The initial work of adapting this scheme, known as WETMECS, for the Irish peatlands was undertaken by Patrick Marshall as part of the EPA work package and completed as a Master’s thesis in November 2006. Broadly the hydrological mechanisms for sustainability of peatlands divide between those wetlands which both discharge and recharge into groundwater and those which are essentially groundwater discharge areas. The thresholds at which changes in the hydrological flows render the peatland unsustainable depend, not only on the discharges and water levels involved but also on measures of the dependent ecology. The latter development is the subject of the next part of the work package.

In the context of a type site which has not been specifically analysed before, a hydrological investigation was undertaken of a blanket bog in North Mayo, along the newly installed gas pipeline north of Bangor Erris. Ecotones and hillside flush sites were perceived to be threatened by the excavation and burial, in the peat, of the gas pipeline immediately up gradient. The hydrological supply mechanisms were investigated by piezometry, augering, and in situ monitoring of vertical profiles of temperature and electrical conductivity. The flows at the flushes appear to be controlled mainly by groundwater movement along structural discontinuities in or at the margins of the underlying metamorphic bedrock. Sustainability is almost certainly controlled by the ultimate source of these flows (recharge area) and the possible disruption caused by the engineering works. Monitoring is continuing to devise a conceptual model and to estimate the tolerable levels of hydrological interference in this ‘type area’. The results to date have also been reported in the thesis by Patrick Marshall, (“The Hydrological Sustainability of Peatlands”, TCD, Nov. 2006).

The considerable work carried out on raised bogs (under the Dutch-Irish Raised Bog project) and on turloughs (mainly through research at TCD and NUIG) mean that there is no requirement to undertake further work on these peatlands for the purposes of this project, except to monitor the results of restoration works which were originally built to restore the hydroecological processes at the margins of the bogs.

Future work
Ongoing work will refine the hydrological classification started in 2006, in continuing collaboration with NPWS, and to establish nominal criteria for hydrological sustainability of peatlands, insofar as currently available data will allow. The ecological dimension of such criteria is clear and will be incorporated under the adapted WETMECS scheme. Further monitoring of the raised bog site and the blanket bog site are being undertaken as ‘case studies’ for the sustainability indicators.
Sub-project 4: Cultural, socio-economic and policy issues
Leader: Frank Convery

WP 4.1 Analysis of socio-cultural aspects
Marcus Collier, Mark Scott, John Feehan, Craig Bullock and Frank Convery

Main objectives and outputs/deliverables
- Subtask 1: Case study to produce a blueprint for cutaway network
- Subtask 2: Socio-cultural analysis through local and national surveys; stakeholder meetings and focus groups
- Subtask 3: Forum for cutaway peatlands: to address issues facing communities living in peatland areas
- Subtask 4: International workshop
- PhD thesis and peer-reviewed papers

Description of progress and results to date
A new action-research, sociological methodology has been devised and field-tested with encouraging results. Focus group research has been concluded and a new round of targeted interviewing has commenced. A nationwide survey is in progress with the commencement of the tendering process for surveying.

Much of the summer months were taken up with fieldwork in Counties Offaly, Longford and Roscommon. This was time consuming but data are encouraging and the new methodology was tested. It also was approved by the ethics committee. Internal feedback was encouraging and a paper was presented to general approval. This will now be worked into two papers for submission. A PhD Masterclass in Scotland was attended by invitation. This was a prestigious event with only one representative from any country accepted (25 people out of a world total of ca. 650 applicants).

Marcus Collier gave a presentation at the 5th European conference on Ecological restoration in Griefswald, Germany, at the British Ecological Society meeting in Oxford and some smaller meetings in Ireland and also to Local Authority Biodiversity and Parks officials – Botanic Gardens. He also attended the Irish Peat Society seminar, Dublin, October 2006.

Milestones for the next six months
- Submissions of two papers will be made
- Nationwide survey will be carried out
- Targeted focus groups will be organised

WP4.3 Socio-economic aspects
Craig Bullock, Peter Clinch, Frank Convery

Main objectives and outputs/deliverables
- Subtask 1: Analysis of socio-economic issues including economic valuation of resources uses, future management options, market and non-market valuation values using local and national surveys
- Subtask 2: analysis of socio-economic issues using scientific indicators
- Subtask 3: Policy review: examination of particular relevant government policies – energy, conservation, biodiversity

Description of progress and results to date
Coordination has continued with 4.1 (socio-cultural) with respect to focus group analysis and development of questionnaire. Stakeholder discussions have been held (e.g. with Bord na
Mona). Visual and information material has been prepared for the both the local and national surveys. This includes both photographic images and others produced by an artist to demonstrate future scenarios for cut-away peatlands. A valuation methodology that incorporates both choice experiments and contingent valuation has been prepared. To our knowledge this combined approach has not been used elsewhere, but we believe it to be justified so as to distinguish the specific impact that assumed cost would have on preference for peatland alternatives. The local survey is expected to be more concentrated, but to assume the same design as the national survey for comparison purposes. However, additional focus will be placed on the proposed Wetlands Park and the questionnaire is likely to include a separate reply-paid questionnaire. Tenders are now being requested for the administration of the survey.

A document describing existing policy aspects has been prepared. Craig Bullock attended the Irish Peat seminar, Dublin, October 2006.

**Milestones for the next six months**
- To complete survey and carry out analysis
- By end June 2007, should have commenced work on production function approach

WP4.4 Synthesis report and policy document
Mark Scott, John Feehan, Frank Convery
*Main objectives and outputs/deliverables*
- Guidelines for a holistic approach to sustainable peatland development, including an evidence-based approach to policy development
*Description of progress and results to date*
This work-package is due to start at a later stage of the project.

3. **Project management issues including staffing and equipment**
- 6 PhD students, 4 Masters students and 4 Post-Docs were working full time on this project during the reported period
- It was not possible to appoint a Masters student for WP3.6 (sheep grazing) and further interviews will be carried in summer 2007

4. **Milestones for next six months**
- During the next six months, field sampling and measurements will be conducted under many work packages
- The sub-project leaders will meet with the steering committee on 17 January 2007
- See specific milestones under each work-package

5. **Overall statement regarding progress vis-à-vis project aims and timeframe**
Progress over the third six-month period of the project has been good and is in line with the overall time frame of the project except for one sub-task within work-package 3.6. If successful the candidate will have completed the Masters by June 2009.

**Section D (Report on Physical Indicators):**

1. **Number of peer reviewed publications:**
<table>
<thead>
<tr>
<th>Authors</th>
<th>Title of Paper and publication details</th>
<th>Journal</th>
<th>Status (in press or published)</th>
</tr>
</thead>
</table>

2. **Number of other scientific/technical articles/reports published**

3. **List of Conferences/Workshops presentations**

1) Three oral presentations were given by members of the BOGLAND team at the first Irish Peatland Society seminar held in Dublin, 10 October 2006 (including a presentation on the BOGLAND project see Appendix 3).


3) Florence Renou and David Wilson gave a seminar to the RECIPE project team in Aberdeen, 11 September 2006.

4) Florence Renou chaired a workshop on 21 November 2006 inviting all members of BOGLAND team as well as experts in Soil Science in Ireland to discuss ‘the definitions of peat and peatland’ in the context of the BOGLAND project (see Appendix 2).

5) Noel Boylan gave a presentation on two occasions:


4. **Other Publicity Events (e.g. open days, launches etc.)**
   None

5. **Number of research products (e.g. models, data-sets, methodologies, innovations):**
   None

6. **Number of Reports to policy and decision makers on urgent environmental issues**
   None

7. **Number of examples / case studies illustrate the principle of sustainable development in action:**
   None

8. **Number of new eco-audit methodologies developed:**
   None

9. **Number of firms/ organisations adopting new processes and products for sustainable development developed as a result of funded research:**
   None

10. **Reports on integrated assessments of sectoral development impacts with particular reference to agriculture, forestry, industry, tourism and transport**
    None
Appendix 1:

Data Management Plan

BOGLAND

Project information

Project: BOGLAND

Project Number: 2004-CD-P1-M2

Principal Investigator(s): UCD School of Biology and Environmental Science, Agriculture and Food Centre, University College Dublin, Belfield, Dublin 4, Ireland

Project organisation

Project leader: Jim Curry
Project manager: Florence Renou
Designated data centre: UCD
Other team members: See Bogland website: www.ucd.ie/bogland

1. Data management within BOGLAND

This Data Management Plan (DMP) covers objectives, data collection policies, data standards, sourcing of data management and data dissemination for the BOGLAND project. It is designed to put different types of relevant information into an accessible location for many users. It will provide data spatially and temporally from disparate data sets. The main tasks in relation to the DMP are as follows:

- Identification of potential relevant data sources
- Capture of data from field studies
- Loading data into a database
- Purchase of data from 3rd parties
- Data processing
- Production of metadata: data about the data also called data documentation
- Dissemination of data including submission of dataset to EPA centre of excellence

Three kinds of data are dealt within this plan:
- data already existing and published
- data already existing but unpublished
- data collected during the project
2. Published data

Data which have been published are easily available and a library of references (using Endnote programme) is being compiled so that all references used in the project will be properly referenced in the BOGLAND library (containing details pertaining to where it can be accessed (e.g. URL or physical location).

3. Identification of potential relevant data sources

Data relevant to this project has often not been published. There exists several sources of data pertaining to the project objectives and which have been identified below.

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPWS</td>
<td>Ely Place, Dublin 2</td>
<td>Surveys, study reports, GIS maps</td>
</tr>
<tr>
<td>IPCC</td>
<td>Lullymore, Co. Kildare</td>
<td>Surveys, database, study reports</td>
</tr>
<tr>
<td>BNM</td>
<td>Main street, Newbridge, Co. Kildare</td>
<td>Study reports</td>
</tr>
<tr>
<td>Universities</td>
<td>Ireland and UK</td>
<td>Theses</td>
</tr>
</tbody>
</table>

4. Capture of data from field studies

*Five types of data will be collected by the project: (a) biological, (b) physical, (c) geographical, (d) textual (from surveys) and (e) visual (photos, films etc..)*

a. Biological and physical data will be collected through field observations and this information will be copied into a digital format (Excel spreadsheets) by site.

b. Geographical data will be recorded in a GIS format.

c. Textual data will be recorded and copied into a digital format (Excel spreadsheets).

d. Visual data will be stored appropriately in digital format and linked to an Excel spreadsheet database.

5. Loading data into a database

All the data will be loaded into a database which can be access under several fields: e.g. site name, peatland types, dates etc… ArcGIS system is being used to process the data and to display outputs.

6. Purchase of data from 3rd parties

Added data have already been acquired in order to complete sub-task objectives.

a. Corrine map
b. Soil and sub-soil map of Ireland
7. Data Formats
All data collected by the project will be supplied in Microsoft Excel spreadsheets where the columns and rows are laid out in accordance with xyz format. Statistical and model outputs will be submitted in specific formats and will be accompanied by model descriptions in MS-word. Version and software used will be specified.

8. Production of metadata: data about the data also called data documentation
Metadata for all the datasets will be included and recorded as ‘headers’ in each Excel spreadsheet used to store acquired data or supplied using the Metadata capture tool in GIS. Detailed information will be recorded as this is very important for the long-term monitoring of the sampled sites.

9. Dissemination of data including submission of dataset to EPA centre of excellence
All data collected under this project will be stored digitally on (compact disk) and appended to the final report. The final report will also be placed in a downloadable format on the internet websites of University College Dublin. Data will also be submitted to the EPA centre of excellence (COE-DMGT), following the required protocol.

Prepared by:

Name: Florence Renou
Date: 13 October 2006
Appendix 2:
THE DEFINITION OF PEAT, PEAT SOIL AND PEATLAND
IN THE CONTEXT OF THE BOGLAND PROJECT

A workshop took place on Tuesday, 21 November 2006 in UCD in order to define peat soil and peatland definitions in the context of the BOGLAND project.


Apologies: Jim Ryan, Jim Collins, Jim Curry, John Feehan, Con Cunnane, Marcus Collier, Craig Bullock

At the end of the workshop, the following definitions were accepted as working definitions for all those involved in the BOGLAND project:

**Peat:** sedentarily accumulated material consisting of at least 30% (dry mass) of dead organic material

**Peat soil:** organic soil materials which have sedentarily accumulated and have at least 30% (dry mass) organic matter over a depth of at least 45 cm on undrained land and 30 cm deep on drained land; the depth requirement does not apply in the event that the peat layer is over bedrock.

**Peatland:** a geographical area where peat soil occurs

For mapping purposes, a peatland should cover a minimum spatial extent of 1 ha.

It was agreed that, for the purpose of the project, the Derived Irish Peatland MAP (Connolly *et al.* In press) which is an estimate of the extent of contemporary peatlands in Ireland from soil and landcover maps dating from the 1970s, 1980s and 1990s, should be amended to include all peatlands which meet the definition given above. In particular, industrial cutaway peatlands should be included in the hierarchical rules used in ArcGIS to produce a new map of peatlands.

It was also agreed to produce a further categorization of peatlands using a dichotomous key leading to the identification of many peatland ‘soilscapes’ (Finke *et al.* 2001). The criteria for the identification of these objects may include soil variables but also relief, vegetation, climate and human influence. For example, a peatland may be man-modified or relatively intact; peat-forming vegetation may or may not be present etc.

References

BOGLAND PROJECT:  
A RESEARCH PROGRAMME TO DEVELOP A PROTOCOL FOR THE SUSTAINABLE MANAGEMENT OF PEATLANDS IN IRELAND

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Keywords: sustainable development, biodiversity, physical characteristics, socio-economic, socio-cultural, policy

Summary:  
The BOGLAND project is a multi-disciplinary research study that is seeking to collate available information and will attempt to fill information gaps that exist on Irish peatlands. The project aims to develop a protocol for the future management of peatlands in Ireland with the aim of sustaining the environmental and ecological goods and services they provide as well as the human communities that use them. This is addressed by first characterising the peatland resource, their physical and ecological characteristics as well as their values, by assessing their vulnerability and by understanding their socio-cultural and economic attributes.

Introduction

The concept of sustainable peatland management

While the area of Ireland covered by peat is considerable (over 16%), much of this has been extensively modified by man. Peat has been used in Ireland since prehistoric times but since the advent of industrial peat extraction, the process has accelerated and within a few decades most of the larger raised bogs in the Irish midlands will have been exploited. It is crucial that appropriate measures be put in place to promote the sustainable development of remaining peatland resources, to ensure that adequate pristine areas of high ecological value are identified and conserved and that the extensive cutaway peatlands which remain following mechanical peat extraction are used in the best interests of society as a whole. Ireland is obliged under the terms of the Convention on Biological Diversity (CBD) to take account of ‘multifunctionality’ when considering the future development and use of cutaways. Also arising out of its commitments under CBD, Ireland has undertaken to carry out and implement local Biodiversity Action Plans which are currently being prepared on a county basis. In parts of Ireland where bogs are prevalent, peatlands will feature prominently in these plans (e.g. Offaly and Longford). It is thus timely to explore and enhance awareness of the Irish peatlands and to set the principles of wise use of peatlands identified in Joosten and Clarke (2002) in an Irish context.  
In September 2005, a three-year project named “BOGLAND” was launched by the Environmental Protection Agency and is being led by University College Dublin. BOGLAND principal aim is to develop a protocol for the sustainable management of peatlands. This is an ambitious objective, which will be achieved by communicating the reality of peatlands to the public and the Irish government. This will be done by answering the following questions:
1. What is this resource called ‘peatlands’?
2. What are its benefits and values (e.g. ecological, socio-cultural and economic)?
3. What are the current pressures and threats to this resource and concerns for its future?
4. What are the current policies and do they give rise to tensions?

Answering these questions will expose the need for a sustainable management policy for peatlands, leading to the critical question: how can peatlands be managed in a sustainable fashion so that their functions are still there for our children?

Sustainable development represents one of the most fundamental challenges facing the world today. Given the challenges facing Ireland in the 21st century, the integration of economic, social and environmental policies required to enshrine sustainable development, is a formidable task. Research has an essential role to play in helping to lift barriers by providing intellectual foundations, analytical tools and empirical evidence upon which to build a more sustainable future. BOGLAND aspires to play this role by:

- quantifying the main features of the peatland resource, notably extent and volume, biodiversity, hydrology, carbon balance and contribution to greenhouse gas fluxes;
- assessing their vulnerability to environmental pressures and threats arising out of various kinds of uses (drainage, mining, forestry, energy, agriculture, uncontrolled recreational activities etc.);
- understanding their socio-cultural attributes and the economic, institutional and policy issues attached to them.

**Knowing our peatlands**

There is currently a considerable amount of scattered information on various aspects of the ecological, physio-chemical, socio-economic and policy issues regarding peatlands that need to be considered in the development of guidelines for sustainable management of peatlands. However, much more extensive review and evaluation of this information is required and further research is needed in many areas where significant knowledge gaps have been identified. The work will be conducted in four subprojects (see Diagram A), with the core research work focusing on three areas:

- Biodiversity
- Characterisation of the physical peatland resource and its use
- Socio-cultural, economic and institutional/policy

**Biodiversity**

**Objectives**

This work builds on the considerable body of existing information on vascular plant communities and macrofauna of Irish peatlands. Vegetation can be used as a visible indicator of disturbance and is one of the simplest observable characteristics to assess the conditions and development of a peatland. However, bryophytes and soil and aquatic invertebrates have an important role to play in the functioning of peatlands and will be studied in detail in this project as little work has been carried out so far. Biodiversity is also not limited to the ‘visible’ diversity present on the bog surface. Micro-organisms (e.g. methanogenic archaea) are at the ‘heart of the matter’ and for the first time, the significance of this rich repertoire of Irish peatland biodiversity will be quantified and assessed.
First year activities
The first activity in this ‘biodiversity’ sub-project was to set up a stratified sampling programme representing all types of peatlands found in Ireland. Three representative sites were identified among the following categories: 1) lowland/Atlantic blanket bogs, 2) montane blanket bogs, 3) raised bogs and 4) fens, with cutaway peatlands forming an added category where certain studies will be carried out to supplement already existing projects. Where possible, studies will be replicated in both a ‘natural’ and ‘degraded’ areas within the same peatland. This will help assessing the impact of activities such as turf-cutting and afforestation as well as considering the effects of restoration or rehabilitation, for example where drains have been blocked. The initial observation is that there is a great variation in the status of peatlands from relatively intact or ‘where little contemporary anthropogenic disturbance has taken place’ to high degree of degradation. It is thus important that for each peatland category, reference conditions will be given which show a range of variation including alternative states that a peatland may exhibit with environmental variation or natural disturbance.

Characterisation of the physical peatland resource and its use

Objectives
An estimation of the volume and carbon content of peat is still required in order to improve estimates of the magnitude of the Irish peatland carbon reservoir. As well as producing maps, this sub-project will explore the impact of climate change scenarios on the stability of the peatland carbon resource. It will examine peatland vulnerability to man-induced interferences (mining, afforestation, sheep grazing, wind farms) with respect to 1) physical aspects (risk of ‘bogslides’), 2) carbon and methane fluxes, and 3) hydrological features. This sub-project endeavours to report on the physical criteria used for the assessment of management options.

First year activities
Field, laboratory and modelling work was initiated to ascertain the extent of peatlands in Ireland (volume and carbon content). A review of different uses and after-uses of peatlands (including peat exploitation, biomass production, sheep grazing, etc…) is being compiled, with particular attention given to their environmental impacts and economic aspects. A study of carbon exchange was established at different sites displaying a gradient of degradation in order to assess the effect of small-scale peat harvesting on C gas exchange and to investigate whether restoration of a peatland formerly harvested results in C gas exchange dynamics similar to those of an ‘intact’ peatland. The stability of peatlands is being investigated in laboratory as well as in the field where slippages have occurred. The identification of hydrological criteria is being carried out in the context of sustainable ecological restoration and rehabilitation of peatlands and cutaway peatlands.

Socio-cultural, economic & institutional/policy

Objectives
This sub-project aims to develop an understanding of the values of peatlands within the Irish public in general and how the contribution of peatlands in social, economic and environmental terms can be characterised by indicators over time. This will be done through 1) the examination of communities linked to peatland areas, rural development, archaeology and culture and tourism; 2) the economic valuation of resource uses, market and non-market values including carbon sink and 3) the appraisal of relevant policies. In addition, an in-depth
case study will be carried out in an area largely dominated by industrial cutaway peatlands with a view to producing a blueprint on community and stakeholder involvement in the future of peatlands. Conflict management, perception and representation and valuation are the key components of socio-economics, where social and natural sciences can co-operate particularly at the scale of landscape management.

First year activities
Stakeholder consultation and public focus groups have been completed though this will be ongoing throughout the study. Relevant literature relating to socio-cultural and socio-economic aspects of peatlands has been recorded, including aspects of environmental restoration, landscape value and biodiversity value. Meetings have also been held with scientists working on the project so as to learn more about the scientific data on which a future economic analysis will depend and to advise colleagues of economic data requirements. A case study was initiated aiming to develop the Wetlands Wilderness Park into a blue-print for future, non-commercial peatland after uses. This strategy aims to integrate the needs of the community (amenity after use) and ecological needs (biodiversity after use).

Conclusion
This exercise will help in detecting changes and trends in the quantity and quality of the peatland resource by producing baseline data against which to assess policy and management options. Thus the project will help bridging the gap between scientific priorities and the real world of management. Several difficulties have already been identified. Due to different understandings of the terms associated with peatlands, the project needs the scientific community to rethink definitions and classification systems of Irish peatlands. Another difficulty arises from the fact that a long-term perspective is required to see how peatland respond to management or impacts. It is thus important that the project highlight the need of continuous monitoring and research, which is required to record progress on achieving sustainable development.

The outputs of this research programme will greatly enhance the knowledge of Irish peatlands and will be presented in time for the 2008 congress. It will only succeed however, if it can bring together all the expertise already existing around the island of Ireland.

Acknowledgements
The project is multi-disciplinary and brings together the expertise from different organisations around Ireland: UCD, TCD, NUIG, UL, NPWS, Teagasc and Bord na Móna. The project also benefits from the contribution of experts from Northern Ireland, Finland and Germany through an international steering committee. BOGLAND is supported by the Environmental RTDI Programme 2000-2006, financed by the Irish Government under the National Development Plan and administered on behalf of the Department of the Environment, Heritage and Local Government by the Environmental Protection Agency.

References
Diagram A: PERT chart for BOGLAND:

A Protocol for Sustainable Peatland Management (SPM)

Sub-Project 1
Project Management & Co-ordination (+ Website)

Sub-Project 2
Biodiversity in Peatlands
Leader: SBES @ UCD

Workpackages
WP 2.1: Biodiversity Database
WP 2.2: Vegetation studies
WP 2.3: Soil microbial community
WP 2.4: Terrestrial invertebrates
WP 2.5: Avian diversity
WP 2.6: Aquatic invertebrates

Sub-Project Report

Sub-Project 3
The Peatland Resource – its extent, use and potential
Leader: Bioresources Research Centre (BRC) @ UCD

Workpackages
WP 3.1: Peat maps (volume and C)
WP 3.2: Climate change scenarios
WP 3.3: Peat extraction, biomass & wind energy
WP 3.4: Slope stability & slippage
WP 3.5: GHG fluxes
WP 3.6: Sheep grazing
WP 3.7: Peatland hydrology

Sub-Project Report

Sub-Project 4
Cultural, socio-economic and policy considerations
Leader: Environmental Inst. @ UCD

Workpackages
WP 4.1: Stakeholder interviews
WP 4.2: Socio-cultural analysis
WP 4.3: Socio-cultural case study
WP 4.4: Socio-economic aspects
WP 4.5: Institutional/policy aspects

Sub-Project Report

Synthesised Final Report presenting a Protocol for Sustainable Peatland Management (SPM)