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REF 2014 / UoA16

OUTPUT 01 / portfolio

PEATBOGS AND CARBONN, A CRITICAL SYNTHESIS TO INFORM POLICY DEVELOPMENT IN OCEANIC PEATBOG CONSERVATION AND RESTORATION IN THE CONTEXT OF CLIMATE CHANGE

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2.1 Lindsay, R.A. (2008), 'Peatlands : an International Perspective', Presentation to Peter de Haan Charitable Trust, October, London.

2.2 Lindsay, R.A. (2010) 'Peatlands : A Global Concern', Presentation to launch Open Inquiry event of *IUCN UK Peatland Commission of Inquiry*, University of Edinburgh, 3 November.

2.3 IUCN (2010) *UK Peatland Commission of Inquiry*, report downloadable at www.iucn-uk-peatlandprogramme.org/commission/findings

2.4 Brooks, Stuart, Chair, IUCN UK Committee (2013) 'Critical assessment of Peatlands and carbon management' : Reference letter on behalf of R A Lindsay, 22 January

2.5 Joint Environment Ministers (2013) 'Securing benefits from UK peatlands' Joint Ministerial letter making commitments to peatland conservation and restoration, 5 February

2.6 Moxey, Andrew, Chair, Pareto consulting (2013), Reference letter on behalf of R A Lindsay, 23 January

2.7 Lindsay, R.A. 2012. Peatland Systems of Serras Septentrionais of Galicia – Unpublished Report requested by Spanish NGOs for submission to Government of Spain.

2.8 Stott, Andrew, Head of Biodiversity Evidence, DEFRA 2013. "Ecosystem Services and Aichi Targets"- Letter inviting R A Lindsay to attend workshop exploring indicators for Aichi Targets, Cambridge, 19th April 2013.

2.9 Joint Nature Conservation Committee (2011) Towards an assessment of the state of UK Peatlands, JNCC report No. 445. Peterborough : Joint Nature Conservation Committee.

2.10 The Daily Yomiuri and The Japan Times 2010. Headline announcement of agreement for Convention on Biological Diversity Strategic Plan and Aichi Targets, 31st October 2010.

2.11 Lindsay, R.A., 2010. UK Peatlands: Habitat restoration delivering ecosystem benefits. Host and keynote speaker at IUCN/DEFRA Side-Event at Convention on Biological Diversity (CBD) 10th Conference of Parties, October 2010, Nagoya, Japan

2.12 O'Reilly, J., O'Reilly, C and Tratt, R. (2012) Field Guide to Sphagnum Moses in Bogs. Telford : Field Studies Council Publications. R.A.

3 LECTURES, WORKSHOPS and STRATEGY

Selection of lectures between 2008-2013

4 BIBLIOGRAPHY

4.1 Lindsay, R.A. (2010) *Peatbogs and carbon: a critical synthesis to inform policy development in oceanic peat bog conservation and restoration in the context of climate change*, Commissioning body: RSPB (Royal Society for the Protection of Birds)

4.2 UK Climate Change Adaptation Sub-Committee (2013) *Progress Report 2013*. http://www.theccc.org.uk/wp-content/uploads/2013/07/ASC-2013-Book-singles_2.pdf

4.3 Wilson, L., Wilson, J., Holden, J., Johnstone, I., Armstrong, A. and Morris, M, (2011)` Ditch blocking, water chemistry and organic carbon flux: Evidence that blanket bog restoration reduces erosion and fluvial carbon loss`, *Science of The Total Environment*, 409(11), 2010- 2018.

4.4 Wellock, M.L., Reidy, B., Laperle, C.M., Bolger, T. and Kiely, G, (2011) ` Soil organic carbon stocks of afforested peatlands in Ireland`, *Forestry*, 84 (4), pp. 441-451.

4.5 Essl, F, Dullinger, S., Moser, D., Rabitsch, W. and Kleinbauer, I, (2012) `Vulnerability of mires under climate change: implications for nature conservation and climate change adaptation`, *Biodiversity and Conservation*, 21(3),pp 655-669.

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4.10 Marsden K. and Ebmeier, S. (2012) *Peatlands and Climate Change*. SPICe Briefing 12/28. Edinburgh : SPICe Information Centre, The Scottish Parliament.

4.11 Natural England (2011), *Guidelines for monitoring and peatland restoration.* Natural England Technical Information Note TIN097. Peterborough : Natural England.

4.12 Bullock, C., Collier, M. and Convery, F.J, (2012) `Peatlands, their public good value and priorities for their future management – the example of Ireland` in *Land Use Policy,* 29(4), pp. 921-928.

more info can be found at http://www.uel.ac.uk/erg/publications.htm

1 DESCRIPTION, PICTURES and DRAWINGS

supporting documents in folder

This critical research review has underpinned key policy developments concerning peatland management in the UK and in the wider global community. The review was commissioned by RSPB Scotland with funding from Scottish Natural Heritage, Countryside Council for Wales, Natural England and the Forestry Commission. It was commissioned to bring clarity to policy discussions about the role of peat bog carbon flux and the potential relationship with climate change. Existing scientific literature appeared contradictory and confusing, leaving policy-makers unsure about how to proceed in terms of peat bogs and carbon. The review re-assessed and evaluated many research sites, sometimes in the field, and also re-analysed much published literature in the light of these re-assessments. The review revealed that confusion and contradiction in the scientific literature has arisen because researchers have not described their research sites appropriately. The review assembled a wide range of figures concerning peat bogs and carbon flux, and subsequently underpinned establishment and establishment of the International Union for the Conservation of Nature (IUCN) UK Peatland Programme in 2009. It was used as the core briefing document for the IUCN's UK Peatland Programmes Commission of Inquiry on Peatlands and underpins subsequent Ministerial announcements concerning peatland restoration (see RO 2). The review has also informed the UK Committee on Climate Change in terms of peatland ecosystem responses. It also formed the basis of a keynote presentation made by Mr Lindsay on behalf of the IUCN UK Peatland Programme to a DEFRA-sponsored Side Event at COP10 of the Convention on Biological Diversity in Nagoya, Japan, following which peatlands were confirmed as key ecosystems within the CBD Aichi Targets and Strategic Plan 2011-2020. The review also assisted the decision-making process to include peatlands as part of the carbon-accounting process for the Kyoto Protocol.

UK peatland landscape
photo Norman Russell

2 EVIDENCE OF IMPACT

supporting documents in folder

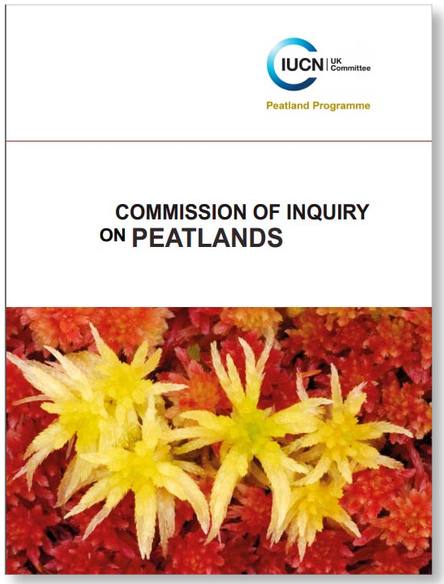
R A Lindsay was invited by the Yorkshire Wildlife Trust to speak about the international significance of peatlands at a presentation made to Mr Peter de Haan and the Peter de Haan Charitable Trust. As a result of the presentation, the PdH Trust provided £400,000 over a three year period to support establishment of the IUCN UK Peatland Programme. The need for such a programme was highlighted by R A Lindsay's RO.1, which then underpinned the establishment and objectives of the programme. The letter from Mr Stuart Brooks, Chair of the IUCN UK National Committee points to the part played by Lindsay's report in establishing the IUCN programme.

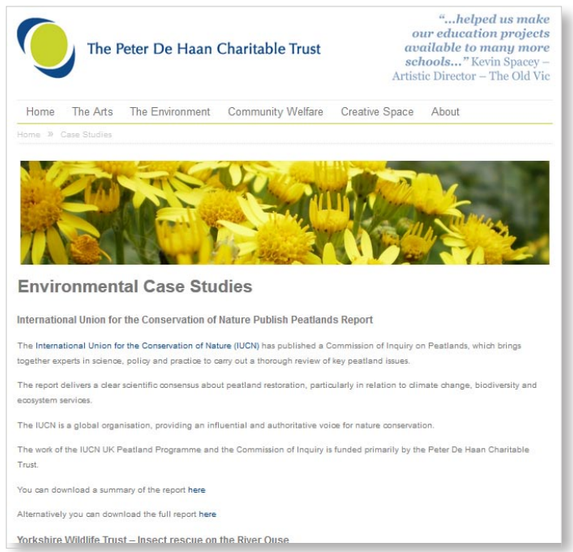
One of the key things to emerge from R A Lindsay's RO.1 Report was the scale of confusion which existed about peatlands across a whole range of sectors, including the scientific literature. The first act of the IUCN UK Peatland Programme was thus to establish a Commission of Inquiry into Peatlands in order to bring clarity to the peatland debate.

2.1 Lindsay, R.A. (2008), 'Peatlands : an International Perspective', Presentation to Peter de Haan Charitable Trust, October, London.

2.2 Lindsay, R.A. (2010) 'Peatlands : A Global Concern', Presentation to launch Open Inquiry event of *IUCN UK Peatland Commission of Inquiry*, University of Edinburgh, 3 November.

2.3 IUCN (2010) *UK Peatland Commission of Inquiry*, report downloadable at www.iucn-uk-peatlandprogramme.org/commission/findings





2.4 Brooks, Stuart, Chair, IUCN UK Committee (2013) 'Critical assessment of Peatlands and carbon management' : Reference letter on behalf of R A Lindsay, 22 January

IUCN National Committee United Kingdom

22nd January 2013

To whom it may concern

Critical Assessment of Peatlands and Carbon Management

I am writing to give an outline account of the very positive impact which has been achieved by Mr Richard Lindsay's commissioned work on peatlands. The International Union for the Conservation of Nature (IUCN) is a global organisation providing an influential and authoritative voice for nature conservation and helping build dialogue across the public and private sector. The IUCN UK Peatland Programme promotes peatland restoration and conservation, through partnerships, strong science, sound policy and effective practice.

The important role of peatlands in relation to climate change has been highlighted at a global level by the United Nations following publication of an Assessment on Peatands in 2008[1]. Around that time a major gathering of peatland interests in policy and carbon science (London Conference) failed to agree on the carbon benefits of peatland management and highlighted a need for consensus on the science to enable stronger policy and action to conserve peatlands

The work commissioned from Richard Lindsay on Peatbogs and Carbon provided a critical insight into the reasons behind the confusing and apparently conflicting science and identified ways forward to help build consensus. This work provided the catalyst for the development of the IUCN UK Peatland Programme whose work, included objectives to address the science issues raised in Mr Lindsay's report.[2]

With Mr Lindsay as an expert advisor to the IUCN UK PP, a Commission of Inquiry on peatlands was established, with patrons, Prof Andrew Watkinson, Lord Jamie Lindsay and Sir Graham Wynne. A series of scientific reviews was undertaken [3] and Mr Lindsay's work was used as briefing to all review teams to help establish a common understanding on peatland definitions, form and function. As a result, the review teams overcame many of the earlier confusions in interpreting peatland science and provided greater clarity and consensus which enabled stronger recommendations from the Inquiry. The work of the Inquiry has enabled representation to be made in Parliaments in Scotland, Northern Ireland and the House of Lords which have been followed up by Government Ministerial statements, policies and funding in support of peatlands[4][5]

[1] Parish et al 2008. http://www.imcg.net/media/download_gallery/books/assessment_peatland.pdf)

[2] Business Strategy 2009 – 2012 http://www.iucn-uk-peatlandprogramme.org/sites/all/files/IUCN_UKPeatlandProgrammeBusinessStrategy2009.pdf

[3] Commission of inquiry on Peatlands 2011 http://www.iucn-uk-peatlandprogramme.org/commission

[4] http://www.scotland.gov.uk/News/Releases/2012/10/Peatlands22102012

Mr Lindsay's work was also taken to the international Convention on Biological Diversity (COP10) in Japan where peatlands and their climate change role were subsequently highlighted in the Strategic plan for 2011 – 2020. The work was also used as a basis for presentations made by the IUCN UK Peatland Programme at several international climate change conventions under the UN Kyoto Protocol, the most direct impact being that the UK was able to provide a strong consensual message about peatlands and climate change benefits which previously would have been difficult, given the apparently conflicting evidence. With peatlands firmly included in the carbon accounting process for the Kyoto Protocol, Mr Lindsay's work is having further impact in providing valuable background for UK scientists who are developing the Intergovernmental Panel on Climate Change (IPCC) guidance on peatland rewetting. Mr Lindsay's work helps in interpreting the variety of carbon metrics arising from peatlands which will enable agreed values that could have huge benefits in securing carbon funding for peatland restoration.

Mr Lindsay's work also has an important benefit in the public-affairs work of the IUCN UK Peatland Programme. Previously the apparent contradictions in the science made it difficult to convey a compelling case for peatland conservation and restoration. Several briefings and media stories have now been produced which help overcome such confusions. Current work is underway to develop Mr Lindsay's report into a series of briefings for a more widespread audience of peatland managers and policy makers.

Mr Lindsay has also had an impact in individual site protection where his analysis has allowed robust evidence to be presented by statutory bodies and NGOs in addressing potentially damaging planning developments. These include the Lewis windfarm proposal on Islay, which was subsequently refused by Scottish Government. Further beneficial impact is also likely in that Mr Lindsay's report is available to consultants and advisors to developers helping interpret the science at an early stage and reduce lengthy and costly arguments at the Inquiry.

In conclusion, Mr Lindsay's work has provided an immensely important catalyst in securing action across a wide range of policy, science and practice activities aimed at restoring and conserving peatlands. The further strength in this work is that it continues to be used as a foundation for both interpreting the science and in framing new research activity.

Yours faithfully

Stuart Brooks

Chair, IUCN UK National Committee

[5] News Items http://www.iucn-uk-peatlandprogramme.org/news

2.5 Joint Environment Ministers (2013) 'Securing benefits from UK peatlands' Joint Ministerial letter making commitments to peatland conservation and restoration, 5 February

Department for Environment Food & Rural Affairs

Llywodraeth Cymru
Welsh Government

DOE
Department of the Environment
www.doeni.gov.uk

The Scottish Government

Clifton Bain
Director, IUCN UK Peatland Programme

5 February 2013

SECURING BENEFITS FROM UK PEATLANDS

We welcome the publication of the IUCN UK Peatland Programme Commission of Inquiry on Peatlands. The UK's peatland habitats are of importance for wildlife and biodiversity, landscape value and economic, including leisure, activities. The Commission of Inquiry has drawn public attention to the value of our peatlands.

Recognising the impact of past land use on the condition of our peatland ecosystems, this letter outlines the actions and intentions of Defra, the Scottish Government, the Welsh Government and the Northern Ireland Executive to achieve our collective aim of enhancing the natural capital of UK peatlands.

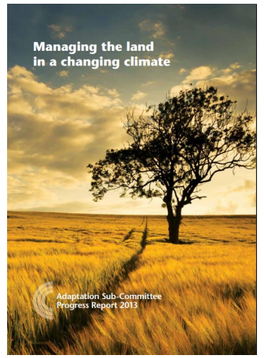
Policy co-ordination

The UK, together with the British Overseas Territories, supports internationally important peatland habitats and species including some of the finest examples of Atlantic blanket bog in the world. Conserving and restoring peatlands (blanket bogs, raised bogs and fens) makes an important contribution to the UK's biodiversity objectives. As one of our major wetland types, peatlands have a potentially significant role in contributing to water quality and quantity benefits. The importance of peatlands in terms of climate change mitigation through conserving the carbon stocks and enhancing sequestration makes a strong case for improving the condition of our peatlands.

We recognise the wide ranging importance of peatlands and the need for co-ordinated Government action across biodiversity, climate change, water, heritage and land use. Whilst acknowledging that further research is required, action can be and is being taken.

INVESTORS IN PEOPLE

2.6 Moxey, Andrew, Chair, Pareto consulting (2013), Reference letter on behalf of R A Lindsay, 23 January



By email

Pareto Consulting
29 Redford Avenue
Edinburgh
EH13 0BX

Tel: 0131 441 1029
Mob: 0774 967 9301

University of East London
c/o Richard Lindsay

23/01/2013

To whom it may concern,

I am a freelance economist assisting the UK's Climate Change Committee (CCC) to assess peatland restoration as an adaptive response (kiran.sura@theccc.gsi.gov.uk is the CCC contact for this). Prior to being an independent consultant I was a Senior Lecturer at the University of Newcastle upon Tyne and then a Senior Civil Servant in the Scottish Executive and I have some appreciation of how academics can influence policy making – and indeed of the weight attached to "impact" under the Research Excellence Framework.

Hence I wish to draw your attention to the fact that Richard Lindsay has been very helpful in improving my understanding of peatlands, their restoration and the likely impact upon them of climate change. He has provided useful information via email and a telephone conversation, elaborating upon his excellent 2010 report on "Peatbogs and carbon: a critical synthesis". The latter is cited in several subsequent studies as an authoritative source and I have no doubt that it has had an impact on policy thinking.

Yours faithfully,

Andrew Moxey

Dr Andrew Moxey

Pareto Consulting was formed on January 1st 2006 as the trading name of Andrew Moxey, to offer economic analysis of agricultural, agri-environmental and rural land use policy issues.

VAT REG No. 948 4928 65; D&B DUNS 21-705-8942

2.7 Lindsay, R.A. 2012. Peatland Systems of Serras Septentrionais of Galicia – Unpublished Report requested by Spanish NGOs for submission to Government of Spain.

Peatland Systems of *Serras Septentrionais* of Galicia

Richard Lindsay
Head, Environmental Research Group
Sustainability Research Institute
University of East London
UK

General overview

The distribution of peatland habitats in Western Europe is heavily skewed to temperate and boreal parts of that Region, with peat formation occurring across entire landscapes in Britain, Ireland, Norway and, to a lesser extent, Sweden and Finland. While the limitations which restrict overall peatland formation in the latter two countries are permafrost in the north and dry continental summers in the south, there are few such restrictions in the more oceanic nations. Consequently peat formation can be found throughout the land masses of Britain and Ireland, from sea level to the highest mountain summits. However, in slightly less oceanic parts of Britain, extensive peatbog formation is restricted to hill ground where higher elevations give rise to lower temperatures and greater duration of cloud cover.

This tendency for peat bog formation to occur at higher elevations under conditions of decreasing latitude and higher summer temperatures can be seen most strikingly in the mountains of Northern Spain, where a sparse network of blanket bog – the most southerly example of this Priority Habitat in the EU – and scattered raised bogs (again, a Priority Habitat under the EU Habitats Directive) can be found located along the ridge tops of mountain ranges such as the Serras Septentrionais of Galicia. These systems are remarkable in a number of ways and offer considerable opportunities for research and conservation action with the potential to generate high-value benefits to society at large both within the Region and within the EU as a whole.

Significance of the peat bog systems of the *Serras Septentrionais*

The particular conditions (both environmental and socio-economic) which have given rise to and influenced the surviving peat bogs of the Serra do Xistral are a combination of both large-scale and locally characteristic elements. They lie on the fringes of a regional climate envelope (Atlantic) which enables peat to form, and some of the land uses to which they have been put are similar to those experienced by peat bog systems elsewhere in the region, but some elements of natural biodiversity and land-use history are much more localised and restricted to Northern Spain. As such, these peat bog systems offer the potential to shed light on broad issues such as climate change and

2.8 Stott, Andrew, Head of Biodiversity Evidence, DEFRA 2013. "Ecosystem Services and Aichi Targets"- Letter inviting R A Lindsay to attend workshop exploring indicators for Aichi Targets, Cambridge, 19th April 2013.

2.9 Joint Nature Conservation Committee (2011) Towards an assessment of the state of UK Peatlands, JNCC report No. 445. Peterborough : Joint Nature Conservation Committee.

Department for Environment Food & Rural Affairs

Web: www.defra.gov.uk

Our ref: UKBISG110512
Date: 17th April 2013

Dear Dr. Richard Lindsay,

Re: Invitation to a workshop to explore options for indicators of Ecosystem Services to track the Aichi biodiversity targets at UK and country levels

Thank-you for confirming your attendance at the **1-day workshop** named above, which will be held on **19th April 2013** from **10:00-17:30** at the UNEP World Conservation Monitoring Centre (UNEP-WCMC), Cambridge.

As you are aware, the UK government is committed to reporting against global, regional and national frameworks which aim to address biodiversity loss. Following the adoption of the new Strategic Plan for biodiversity (2011-2020), a flexible framework has been proposed to report on the 20 Aichi targets at multiple scales (UNEP/CBD/COP/DE/X/2). In response to these significant changes, a review of the UK indicators was undertaken to ensure that they remain relevant and based on the most robust and reliable data. Based on the outcomes of this review, the UK Biodiversity Indicator Steering Group (BISG) has proposed an interim set of 24 indicators for reporting against global and European frameworks. A number of the proposed indicators need refinement and/or development, including those for reporting on the benefits humans receive from the environment (ecosystem services).

In this context, Defra has commissioned UNEP-WCMC to identify options for developing indicators of the status of ecosystems that provide essential services to the UK, which will presented to the BISG for consideration. Codified methodology will then be developed for selected options.

The workshop will draw upon discussions that were held at an initial, exploratory meeting held in September 2012, a review of the UK NEA and the UK country biodiversity strategies and the outcomes from a specialist session held at the 6th UK Biodiversity Indicators Forum (see accompanying background documents for further information), to refine the priority list of essential ecosystem services that have been identified through these processes, and help to identify relevant indicators and suitable datasets for their development. Consideration will also be given as to how indicators might be best portrayed to track the Aichi Targets at both the UK and country (i.e. England, Wales, Scotland, Northern Ireland) scales. Detailed objectives and a provisional agenda will follow shortly.

The meeting will be organised by UNEP-WCMC. Funds for travel and hotel accommodation will be provided, if required (although these will not be available for attendees from Agencies or Government).

Yours sincerely,

Andrew Stott,
Head of Biodiversity Evidence, Defra
Chair of the Biodiversity Indicators Steering Group (BISG)

Following COP10 of the CGB and agreement on the Aichi Targets, Lindsay was subsequently invited to contribute to a DEFRA/UNEP workshop which sought to identify appropriate indicators for the various Aichi Targets.

JNCC
Joint Nature Conservation Committee

JNCC Report

No. 445

Towards an assessment of the state of UK Peatlands

JNCC

April 2011

ISSN 0963 8901

2.10 The Daily Yomiuri and The Japan Times 2010. Headline announcement of agreement for Convention on Biological Diversity Strategic Plan and Aichi Targets, 31st October 2010.

2.11 Lindsay, R.A., 2010. UK Peatlands: Habitat restoration delivering ecosystem benefits. Host and keynote speaker at IUCN/DEFRA Side-Event at Convention on Biological Diversity (CBD) 10th Conference of Parties, October 2010, Nagoya, Japan

Based on his RO.1 Report, Lindsay was commissioned by the IUCN UK Peatland Programme to host and speak at a DEFRA-sponsored Side Event at COP10 of the Convention on Biological Diversity (CBD) to push for specific recognition of peatlands within the CBD Strategic Plan. Lindsay invited every official delegation to the event, with supporting briefing leaflet. Lindsay's presentation drew on the issues highlighted in his RO.1 Report, as well as the work of the IUCN UK Peatland Programme in promoting peatland restoration. The Strategic Plan and Aichi Targets for Biodiversity were finally agreed after intense negotiation, and peatlands explicitly feature in these Aichi targets.


Sunday: THE TIMES
Comment and news from Europe and the world, Pages 7-13
THE DAILY YOMIURI
COP10—Biodiversity
Genetic resource pact OK'd
COP10 delegates approve protocol on access, b

By Mikiko Miyakawa and Heather Howard
Daily Yomiuri Staff Writers

NAGOYA—Delegates from more than 190 countries adopted a protocol on access and benefit-sharing (ABS) of genetic resources early Saturday in Nagoya, following two weeks of strenuous meetings.

Participants gave a standing ovation to the chair of the meeting, Environment Minister Ryu Matsumoto, when the Nagoya Protocol and two other key documents were finally adopted at about 1:30 a.m. at the 10th Conference of the Parties to the Convention on Biological Diversity (COP10).

"Your wisdom, efforts, sweat and tears have been rewarded," said Matsumoto, who also served as COP10 president.

Participants also expressed satisfaction with the successful outcome: "It's important for the environment, for all ecological interests, and it is also important for the

Environment Minister Ryu Matsumoto, left, shakes hands with Ahmed Djoghlaf, executive secretary of the Convention on Biological Diversity, after the Nagoya Protocol and two other key documents were adopted at about 1:30 a.m. Saturday at the 10th Conference of the Parties to the Convention on Biological Diversity in Nagoya.

smh.com.au
The Sydney Morning Herald
Environment
UN seals historic treaty to protect ecosystems

ALL THE NEWS WITHOUT FEAR OR FAVOR
The Japan Times
Sunday, October 31, 2010
4TH EDITIO
COP10 signs off on protocol
Pact reached on biodiversity, genetic assets
Deal called biggest since '97 Kyoto pact

ANALYSIS
Eric Johnston
STAFF WRITER
Nagoya

Nearly two decades after its creation, the United Nations Convention on Biological Diversity has finally realized one of its main goals.

The Nagoya Protocol, approved early Saturday morning at COP10, formalizes rules for achieving the CBD's third objective, which is the fair sharing of benefits from genetic resources.

Adoption of the protocol is being hailed by delegates and nongovernmental organizations as one of the most important measures the world has ever taken against biopiracy, and the most important U.N. environmental agreement since the 1997 Kyoto Protocol.

Despite being couched in highly bureaucratic legal language, the Nagoya Protocol has the potential to affect is- turned to the people whose knowledge made their development possible.

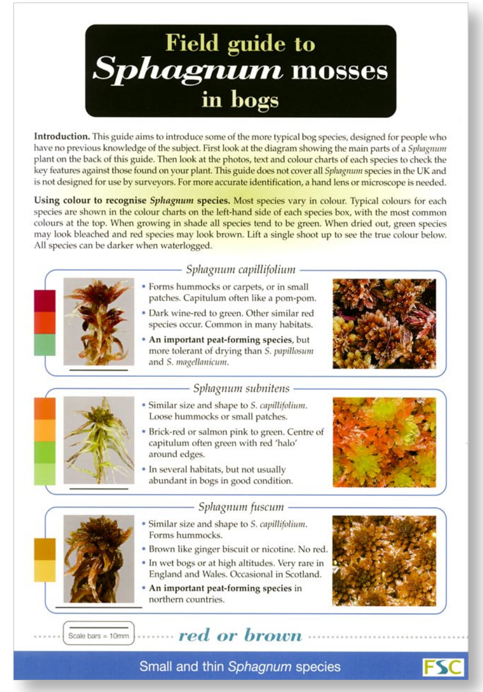
Under the Nagoya Protocol, access to genetic resources shall be subject to prior informed consent by the party that provides such resources. In addition, parties to the protocol are required to take appropriate measures in accordance with their domestic laws to ensure prior, informed consent or approval and involvement of indigenous and local communities is obtained for access to those resources.

In a separate section in the protocol on traditional knowledge, parties must establish ways to inform potential users of traditional knowledge associated with genetic resources about their obligations.

"The Nagoya Protocol is a crucial legal document that will help determine how we will deal with genetic resources. It creates a new balance, providing a fairness that was, until now, missing. . . . It of-

Nailed it: Environment Minister Ryu Matsumoto raises the hammer to end the COP 10 conference in Nagoya on Saturday.

2.12 O'Reilly, J., O'Reilly, C and Tratt, R. (2012) Field Guide to Sphagnum Moses in Bogs. Telford : Field Studies Council Publications. R.A.


Field guide to *Sphagnum* mosses in bogs

Introduction. This guide aims to introduce some of the more typical bog species, designed for people who have no previous knowledge of the subject. First look at the diagram showing the main parts of a *Sphagnum* plant on the back of this guide. Then look at the photos, text and colour charts of each species to check the key features against those found on your plant. This guide does not cover all *Sphagnum* species in the UK and is not designed for use by surveyors. For more accurate identification, a hand lens or microscope is needed.

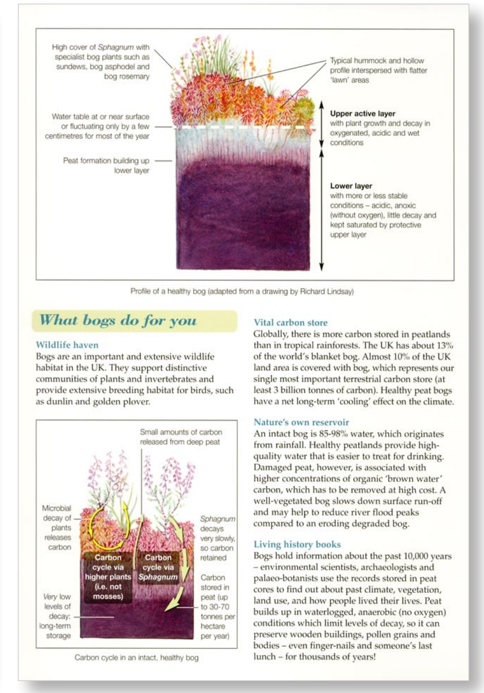
Using colour to recognise *Sphagnum* species. Most species vary in colour. Typical colours for each species are shown in the colour charts on the left-hand side of each species box, with the most common colours at the top. When growing in shade all species tend to be green. When dried out, green species may look bleached and red species may look brown. Lift a single shoot up to see the true colour below. All species can be darker when waterlogged.

Sphagnum capillifolium
- Forms hummocks or carpets, or in small patches. Capitulum often like a pom-pom.
- Dark wine-red to green. Other similar red species occur. Common in many habitats.
- **An important peat-forming species**, but more tolerant of drying than *S. papillosum* and *S. magellanicum*.

Sphagnum subnitens
- Similar size and shape to *S. capillifolium*. Loose hummocks or small patches.
- Brick-red or salmon pink to green. Centre of capitulum often green with red 'halo' around edges.
- In several habitats, but not usually abundant in bogs in good condition.

Sphagnum fuscum
- Similar size and shape to *S. capillifolium*. Forms hummocks.
- Brown like ginger biscuit or nicotine. No red.
- In wet bogs or at high altitudes. Very rare in England and Wales. Occasional in Scotland.
- **An important peat-forming species** in northern countries.

Scale bars = 10mm
red or brown
Small and thin *Sphagnum* species
FSC



Profile of a healthy bog (adapted from a drawing by Richard Lindsay)

What bogs do for you

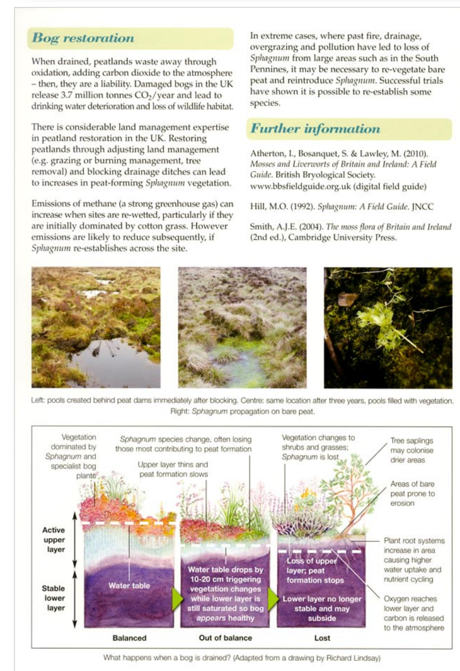
Wildlife haven
Bogs are an important and extensive wildlife habitat in the UK. They support distinctive communities of plants and invertebrates and provide extensive breeding habitat for birds, such as dunlin and golden plover.

Carbon cycle in an intact, healthy bog

Vital carbon store
Globally, there is more carbon stored in peatlands than in tropical rainforests. The UK has about 13% of the world's blanket bog. Almost 10% of the UK land area is covered with bog, which represents our single most important terrestrial carbon store (at least 3 billion tonnes of carbon). Healthy peat bogs have a net long-term 'cooling' effect on the climate.

Nature's own reservoir
An intact bog is 85-98% water, which originates from rainfall. Healthy peatlands provide high-quality water that is easier to treat for drinking. Damaged peat, however, is associated with higher concentrations of organic 'brown water' carbon, which has to be removed at high cost. A well-vegetated bog slows down surface run-off and may help to reduce river flood peaks compared to an eroding degraded bog.

Living history books
Bogs hold information about the past 10,000 years – environmental scientists, archaeologists and palaeo-botanists use the records stored in peat cores to find out about past climate, vegetation, land use, and how people lived their lives. Peat builds up in waterlogged, anaerobic (no oxygen) conditions which limit levels of decay, so it can preserve wooden buildings, pollen grains and bodies – even finger-nails and someone's last lunch – for thousands of years!


Bog restoration

When drained, peatlands waste away through oxidation, adding carbon dioxide to the atmosphere – then, they are a liability. Damaged bogs in the UK release 3.7 million tonnes CO_2/year and lead to drinking water deterioration and loss of wildlife habitat.

There is considerable land management expertise in peatland restoration in the UK. Restoring peatlands through adjusting land management (e.g. grazing or burning management, tree removal) and blocking drainage ditches can lead to increases in peat-forming *Sphagnum* vegetation.

Emissions of methane (a strong greenhouse gas) can increase when sites are re-wetted, particularly if they are initially dominated by cotton grass. However emissions are likely to reduce subsequently, if *Sphagnum* re-establishes across the site.

In extreme cases, where past fire, drainage, overgrazing and pollution have led to loss of *Sphagnum* from large areas such as in the South Pennines, it may be necessary to re-vegetate bare peat and reintroduce *Sphagnum*. Successful trials have shown it is possible to re-establish some species.

Further information

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Left: pools created behind peat dams immediately after blocking. Centre: same location after three years, pools filled with vegetation. Right: *Sphagnum* propagation on bare peat.

What happens when a bog is drained? (Adapted from a drawing by Richard Lindsay)


IUCN UK Committee Peatland Programme

The **International Union for the Conservation of Nature** (IUCN) is a global organisation, providing an influential and authoritative voice for nature conservation. The **IUCN UK Peatland Programme** promotes peatland restoration in the UK and advocates the multiple benefits of peatlands through partnerships, strong science, sound policy and effective practice.

www.iucn-uk-peatlandprogramme.org

THE HEATHER TRUST
Promoting Integrated Moorland Management

The Heather Trust is an independent charity dedicated to promoting high standards of moorland management across the whole of the UK. The Trust encourages sound management and seeks active knowledge exchange between researchers and land managers with a view to developing and promoting improved management techniques.

www.heathertrust.co.uk

The MoorLIFE Project is co-funded by the European Union's Life+ Programme and delivered by the Moors for the Future Partnership. Partners include Environment Agency, Natural England, National Trust, Peak District National Park Authority, United Utilities and Yorkshire Water.

www.moorsforthefuture.org.uk

Credits
This guide developed out of a successful land manager meeting in Whitfield, where game keepers and land owners suggested that a simple guide to *Sphagnum* bog mosses would be useful. We are grateful to Aletta Bonn, Simon Thorp and Louise Turner for their great support. We thank Simon Caporn, Richard Lindsay, Bryan Wheeler, PDNPA Rangers and MFF volunteers, Wildlife Trust staff, Natural England staff and many other reviewers for their significant input, as well as all the photographers.

Photographs
Ian Atherton (*Aulacomnium palustre, Dicranum scoparium, Plagiothecium undulatum*), John Birks (*S. fuscum*), Des Callaghan (close-up of *Sphagnum* shoots, *Odontoschisma sphagni, Polytrichum commune, S. denticulatum*), Sean Edwards (*Cladonia floerkeana, Hypnum jutlandicum, Rhytidiadelphus loreus, Sphagnum magellanicum*), David Genney (*Cladonia chlorophaea*), Robert Goodison (*Cladonia portentosa, S. capillifolium, S. cuspidatum, S. fimbriatum, S. subnitens*), GorgorsCymru (peat dams), David Holyoak (*Racomitrium lanuginosum, S. austinii, S. fallax, S. palustre, S. papillosum*), David Long (*Campylopus introflexus*), Moors for the Future (*Sphagnum* propagation), Graham Motley (*Pleurozium schreberi*), Sharon Pilkington (*S. tenellum*).

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FSC
Bringing Environmental Understanding To All

The FSC (Field Studies Council) is an independent educational charity committed to raising awareness about the natural world. The organisation works through a network of residential and day Centres throughout the UK providing courses for schools and colleges at all levels. A programme of leisure learning and professional development courses is offered. The FSC also provides outreach education and training and publishes many titles to support its work. This guide is part of the AIDGAP project and will be updated regularly. AIDGAP aims to produce user-friendly identification guides. We would be grateful for your comments. To make suggestions, or for more information about the FSC, please contact:

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3 WORKSHOPS, LECTURES and STRATEGY

supporting documents in folder

3.1 Lindsay, R.A. (2013), Course Leader, *Shetland training course*, Shetland Amenity Trust - Shetland, Lerwick, August

3.2 Lindsay, R.A. (2013), Contributor. Participation in *MoorFutures Workshop* - Moore Foundation, Berlin, January

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3.5 Lindsay, R.A., (2011), 'Peatlands and Carbon: restoration at the leading edge', presentation to British Ecological Society Conservation Ecology Specialist Group Conference *Peatlands : Restoration and Carbon*, Preston, June

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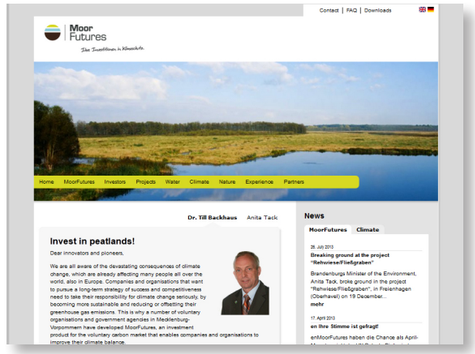

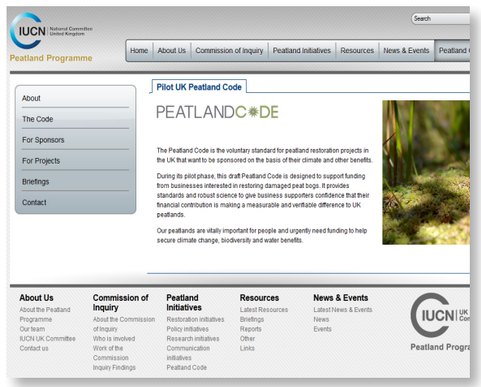

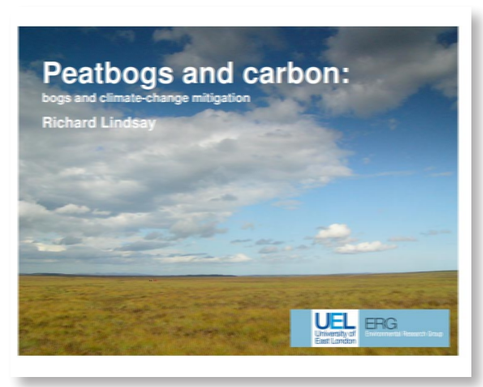

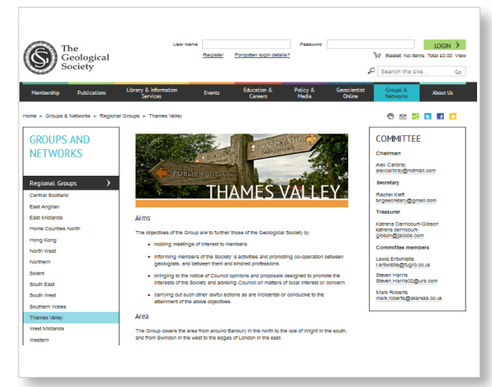

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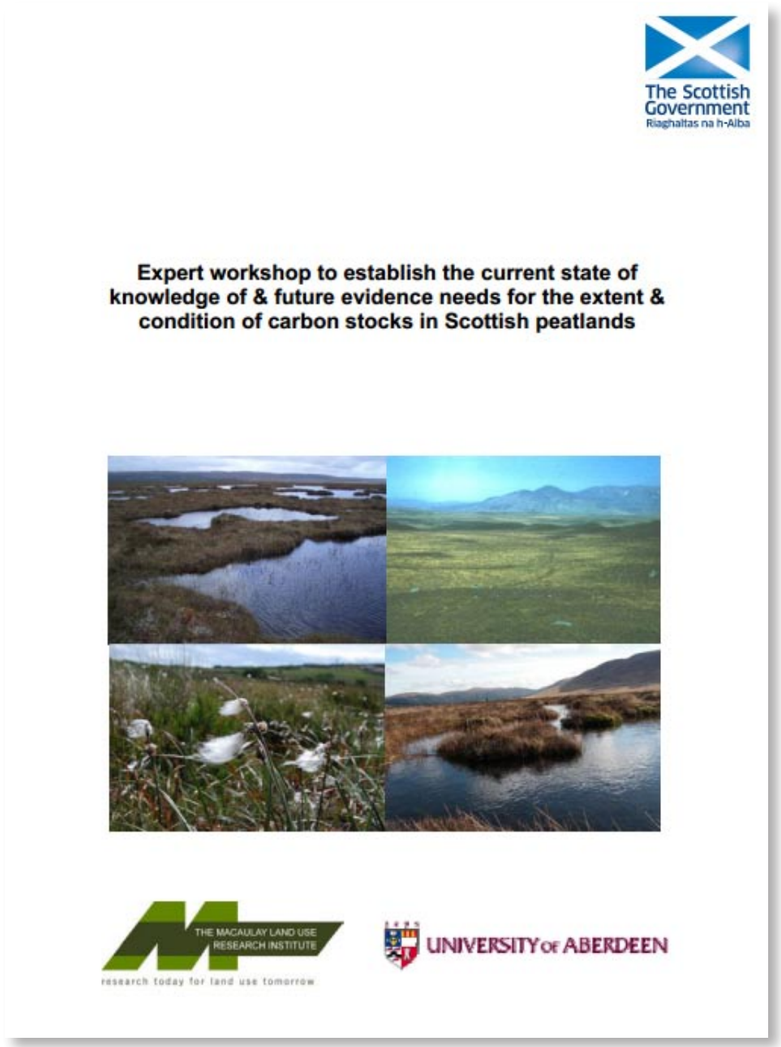

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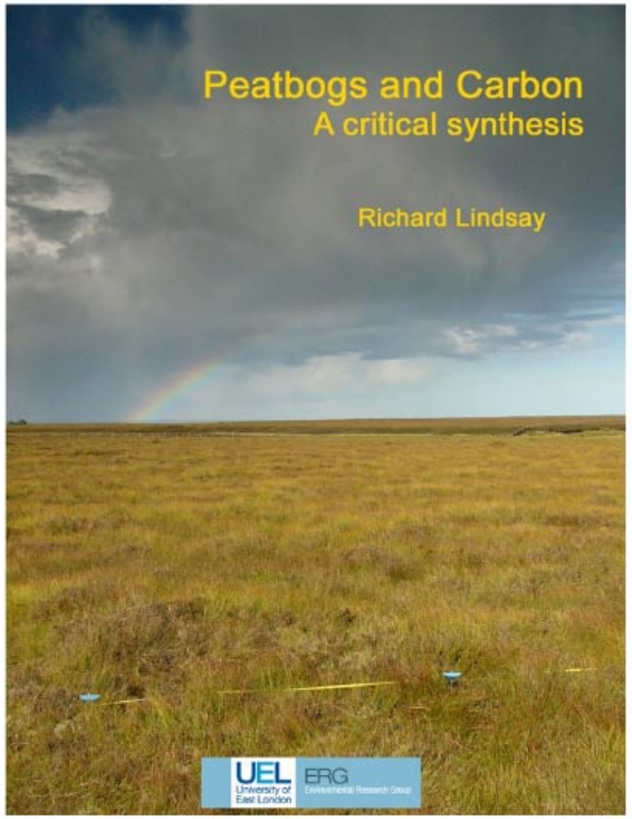

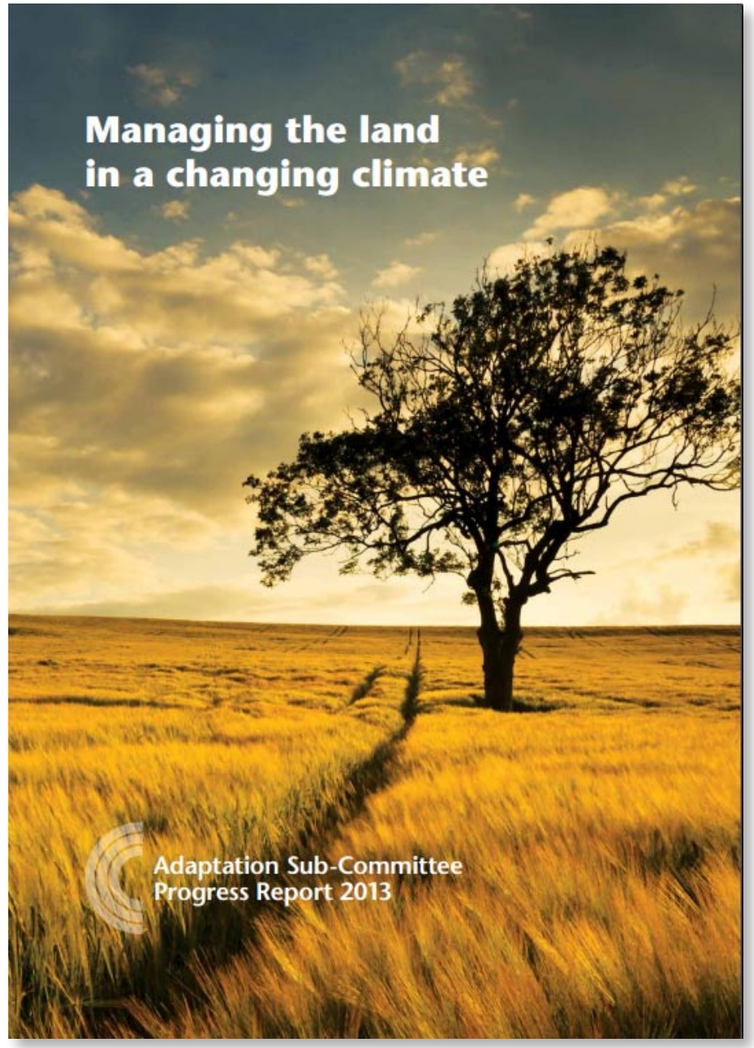

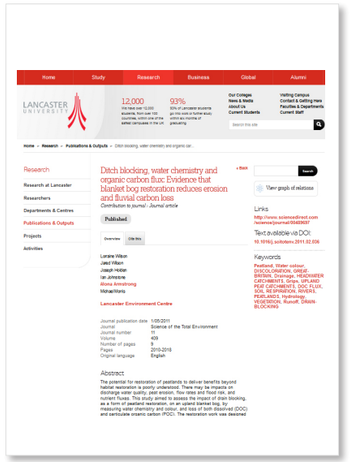

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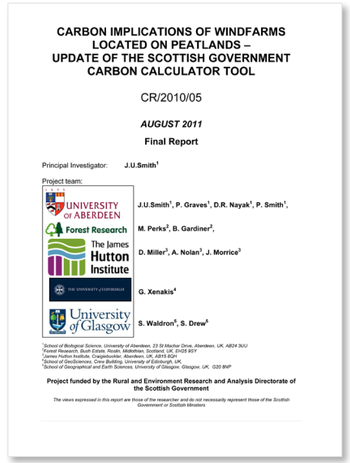

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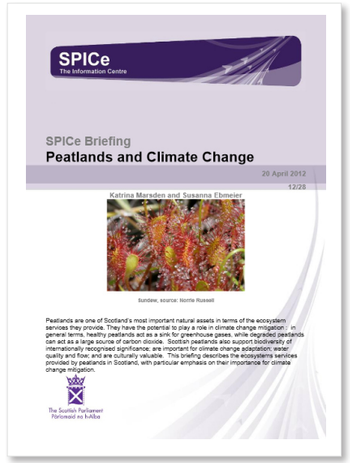

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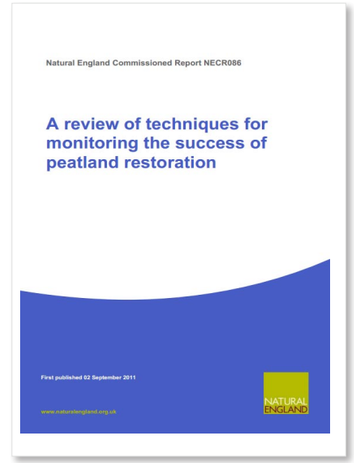

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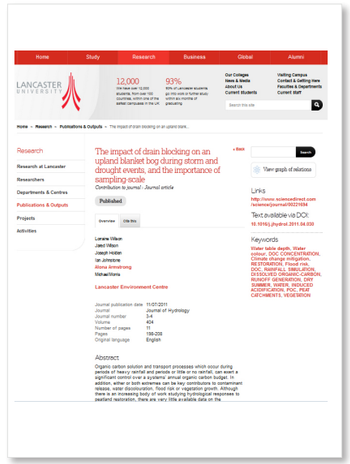

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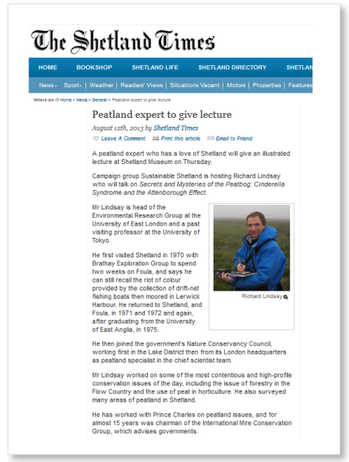

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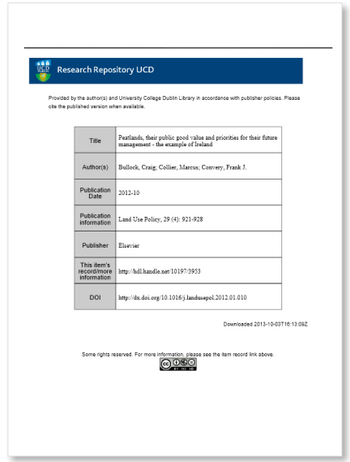

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