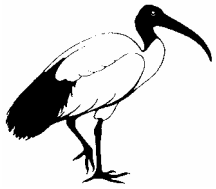

BRITISH ORNITHOLOGISTS' UNION

WIND, FIRE & WATER:
RENEWABLE ENERGY & BIRDS

THE UNIVERSITY OF LEICESTER
1 – 3 APRIL 2005

BRITISH ORNITHOLOGISTS' UNION
ANNUAL SPRING CONFERENCE

supported by
Royal Society for the Protection of Birds
Department of Trade and Industry
Renewables Advisory Board
British Wind Energy Association
English Nature

BRITISH ORNITHOLOGISTS' UNION
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Wind, Fire & Water: Renewable Energy & Birds
A BOU conference held at the University of Leicester, 1-3 April 2005.

The **British Ornithologists' Union** (BOU), founded in 1858 by Professor Alfred Newton FRS, is one of the world's oldest ornithological bodies. The BOU's aim is to promote ornithology and a better understanding of ornithology, birds and related issues, within the scientific and birdwatching communities.

To help achieve this aim, the BOU organises regular meetings, seminars and conferences at which ornithologists and others can discuss and learn more about work being undertaken around the world and topical ornithological issues.

The has been organising BOU conferences and meetings for over 100 years, and they provide an opportunity for people, from widely differing professional backgrounds, to explore and relate to a discrete scientific theme of common interest. Recent topics have included *Lowland Farmland Birds* (in 1999 with follow up conference being held in March 2004), *Long-term Studies of Birds* and *Birds & Public Health*. Such meetings help to promote understanding of environmental issues and the sharing of knowledge, the presentation of contentious academic theories to critical public debate and the defence of such ideas lie at the heart of healthy science.

The BOU further achieves its aim by the quarterly publication of our international journal - *Ibis*. Established in 1859, *Ibis* - the world's leading ornithological journal - publishes work at the cutting edge of our understanding of the world's birdlife, be it behaviour, population dynamics, systematics, breeding biology, taxonomy, habitat use or conservation. *Ibis* is available in print and online – visit www.ibis.org.uk.

Acknowledgements
Wind, Fire & Water: Renewable Energy & Birds was a conference organised by Rowena Langston (The RSPB) and Steve Dudley (BOU) on behalf of the British Ornithologists' Union.

The BOU and the conference organisers are grateful to Richard Evans (The RSPB) for co-ordinating the poster presentations for the conference, to Guy Anderson (The RSPB) and Sam Gardner (The RSPB) for their assistance with the audio-visual facilities and to Alison McLennan (The RSPB) for help during the question/discussion sessions.

The BOU is grateful to the individual speakers and their respective organisations for presenting their work at the conference.

The proceedings of this conference will be published as a supplement of *Ibis* thanks to support from The RSPB, Department of Trade and Industry, Renewables Advisory Board, British Wind Energy Association and English Nature.

PROGRAMME

The venue is DIGBY HALL unless otherwise stated

FRIDAY, 1 APRIL

1700	**Conference registration** (Digby Hall) and **accommodation check in** (Stamford Hall)
1900	**Dinner (Stamford Hall)**
Chair	*Dr David Gibbons (The RSPB)*
2030	**Potential impacts of climate change upon birds** *Prof Brian Huntley (University of Durham)*

SATURDAY, 2 APRIL

0830	**Registration**
0900	**Welcome to the conference** *Prof Christopher Perrins, BOU President*
0905	**Opening of conference on 'Renewable Energy and Birds'** *Elliot Morley MP, Minister for Environment and Agri-Environment*
Session 1	**Overview of climate change and renewable energy**
Chair	*Prof Chris Perrins (BOU President / University of Oxford)*
0915	**The impacts of current energy generation and the need for renewables** *John Lanchbery (The RSPB)*
0940	**Overview of renewable energy in the UK — policy drivers and market readiness** *Catherine Mitchell (Warwick Business School)*
Session 2	**Wind Energy I**
1005	**Wind energy, technology and capability** *Chris Tomlinson (British Wind Energy Association)*
1030	**Birds and wind farms** *Allan Drewitt (English Nature)*
1050	**Coffee and time to view posters**
Session 3	**Wind Energy II**
Chair	*Dr Carolyn Heeps (The Crown Estate)*
1130	**Wind turbines as obstacles to migrating birds** *Prof Colin Pennycuick (University of Bristol)*
1155	**Upland bird studies and wind farm collision risk models with reference to raptors** *Mike Madders (Natural Research)*
1220	**Experience of wind farms on Smøla (Norway) in relation to White-tailed Sea Eagle** *Alv Ottar Folkestad (Norwegian Sea Eagle Project)*
1245	**Radio telemetry as a tool for impact assessment of wind farms: the case of Little Terns at Scroby Sands, Norfolk, UK** *Martin Perrow (ECON Ecological Consultancy)*
1315	**Lunch and time to view posters**

SATURDAY, 2 APRIL (CONTINUED)

Session 4 **Wind Energy III**

Chair *Philip Bloor (Department of Trade and Industry)*

1430 **Remote techniques for observing bird behaviour: a review with special reference to offshore wind power installations**
Mark Desholm (National Environmental Research Institute, Denmark)

1455 **Bird migration studies and potential collision risk with wind turbines**
Ommo Hüppop (Vogelwarte Helgoland, Germany)

1520 **Disturbance displacement of Common Scoters in relation to wind farms**
Richard Caldow (Centre for Ecology & Hydrology)

1545 **Research needs for adequate environmental impact assessment, including cumulative impacts of wind farms on birds**
Prof Tony Fox (National Environmental Research Institute, Denmark)

1610 **Coffee and time to view posters**

Session 5 **Testing solutions by experiment**

Chair *Prof Jeremy Greenwood (BTO)*

1640 **Tidal current energy technologies**
Prof Peter Fraenkel (Marine Currrent Turbines)

1650 **Tidal barrages and birds**
Nigel Clark (British Trust for Ornithology)

1730 **Behaviour based models — habitat loss and disturbance**
Richard Caldow (Centre for Ecology & Hydrology)

1800 **BOU Annual General Meeting**

2000 **BOU Annual Dinner** (Stamford Hall)

SUNDAY, 3 APRIL

0830 **Registration**

Session 6 **Energy from Wave and Hydro**

Chair *Dr Fred Slater (University of Cardiff)*

0900 **An overview of wave energy in the UK**
Michael Hay (British Wind Energy Association)

0925 **Hydro technology in the UK**
Alastair Gill (RWEnpower Renewables)

0950 **Hydropower and environmental regulation - a Scottish perspective**
Paul Copestake (Scottish Environmental Protection Agency)

Session 7 **Energy from Biomass**

1015 **Biomass for renewable energy generation, including forestry, short rotation coppice and Miscanthus**
Malcolm Fergusson (Institute of European Environmental Policy)

1040 **A review of birds using energy crops in Britain and findings from an extensive study of birds in commercial willow SRC**
Rufus Sage (Game Conservancy Trust)

1100 **Coffee and time to view posters**

Session 8 **Round up and the way forward**

Chair *Prof Ian Newton (Centre for Ecology and Hydrology)*

1135 **Overview of key points from presentations & discussions**
What the technologies involve, scale required for UK energy supply, potential impacts on birds

1200 **Plenary discussion**
i) research needs and development of innovative study techniques, international collaboration, dealing with cumulative impacts
ii) technology — what is needed to bring to market, impact reduction, proper assessment of biodiversity costs set against other cost benefits)

1300 **Conference conclusion**
Mark Avery (The RSPB)

1315 **Lunch and departure**

POTENTIAL IMPACTS OF CLIMATE CHANGE UPON BIRDS

Brian Huntley
University of Durham

Birds, in common with other terrestrial organisms, are expected to exhibit one of three general responses to climatic change: they may adapt to the changed conditions without shifting location; they may show a spatial response, adjusting their geographical distribution to maintain dynamic equilibrium with the changing climate; or, if they are unable to achieve a sufficient response by either or both of these mechanisms, they will be at risk of extinction. The Quaternary geological record provides examples of organisms that responded to the climatic fluctuations of that period in each of these ways, but also indicates that the primary response of most species was spatial.

The potential climatic changes of the near future have important characteristics that differentiate them from the largest magnitude and most rapid of climatic changes of the Quaternary. These potential climatic changes are thus a cause for considerable concern in terms of their possible impacts upon biodiversity.

The relationships between the geographical distributions of birds and the present climate have been modelled for species breeding in both Europe and Africa. The resulting models have very high goodness-of-fit and provide a basis for assessing the potential impacts of anthropogenic climatic changes upon avian diversity in the two continents. Simulations made for a range of general circulation model projections of late 21st century climate lead to the conclusion that the impacts upon birds are likely to be substantial. The boundaries of many species' potential geographical distributions are likely to be shifted by up to 1000 km, and in some cases even more. There is likely to be a general decline in avian diversity, with the mean extent of species' potential geographical distributions likely to decrease. Species with restricted distributions and specialised species of particular biomes are likely to suffer the greatest impacts. Migrant species that breed in Europe and winter in sub-Saharan Africa also are likely to suffer large impacts as climatic change alters both their breeding and wintering areas and also potentially increases the distances they must migrate seasonally between the two.

Without the implementation of new conservation measures, these impacts are likely to be exacerbated by land-use change and associated habitat fragmentation. Unless strenuous efforts are made to address the root causes of anthropogenic climatic change, much current effort to conserve biodiversity will be in vain.

Biography
Graduate of the University of Cambridge, where he also completed his PhD. Post-Doctoral Fellow at Trinity College, Dublin and subsequently Research Assistant at Cambridge. Appointed to a Lectureship at Durham in 1981; promoted Professor in 1996; Head of School since 2000. Research interests: how species and ecosystems respond to, and interact with, the changing global climate.

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THE IMPACTS OF CURRENT ENERGY GENERATION AND THE NEED FOR RENEWABLES

John Lanchbery
Head of Climate Change Policy, RSPB, The Lodge, Sandy, Beds, SG19 2DL, UK

The RSPB consider that climate change poses the single biggest long-term threat to birds and other wildlife. Early in 2004, for example, a paper was published that assessed the extinction risks for sample regions covering about 20% of the Earth's terrestrial surface, including parts of Australia, Brazil, Europe, Mexico and South Africa. It concluded that '15 to 37% of species in our sample of regions and taxa will be "committed to extinction" as a result of mid-range climate warming scenarios for 2050". Indeed, there is evidence that the degree of change that has already occurred is affecting some species and ecosystems adversely. For example, there is evidence that last year's

large scale breeding failure of sea birds on the North Sea Coast of Britain was, in large part, caused by climate change.

We thus need to keep any further climate change to a minimum, and the lowest practically achievable limit on mean global temperature rise is probably to peak at 2 Celsius above pre-industrial levels. To stay below 2 Celsius, we need to keep atmospheric concentrations of greenhouse gases, mainly caused by fossil fuel burning for energy, to below 450ppmv, possibly lower. This will, in turn, entail a downturn in global emissions within the next decade and global cuts of 80% or more by the end of the century. For developed countries, greater cuts will be necessary.

The UK has set itself a target to reduce carbon dioxide emissions by 60% by 2050. There are two main ways of achieving this target: by reducing energy demand (largely by energy efficiency) and by clean energy supply, such as renewable electricity generation. To achieve deep emission cuts by either means would be hard, however, and so both will be needed to meet the UK target. In practice, renewable generation will initially be largely from wind, both on and offshore, because this is the nearest market of the renewable technologies and the main policy driver for renewable generation (the Renewables Obligation) favours those technologies that are nearest market.

Biography
John Lanchbery is head of climate change policy at the RSPB. He has worked on climate policies issues since 1991, starting with work on the negotiations that led to the UN Convention on Climate Change in 1992. Prior to that, John conducted resarch in plasma and condensed matter physics at the Electrical Research Association.

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OVERVIEW OF RENEWABLE ENERGY IN THE UK – POLICY DRIVERS AND MARKET READINESS

Dr Catherine Mitchell
Warwick Business School

The UK's climate change and energy policy has central twin planks of increasing the amount of energy used from renewable energy sources relative to fossil or nuclear based power and reducing the total demand for energy. While successful in some spheres on the demand side, overall the Government's delivery of these policy objectives cannot be said to be successful.

The UK has a target for supplying 10% of electricity from renewable electricity sources by 2010. A proposal to increase this to 15% by 2015 is under discussion and there is an aspiration for 20% to be supplied by 2020. The UK currently supplies about 2.5% of electricity from renewable electricity sources and only about 1% (i.e. from 1.5%) has been added since 1990 when support for renewables in the UK began. Meeting the targets is therefore a major challenge for the Government. It will be important that all those in the UK who would wish to generate electricity or produce heat from renewables are helped to do so. Similarly, it is important that consumers are able to reduce their demand as they wish and have choices over their consumption.

The mechanism for supporting renewable energy in the UK, the renewable obligation (RO), is almost unique in Europe in that it is a market based mechanism and this has led to it primarily supporting wind power. While wind power is a very valuable source of electricity (and central to meeting the 2010 target), the RO has not been successful in supporting more diverse sources of renewable electricity or non-electricity technologies. Moreover, it has, on the whole, been beneficial to the large ex-monopoly electricity companies and it has not supported small scale developments nor new entrant companies. The paper puts forward various recommendations for an improvement to policy.

While some sources of renewable electricity are competitive, others are not. Moreover, the scale of the development also affects their competitiveness. The paper discusses this and also places renewable heat and generation in to the context of the wider energy market and within the context of energy regulation. It provides an overview of the various barriers to deployment of renewables

and puts forward thoughts on the alternatives to a renewable energy and energy efficiency based energy policy.

Biography
Dr. Catherine Mitchell works on energy policy and regulation issues. She was a member of the Government's Energy Advisory Panel from 1998-2003 and was seconded to the Cabinet Office as a team member of the Performance and Innovation Unit's Energy Review during 2001.

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WIND ENERGY: TECHNOLOGY AND CAPABILITY

Chris Tomlinson
British Wind Energy Association

Chris Tomlinson will outline the progress which is being made in meeting the wind energy element of the renewable energy targets for 2010. He will explore how and where the remainder of the wind energy element will need to be met.

While Chris is self admittedly not a technical expert, wind turbine technology in the broadest sense has moved on in leaps and bounds over the last decade. Chris will update delegates on the current specifications of a modern wind turbine, the power it generates and the homes it supplies. This provides the clue as to why we do not need tens of thousands of wind turbines to meet our target, as some would claim.

Even when the technology and capability is evident, there are still a range of factors which need to be considered in the exact siting of wind farms. BWEA is this year updating its Best Practice Guidance for developers, and during the presentation, Chris will be highlighting the key locational factors for finding suitable sites, as well as answering some of the frequently asked questions on the subject of wind farms.

Finally, in the spirit of the conference Chris will present some approaches wind farm developers use in collecting data for Environmental Impact Assessments. He will also investigate the monitoring procedures used post construction and the benefits this can provide for a better understanding of wind farms and potential impacts on birds.

Biography
Chris Tomlinson is the Head of Onshore Wind at BWEA where he has worked for nearly 3 years. Having qualified in Planning in 1996 Chris spent nearly 6 years working in local government planning and urban regeneration. He moved to BWEA as the Head of Planning and now covers the full range of onshore issues.

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BIRDS AND WIND FARMS

Allan Drewitt [1*] & Rowena Langston [2]
[1] English Nature
[2] RSPB, The Lodge, Sandy, Bedfordshire, SG19 2DL, UK

The potential effects of the proposed increase in wind energy developments on birds are explored using information from studies of existing wind farms. Evidence of the four main effects, collision mortality, displacement due to disturbance, barrier effects and habitat loss, is presented and discussed. The requirements for assessments of the potential impacts of future developments are summarised, including appropriate methods for undertaking baseline surveys and post-construction monitoring, with particular emphasis on the rapidly developing area of offshore wind farm assessments. The presentation also summarises the mitigation measures which have the potential to

minimise impacts, where these are likely. Finally, we explore recent developments in the monitoring and research of wind energy impacts on birds and outline some areas for future work.

Biography
Allan Drewitt is a Senior Ornithologist with English Nature. He has worked for EN and the former Nature Conservancy Council, for 19 years. Currently, his main role is to provide advice to EN staff and partner organisations on a wide range of ornithological topics related to habitat management and site protection.

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WIND FARMS AS OBSTACLES TO MIGRATING BIRDS.

Professor Colin J. Pennycuick
University of Bristol

Like other obstructions, wind turbines present little hazard to migrating birds that are dispersed horizontally and vertically, but become hazardous when sited at a point where a migration stream tends to concentrate. The first step in managing the hazard is to identify concentration points, and avoid them when siting turbines. Some concentration points operate even in fine weather, being caused by geographical features such as a mountain pass, or the start or finish point of a sea crossing. Others come into effect when migrating birds are forced down by low cloud. As the cloud comes down ahead of an approaching low-pressure system, any migration stream is concentrated below the "cloudbase" level, eventually forcing birds to fly in the height band occupied by obstructions. When these conditions occur at migration times, they cause heavy mortality at TV towers and bridges. The same effect will occur at wind farms on a larger scale, because of the large numbers of turbines usually deployed. The hazard can be reduced to some degree at the planning stage by siting turbines on high ground, and avoiding gaps in the hills, because these become concentration points when cloudbase descends below the hill tops.

The proposed wind farm on Lewis in the Outer Hebrides coincides with a well known concentration point for migrating Whooper Swans, at the British end of the shortest sea crossing between the British Isles and Iceland. Being underpowered because of their large size, these birds usually fly low, and have very limited capacity for sudden climbs or changes of course. This makes them vulnerable to collision hazards, especially overhead cables. It is possible that Whooper Swans might pass safely below the proposed turbine discs, but overhead cables are lethal to swans, and would have to be replaced in the design by underground cables. As a large fraction of the Whooper population passes through the proposed wind farm site twice in each year, the project is likely to cause continuing attrition of the population, probably above the level that can be offset by reproduction, even without overhead cables. This will not be popular in Iceland. The environmental survey at the Lewis site failed to identify this problem, obvious though it is.

Current survey methods concentrate on occupancy by breeding and wintering birds, but do not address the heights at which birds fly, or identify factors that concentrate flying heights and tracks into the region occupied by the turbines. Specially designed surveys are needed to identify concentration points on migration routes, and to measure the heights at which both resident and migrating birds fly, to determine whether they use the height band occupied by any proposed turbines. Flying heights can be measured in daylight with rangefinding binoculars (Leica Vector) interfaced to a laptop computer, while tracking-radar surveys could be used to identify concentration points that occur when nocturnal migrants are forced down by low cloud.

Biography
Colin Pennycuick, Senior Research Fellow, University of Bristol. Mechanics of bird flight, including ground-based tracking, satellite tracking, observations from aircraft, and wind tunnel experiments. Published program "Flight for Windows" estimates flapping, gliding and migration performance for any bird without using statistics (www.bio.bristol.ac.uk/people/pennycuick.htm).

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UPLAND BIRD STUDIES AND WINDFARM COLLISION RISK MODELS WITH REFERENCE TO RAPTORS

Mike Madders
Natural Research Ltd

Government targets on renewable energy coupled with anthropogenic constraints on development have resulted in a surge in proposals to locate windfarms in upland areas, where they may conflict with the wellbeing of scarce or rare species of bird including raptors. European and UK legislation demand that the effects of windfarm developments, both individually and in combination, be assessed to determine the level of impact on these species.

One way in which birds can be affected is through increased mortality as a result of collision with turbine rotors, overhead lines and guy wires that support wind performance monitoring masts. Few long-term studies on the effects of windfarms have been undertaken and there is a need for better understanding of the numbers of birds likely to be killed at the site level in order to inform planning decisions.

A modelling approach has been developed that attempts to quantify the theoretical risk of collision. This is a valuable tool for impact assessment and its use is now widespread. However there are practical problems associated with gathering the data required to run the model and numerous assumptions must be made concerning bird behaviour. This can lead to deficiencies in the input parameters which potentially have a large effect on the model outputs and yet are rarely acknowledged. In addition, the model outputs are usually adjusted to take account of turbine avoidance by birds and this aspect of birds' behaviour is poorly understood. As a result of these limitations collision predictions are indicative only, and more reliable in some situations, and for some species, than others.

The effects of predicted increases in mortality due to collision at the population scale can be explored by further modelling. Here again there is much variation between species in the availability and quality of the necessary input data.

The use and usefulness of collision and population models are illustrated through case studies of upland bird species (mainly raptors) in Scotland. Preliminary findings from ongoing post-construction studies are presented. The use of predictive spatial models to reduce the likelihood of bird collisions, both at the design and post assessment stages, is examined in relation to golden eagles and hen harriers.

Biography
Dr Mike Madders is a Director of Natural Research Ltd, a registered charity that undertakes wildlife research. Professionally involved in raptor research for 30 years, he has undertaken studies on white-tailed eagle, golden eagle and hen harrier. His recent work has focussed on the effects of windfarms on upland birds.

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EXPERIENCE OF WIND FARMS ON SMØLA (NORWAY) IN RELATION TO WHITE-TAILED SEA-EAGLE

Alv Ottar Folkestad
Norwegian Sea-Eagle Project

The Norwegian company Statkraft got the licence for developing a windfarm on the island Smøla, Mid-Norway in December 2000. The Smøla archipelago has been designated an Important Bird Area (IBA) since 1989 with international importance for a wide variety of bird species, particularly wetland and coastal birds. Attention has been focused on the breeding population of White-tailed

Sea-eagle, estimated at least at 65-70 territorial pairs, most of them nesting on the ground in a very low and barren landscape of heath, moors and mires. The EIA for the windfarm concluded that the development of a windfarm in this area was expected to have a detrimental effect on nature and particularly on a number of bird species, several on the national or international red list, with the White-tailed Sea-eagle as a key species. BirdLife International brought the Smøla case to the Bern Convention Standing Committee in 2001 saying that the licence was in conflict with a number of the statements in the Bern Convention. Based on the fact that the Norwegian Government said that mitigation measures should be put forward to reduce the negative effects of the windfarm, the Standing Committe decided not to open a case file against Norway.

The Norwegian Ornihological Society (BirdLife Norway) in cooperation with the Norwegian Government and a number of nature conservation societies has been running a national monitoring program on the White-tailed Sea-eagle from 1974 onwards, including the Smøla archipelago. Based on these studies there has been established a study on the effects of the develompent of a windfarm in the breeding grounds of the Sea-eagles on Smøla. The studies include the pre building situation with the status of nesting pairs in and close to the windfarm and their reproductive output, compared to the situation during the period of developing and finally operating the windfarm. The Smøla windfarm has been developed in two stages, stage 1 including the first 20 windmills, running from September 2002, and stage 2 with an additional 48 windmills planned to be producing power from the autumn 2005.

The Norwegian Institute for Nature Research (NINA) is responsible for the impact studies of Smøla windfarm on the breeding Sea-eagle population, and the Sea-eagle Project is doing the field studies. The studies include monitoring of the annual breeding status, including the reproductive output, ringing the eaglets according to the international colour ringing scheme, and finally a number of nestling have been tagged with transmittors for satellite GIS to track the movements of the juveniles after fledging.

This paper gives the results of the studies on Smøla so far, including the experience of the effects of human disturbance and activity on the nesting sea-eagles during the pre windpower period, and the nesting and reproduction data from the period of construction and running Smøla Windfarm stage 1, and the Smøla Windfarm stage 2 for the years 2003 and 2004.

Biography
Biologist working with nature management at the governmental, regional and local administration. Head of the BirdLife Norway Sea-eagle Project 1974-2005. Responsible for a number of surveys and monitoring programs on coastal birds within BLN, from 1997 especially windpower and birds, particularily the Smøla Windfarm case.

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RADIO TELEMETRY AS A TOOL FOR IMPACT ASSESSMENT OF WIND FARMS: THE CASE OF LITTLE TERNS *STERNA ALBIFRONS* AT SCROBY SANDS, NORFOLK, UK.

Martin R. Perrow *, Eleanor R. Skeate, Paul Lines & Mark L. Tomlinson
ECON Ecological Consultancy, Biological Sciences
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Many seabirds travel widely to exploit patchily distributed prey resources such as fish. Even profitable patches may only be utilised briefly as prey become available, perhaps depending on the state of the tide and other environmental factors. Assessing the relative importance of particular areas occupied by windfarms thus relies on sufficient effort (frequency and intensity of sampling) to increase the probability of detection and later assessment to an acceptable level. Conventional techniques for evaluating the usage of areas by birds such as boat-based and aerial surveys, suffer from the high cost of sampling and the need to cover large areas, which tends to lead to infrequent sampling of patches. Remote techniques, which continuously sample the habitat, may offer a solution although sufficient coverage may be difficult to achieve and a large amount of analytical time is likely to be required to compensate for negligible use of many areas by birds. *Monitoring the*

bird using its habitat rather than *monitoring the habitat waiting for the bird to use it* is intuitively a more efficacious approach.

In this paper, we outline experiences of the use of radio telemetry upon Little Tern *Sterna albifrons* at its most important population in the UK, centred on the North Denes/Winterton SPA for the species. The wind farm of 30 turbines at Scroby Sands approaches to a minimum of 3 km immediately offshore of the North Denes colony, which in the recent past has frequently held >10% of the UK population of this species classified as in chronic long-term decline. Little terns had not been radio-tagged before in the UK and the lack of previous experience coupled with the technical difficulties of tagging and subsequently following a small (22-24 cm in length and 55g in weight) diving seabird limited data collection. However, comparative data from two years (2003 and 2004), in which the abundance of the terns preferred prey (young-of-the-year Clupeid fish especially Herring *Clupea harengus*) varied massively, revealed striking differences in activity and foraging patterns. Whilst boat-based surveys (and even foraging observations from shore) revealed broadly similar trends, radio telemetry has begun to illustrate the startling scope of these birds, which have been recorded travelling up to 25 km in a single foraging bout to over 3 km offshore whilst flying at a speed of up to 74 km hr^{-1}.

The potential value of radio (and satellite) telemetry in illustrating the scope of habitat use, perhaps to set precautionary distance limits for windfarms potentially overlapping with species of particular conservation concern (e.g. Sandwich Terns *Sterna sandvicensis* in relation to developments in the East Anglian Wash) as well as defining actual use of particular areas including for collision risk assessment is discussed.

Biography
Dr Martin Perrow founded ECON with the aim of bridging consultancy and research driven by the needs of biodiversity and development. Recent work on Little Terns combines his long standing interests in interactions especially those involving fish in aquatic habitats, protected species, sampling problems, anything with feathers, boats and fieldwork.

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REMOTE TECHNIQUES FOR OBSERVING BIRD BEHAVIOUR: A REVIEW WITH SPECIAL REFERENCE TO OFFSHORE WIND POWER INSTALLATIONS

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Since the early 1990s, marine windfarms have become a reality, and no fewer than 13,000 offshore wind turbines are currently proposed in European waters. Great public concerns exist that these man-made utility structures will have a significant negative impact on the many waterbird populations migrating and wintering at sea. We will specifically assess the degree of usefulness as well as the limitations of different remote technologies for studying bird behaviour in relation to bird-turbine collisions at offshore windfarms. Radar is one of the more powerful tools available to describe the movement of birds in three-dimensional space, and although this technique cannot measure bird-turbine collisions directly it offers the opportunity to parameterise input data for collision models. Thermal Animal Detection System (TADS) is an infrared-based technology developed as a means of gathering highly specific information about actual collision rates, but also for parameterisation of input data for collision models. These data include avoidance behaviour by birds in the close proximity to turbine rotor-blades, flock size, and flight altitude. The review also assesses the possibilities and potential of other (some as yet undeveloped) techniques for collecting information on bird flight and behaviour both pre- and post-construction of the offshore windfarms. These include the use of ordinary video surveillance equipment, sound systems, pressure sensors, etc.

Biography
M.Sc. Mark Desholm is a Ph.D. student at the Danish National Environmental Research Institute. His research interests concentrate on the local effects on birds from offshore windfarms and on the

resulting impacts at the population level. Mark has undertaken the development of TADS and uses radar and population matrix models in his research.

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BIRD MIGRATION STUDIES AND POTENTIAL COLLISION RISK WITH WIND TURBINES

Ommo Hüppop
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Are migrating birds threatened by wind turbines?

This is a difficult question! How can we answer it?

Germany is the world leader in the use of wind energy. Since sites for the erection of wind turbines have become scarce on land, ambitious plans have arisen for the offshore regions. So far, there are applications for 31 sites within the German Exclusive Economic Zone (EEZ), in the North and Baltic Seas, comprising up to 12,000 wind turbines. If all of these are realized, more than one quarter of the German EEZ (> 13,000 km^2) will be occupied by windfarms. Seven pilot projects have been approved, but two others were rejected because of large concentrations of resting birds in these respective areas.

Since several 100 millions of birds cross the North and Baltic Seas at least twice every year, the governmental regulation for the construction of technical buildings at sea ('Seeanlagenverordnung') says that licensing is not allowed if the buildings threaten bird migration. Birds are potentially endangered by offshore windfarms through collisions, barrier effects, and habitat loss. To judge these potential risks, the occurrence of birds in space and time as well as details on their behaviour in general (migration, influence of weather) as well as their behaviour when facing windfarms (flight distances, evasive movements, influence of light, collision risk) need to be known. Furthermore, the influences of construction and maintenance works have to be assessed.

The Institute of Avian Research "Vogelwarte Helgoland" investigates bird migration over the North Sea. The main objectives with regard to the offshore windfarms are to assess data on annual and daily phenology, flight altitudes and species composition. These data can contribute to estimations on collision risks at offshore windfarms, the possible impacts on bird populations and possible mitigation measures.

Results from measurements with different techniques, including radar, thermal-imaging, visual and acoustic observations, are compiled, giving fairly detailed information on bird migration across the North Sea. Where real data are missing, or will be impossible to collect, modelling approaches have been used. The combination of both observations and theoretical considerations, can give us first insights into the potential risks of wind turbines for migrating birds.

Biography
PhD on energetics of free-living Herring Gulls at the University of Hamburg in 1988. Since 1988 head of the "Inselstation" of the Institute of Avian Research "Vogelwarte Helgoland" on the small island of Helgoland (southeastern North-Sea). Research topics: Bird migration, seabird ecology, effects of human activities and climate change on birds.

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DISTURBANCE DISPLACEMENT OF COMMON SCOTERS IN RELATION TO WINDFARMS

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Understanding the implications of windfarm developments on common scoter requires a detailed appraisal of those factors that influence their habitat utilisation and choice. The main factors likely to influence the latter are habitat quality, predation risk, interference and disturbance. Habitat quality can be defined in terms of the potential net rate of energy intake from appropriate prey species, while sources of risk and disturbance will include the influence of predators, interference from conspecifics and kleptoparasites, disturbance from shipping and human shore based activities. The current study has evaluated the distribution, quantity and seasonal change in prey species across the areas of Liverpool Bay that fall within potential habitats available to common scoter. While the main aggregations of common scoter coincide with high densities and biomasses of appropriate prey species, the latter also occur in areas that do not appear to be utilised based on daylight observations. Prey quality declines significantly over winter in conjunction with a large (>50%) decline in prey density. Small-scale patchiness in the spatial distribution of individual species is reduced when the distribution of higher taxonomic levels are considered. Thus it is unlikely that common scoter forage in a species specific manner, rather they probably select prey primarily on a size-selective basis irrespective of individual prey identity within a broad range of suitable prey. Water depth appears to be a key predictor of common scoter distribution irrespective of tidal state and birds appear to aggregate primarily over areas with a water depth of between 13 – 18 m and thereby remain as far from the coastline as possible. Other environmental factors such as surface current speed do not appear to be explanatory variables of common scoter distribution.

Biography
Dr Richard Caldow has worked for the Centre for Ecology and Hydrology since 1989 during which time he has been involved in the field studies and computer programming necessary to develop, test and apply individual-based models to a wide range of systems.

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RESEARCH NEEDS FOR ADEQUATE ENVIRONMENTAL IMPACT ASSESSMENT, INCLUDING THE CUMULATIVE IMPACTS OF WIND FARMS ON BIRDS

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Long-distance migratory birds are an internationally shared natural resource, protected under various international legislation and agreements. The current upsurge in proposals to construct large numbers of turbines in extensive wind farms in marine offshore areas throughout the world, with their potential adverse effects on birds, has drawn attention to the need to better understand avian interactions with such structures cited out to sea. In particular, focus will be placed upon the information gaps that need to be filled to support the effective development of environmental impact assessments drafted in association with such constructions. We here attempt to define the hazards presented by turbines and to measure their ecological costs to birds. We base the review on the combined experience from two very detailed pre- and post-construction studies carried out at two Danish offshore wind farms and associated experiences from other projects around Europe. The talk will briefly review the methods developed and used to date, especially the types of data needed to measure (i) flight avoidance responses, (ii) feeding distribution avoidance responses and (iii) to estimate and subsequently measure likely collision rates under operating conditions. Emphasis will be placed on defining the problems still to be addressed and in developing the necessary survey and remote techniques to gather the required data. This is especially the case for developing on from assessing the local effects of individual development projects to the assessment of cumulative impacts from multiple windfarms, for example scattered throughout the migratory

flyway of individual populations. We shall emphasise the need to assess the energetic costs of avoidance responses and the fitness consequences of these and those of collision mortality through modelling. Such approaches are essential in order to offer mechanisms for assessing the cumulative effect of many wind farms and the combined effects of other anthropogenic factors, which affect population processes in migratory birds.

Biography
Two Greenland expeditions convinced Tony to move from conservation and peatland research to waterbirds and he joined the (then) Wildfowl Trust at Slimbridge in 1986. He moved from there to the National Environmental Research Institute of the Danish Ministry of the Environment in 1993, where he is currently research professor.

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TIDAL CURRENT ENERGY TECHNOLOGIES

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The presentation will start with an overview of the so-called "wet renewables" (i.e. primarily tidal currents and wave energy which have low environmental impact but major potential to deliver clean energy) and why it is urgent that they are developed as key tools for combating atmospheric and marine pollution. This will be followed by an explanation of the basic principles of, and key challenges in developing tidal current energy, with a description of the specific siting requirements.

The presentation will then deal with the more technical challenges and give a general overview of the different technologies under development and a more specific overview of Marine Current Turbine's technology which is probably the most advanced at this time. It will also indicate the planned future developments, scale and speed of implementation that might be achieved.

Finally, having described the technologies the presentation will focus on the likely environmental impact in general and more specifically, both perceived and possibly real risks to marine wild-life, including birds.

Biography
Peter Fraenkel is a founder and Technical Director of Marine Current Turbines Ltd, which is pioneering the development of tidal stream power systems. MCT installed the world's first sizeable offshore tidal turbine (300kW), off Lynmouth, Devon in May 2003. Peter has a degree in mechanical engineering and has been working on renewable energy technologies since the mid-1970s. He is an Honorary Professor in the Department of Mechanical & Offshore Engineering at Robert Gordon University, Aberdeen.

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TIDAL BARRAGES AND BIRDS

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Generating power from the tide has long been considered as a way to provide a renewable energy source. There are two ways that this can be done; Extracting power from tidal currents without affecting the topography of the site and building barrages to constrain the tidal flow and then generating energy as the head of water created on one side of the barrage, during high tide, is released through turbines later in the tidal cycle. This presentation focuses on tidal barrages, although issues relating to tidal current generation will be considered in brief. The amount of power

generated from a tidal barrage is in part related to the tidal range. For this reason, most proposals that have been considered involve the building of barrages across estuaries. Very complex schemes have been proposed in the past, involving several lagoons to enable generation of electricity throughout the tidal cycle. However, as the engineering technology was developed, work focused on schemes that allowed free flow of water on the rising tide through sluices and then power generation on the falling tide through turbines. Such barrages have the effect of creating an estuary of approximately half its pre-barrage tidal range. Barrages have been proposed for many of the UK's estuaries with high tidal ranges but the most detailed studies have been undertaken on the Severn and Mersey estuaries. There are four features that will affect bird populations:

1. Loss of inter-tidal area
2. Effect on turbidity
3. Effect on sediment structure and grain size
4. Loss of the highest spring tides that flood saltmarsh

In addition, there may be a reduction in survival if an estuary changes as birds have to adapt to a new environmental regime.

Between 1987 and 1995, the DTI's Energy Technology Support Unit (ETSU) and barrage development companies funded a series of studies with the aim of reducing the uncertainties about the likely effects on bird populations. These studies led to a greater understanding about the distribution of birds within estuaries and the realisation that, in hyper-tidal estuaries, most birds were concentrated in a small proportion of the inter-tidal area. Later studies focused on the relationship between the sediment composition of estuaries and their bird populations, enabling models to be produced that predict post barrage bird populations.
Such studies complement the predictions from the individual based modelling approach and together will reduce the uncertainties of the effect of tidal barrages on bird populations. Further areas for research to reduce the remaining uncertainties are identified.

Biography
Nigel Clark undertook his PhD on the ecology of Dunlin on the Severn Estuary. In 1987 he moved to the BTO to lead their studies into tidal barrages and is now Head of Projects at the BTO. He has a life long interest in the ecology of wader populations and the effects of large-scale developments on them.

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BEHAVIOUR-BASED MODELS – HABITAT LOSS AND DISTURBANCE

Richard Caldow
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Predicting how animal populations will be affected by changes to their environment requires an understanding of the way in which they interact with their environment and with one another. By addressing these two key issues, individual-based simulation models can be used to make such predictions under any number of 'what if' scenarios. First, such models incorporate the behavioural responses of animals to their environment and to one another in the form of simple, theoretically based, behavioural rules such as fitness maximisation. Second, they incorporate individual variation within a population such that all individuals, although following the same simple rules, may make different choices under a given set of circumstances, and may consequently differ in their ability to survive in the face of environmental change.
The development of this approach to modelling the consequences of environmental change for wader and waterfowl populations began in the 1970s. The first major demonstration of the potential power of this approach came in the mid 1990s with the post-diction of the observed density-dependence of oystercatcher mortality on the Exe estuary in Devon. Since then, the model has been applied to predict the consequences of a wide range of human activities at a wide range of locations in the UK and abroad. A number of examples will be described. These will include an examination of: i) the consequences of human disturbance on the Exe estuary, ii) of shellfishing activity on the Burry Inlet and The Wash, iii) a port extension in the Baie de Seine. Current applications of the

approach include predicting the consequences of offshore windfarms on the distribution and fitness of overwintering common scoters in Liverpool Bay and after the fact prediction of the observed consequences of the Cardiff Bay barrage, and examination of whether the proposed mitigation measures would have made a difference to the observed outcome.

Our understanding of the way in which birds forage and interact with one another is now improving to the point where there is less need for detailed field studies in advance of each new application. Our approach is now based increasingly on the outputs of simple sub-models of the foraging behaviour of birds which enable key functions to be predicted from quickly observable measurements of the way in which they forage and interact with one another at a small scale. This development, and the general applicability of the fundamental principles on which the approach is based, means that the model can be very rapidly applied to new systems and new species. The model has the flexibility to examine the potential consequences of a wide range of alternative renewable energy developments on a wide range of bird populations.

Biography
Dr Richard Caldow has worked for the Centre for Ecology and Hydrology since 1989 during which time he has been involved in the field studies and computer programming necessary to develop, test and apply individual-based models to a wide range of systems.

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AN OVERVIEW OF WAVE ENERGY IN THE UK

Michael Hay
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Within its marine environment the UK has an incredible potential source of clean renewable energy. This resource, particularly in the form of waves could meet the entire UK demand for power, but constraints in technological development and accessibility have limited exploitation to date.

In August 2004, after realising both the environmental benefits of marine energy and the market potential within it, the UK Government increased its targeted support for the sector from £15m over the past five years to £50m for the next three. If this is utilised effectively, and with the support of marine stakeholders, wave energy could be on the cusp of expansion in the marine environment.

This presentation will address this emerging sector from the foundations of the necessary need for a mix of renewable energy sources. By highlighting the wave energy resource base, and the leading position of UK technologies, the reasoning behind the recent expansion of Government support becomes clearer.

However when looking at how this support may be allocated the challenges facing marine renewables on their path towards the commercial energy market also come to the fore. These challenges form the focus of this presentation: from financing and political support to the need for understanding and acceptance from all bodies interested and involved in the marine environment.

For all information in this presentation and more see www.bwea.com/marine.

Biography
Mike is Marine Renewables Development Manager at the British Wind Energy Association. He has an MA in Geography from the University of Aberdeen and MSc in Environmental Technology from Imperial College London where he focussed on Energy Policy.

At Imperial his research project was concerned with the potential role for UK regions in the development of a UK marine renewables sector. On completion of this work in September 2003 he joined the DTI/Carbon Trust Renewables Innovation Review Team. This small group assessed the potential in all renewable energy technologies, including wave and tidal, in order to advise funding allocation in the Governments Comprehensive Spending Review.

In February 2004 Mike joined BWEA in this new position that expands its hugely successful wind mandate in order to champion the emerging marine renewables sector.

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HYDRO TECHNOLOGY IN THE UK

Andrew Brown and Alastair Gill *
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This paper briefly describes the hydro schemes currently operating in the UK and distinguishes between schemes with reservoirs and those without. This is then expanded to describe current and expected developments over the coming years. The contribution of UK hydro to reducing carbon emissions is briefly outlined. Case studies of recent installations are then used to describe the consenting process with particular reference to environmental issues and those affecting birds. Finally, the most challenging aspects of balancing environmental impacts and benefits are drawn out, and suggestions made for improving this balance.

Biography
Alastair Gill is a Hydro Development Manager at npower renewables, responsible for running a team consenting new hydro-electric schemes located mainly in Scotland. Activities of the team includes site identification, co-ordinating the preparation of environmental statements and planning applications, technical design, community consultation, liaison with statutory bodies, and lease negotiations with landowners. Physicist and environmental scientist by training.

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HYDROPOWER AND ENVIRONMENTAL REGULATION – A SCOTTISH PERSPECTIVE

Paul Copestake
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Scotland's landscape and climate is highly suitable for generating electricity by hydropower, a resource that has been utilized for over 100 years. The high number of new hydro schemes currently being proposed and built reflects the economic incentives promoted by the Government. This in turn is driven by increasing concerns about climate change.

Opinions are often highly polarised between exploiting Scotland's water resources for Hydropower and keeping the environment in its current state. Legislation has evolved to balance these differing views. Local authorities are responsible for approving schemes below 1MW through planning legislation; larger schemes receive consent by Scottish Ministers through the Electricity Act. The decision making process is supported by statutory consultees, namely Scottish Environment Protection Agency and Scottish Natural Heritage. They provide advice from the scoping and drafting of environmental statements through to formal responses on final proposals. The combined process considers local and national policy statements, conservation legislation (biodiversity, landscape, national and European designations) and the Water Framework Directive.

The Water Framework Directive in particular will introduce in Scotland considerable changes to the regulation of Hydropower in Scotland; enabled by the Water Services and Water Environment (Scotland) Act (2004), it will require all new and existing hydropower schemes to be licensed. These licenses will aim to balance the socio-economic benefits of hydropower and their environmental impact and will establish new principals of best practice for construction and operation of hydropower schemes. This will hopefully ensure that the sustainable benefits of hydropower are achieved without undue environmental harm.

Current assessments of hydropower schemes identify three levels of impact –

- Direct/immediate, changes to hydrology, load and water quality.
- Indirect/delayed, changes to channels, standing water, sediment load and dependant biological elements.
- Resultant impacts, e.g. on Birds and the aquatic margins.

These aspects and how they link to the appropriate environmental legislation are briefly examined.

Finally a selection of case studies is presented to illustrate the application of environmental legislation to hydropower schemes in Scotland.

Biography
Paul Copestake is employed by the Scottish Environment Protection Agency as a Senior Hydrologist to support the implementation of the Water Framework Directive. Duties include providing hydrological advice for consultations on new abstraction and impoundment proposals and assessment of water resource pressures (including hydropower) and their impact in as part of the WFD characterisation report.

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BIOMASS FOR RENEWABLE ENERGY

Malcolm Fergusson
Institute for European Environmental Policy

'Renewable energy' is generally conceived of in terms of the technologies discussed in the earlier sessions of this conference – that is, wind farms, solar power, wave and tidal power, etc. These are concerned primarily with the production of electricity, and have relatively little to offer to other important parts of the total energy system.

As the Royal Commission on Environmental Pollution pointed out on its 22nd Report, there are two very important types of energy demand that are very different in nature and that also need to be addressed:

- Demand for heat makes up about 36% of all end-user energy. It is extremely inefficient to use electricity for heating, so in most circumstances it makes no sense to do so.
- Transport constitutes a further third of end-user demand, nearly 99% of which is accounted for by petroleum-based fuels - primarily petrol and diesel for road transport. In only a few circumstances (most obviously on electrified railways) is it technically viable to use electricity for propulsion purposes.

The Role of Biofuels
In this context, therefore, it can be seen that there are substantial additional roles to be filled in a renewable energy system, and these can best be met by biofuels. A wide range of biomass options is available or will soon become available, some to produce motor fuels, and others for heat and electricity, as follows:

- Biodiesel from oil crops is also known as fatty acid methyl ester, or, when made from rapeseed oil, rape methyl ester. The principal sources are vegetable oil extracted from seeds or oil-rich nuts, and in Europe, rapeseed by far the principal feedstock.
- Bioethanol from sugar and starch crops is currently produced by fermentation or hydrolysis-plus-fermentation respectively. Principal feedstocks for ethanol production in Europe are sugar beet and wheat grain.
- Woody (technically known as 'lignocellulosic') materials including municipal waste, straw, wood (including chippings, coppiced trees, forest debris, etc) and grasses such as *Miscanthus* are already grown to provide heat, for example for Combined Heat and Power plant. Further ahead, a number of different processes are being developed to produce substitute transport fuels.

Environmental Implications
All of these crops, if properly grown and used, can greatly reduce levels of greenhouse gas emissions.

Current UK biofuel production is very limited and based on conventional crops and modest areas of land, so local impacts are broadly comparable to those of other conventional farming. However, to make a significant contribution to transport and heat energy demand would require millions of hectares of land - not all arable - to be given over to energy crops.

Increased production of energy crops in the UK would clearly alter the intensity and diversity of agricultural land use. Environmental impacts could include threats to biodiversity; water quality impacts; changes in soil quality and possible soil erosion; and changes in landscape character. Perennial woody crops could also affect the water table, runoff, etc.

Understanding of the implications of these novel crops, especially if grown on non-arable land, is still developing. These will in any case depend on what crops are grown, and how and where.

Biography
Malcolm Fergusson is a Senior Fellow at the Institute for European Environmental Policy
Publications include an overview of EU transport policy; a review of the energy implications of UK transport policy; the integration of environmental considerations into air and freight transport

policies; and analysis of the EU institutions. He is an expert on the effects of EU enlargement, and on alternative fuels and technologies for transport.

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A REVIEW OF BIRDS USING ENERGY CROPS IN BRITAIN AND FINDINGS FROM AN EXTENSIVE STUDY OF BIRDS IN COMMERCIAL WILLOW SRC

Rufus Sage [1*], Mark Cunningham [1] & Nigel Boatman [2]
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[2] Central Science Laboratory, Sand Hutton, York

We present a review of birds and energy crops, results from a recent major study of birds in SRC and a discussion of the prospects for energy crops in Britain in the context of changing agri-environment schemes. There are two types of energy crops currently envisaged for UK farmland, coppiced trees or shrubs, and grasses. Short-rotation willow coppice (SRC) and Miscanthus grass are the most advanced agronomically, and in terms of existing plantings, the most common.

Within a year or two of planting, fields of SRC and Miscanthus add structural diversity to farmland. SRC is harvested on a two or three-year rotation while Miscanhtus annually. Virtually no work has been done on the use of energy grass crops by wildlife here or elsewhere in Europe. A proper quantification of biodiversity potential in Miscanthus is thus a major omission in the development of energy crops in the UK.

For SRC, early non-commercial plantings in the UK were found to provide new habitat opportunities on farmland for a wide variety of plants and insects. For birds it became clear that these crops support many birds from scrub and woodland type habitats not normally found in intensively managed row crops and at high densities. Harvested SRC also contained traditional farmland birds. The productivity of birds using SRC crops has not been properly quantified.

In a recently completed 4-year study of birds using commercial plantations in Yorkshire 12 willow SRC fields supported a higher density of birds in spring (3.1±0.2) than 12 arable control fields (0.8±0.03) and more species (37 compared to 21). There were also more birds in the hedges around the SRC fields than around the cereal fields. Within the SRC fields, more birds used the 50m edge zone than the interior of large fields. In the winter, SRC supported higher numbers of buntings, thrushes, tits and accipter species while skylarks were more abundant in the arable controls. While many of the birds using SRC are scrub/woodland species and hold small territories, farmland species were also recorded especially in the cut plots. In particular, wader and skylark densities in the spring, and snipe and woodcock densities in the winter, were higher in the cut SRC than the controls.

Despite the recorded extensive use by birds of SRC crops, it is not known whether these birds breed well and some open ground species could be displaced by large SRC plantations. Initial reports suggest that Miscanthus can provide habitat for some of the birds recorded in SRC but extensive surveys have not been undertaken. The future for energy crops and the potential impacts on birds in the context of modern farming practices and recent developments in agri-environment schemes is discussed. It is likely that in certain circumstances a mixture of energy crops and traditional crops on a farm will benefit birds.

Biography
Rufus Sage has worked at the Game Conservancy Trust research department for 14 years and now heads the lowland game and woodlands team. Throughout this time, he has worked on a variety of DTI, Defra or Research Council funded projects concerning the ecology of energy crops.

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POSTER

THE REMOTE MONITORING OF SEABIRD MOVEMENT USING BIRD DETECTION RADAR FROM AN OFFSHORE JACK-UP BARGE LOCH RYAN, DUMFRIES.

Mark Brown
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Documenting local seabird movement patterns in space and time is an area that has received little targeted scientific investigation. This is mainly due to the inherent difficulties of monitoring mobile avian species across a shifting seascape away from the coastline.

For the visual observer this is due to the fact that there are no consistent points of reference from which to gauge and record movement accurately. This can be further compounded by poor weather conditions and bad visibility over extended time periods. Therefore accurately mapping the spatial and temporal pattern of flight movements by seabirds across a specific area has rarely been achieved. Radar as a remote monitoring technique provides a valuable method by which to address this area of marine ornithology.

Seabird movement patterns have become of significant interest with the development of coastal wind farms both inshore and offshore in the UK and Europe. Environmental impact assessments conducted for coastal wind farms by developers are therefore required to undertake marine ornithological monitoring from which to determine the possible impacts and methods for mitigation. These have largely to date been boat-based transect methods or aerial surveys by plane. Increasingly, though bird detection radars are being used as a complementary technique, and radar monitoring, allied with standard monitoring techniques undertaken simultaneously, is providing a valuable and robust data gathering method by which to assess bird movement at sea, particularly at night or in poor visibility or high winds.

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POSTER

AVOIDING IMPACTS OF WIND FARMS ON UPLAND BREEDING BIRDS IN SCOTLAND – A BEHAVIOURAL APPROACH TO THE PRECAUTIONARY PRINCIPLE

Richard Evans
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Renewable energy development in Scotland is focused largely on onshore wind, increasingly in the form of large (50MW+) wind farms in upland areas.

Upland habitats in Scotland host important populations of breeding birds, which are often widely, but not necessarily evenly dispersed.

In the absence of clear and reliable information on the impacts of large (2MW+) wind turbines on these species, applying what we know of these species' behaviour and of the impacts of other types of development, and guided by existing government policies on nature conservation, it is possible to formulate reasonable criteria for selecting new wind farm sites in the uplands in such a way as to minimise adverse impacts on key species.

Such an approach could also be applied to other species and to other types of renewable energy development.

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POSTER

QUANTIFYING THE COLLISION FREQUENCY BETWEEN BIRDS AND OFFSHORE WIND TURBINES: THE DEVELOPMENT OF THE THERMAL ANIMAL DETECTION SYSTEM

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The aim of the present poster is to report on the newly developed Thermal Animal Detection System (TADS), which is an automated bird monitoring system based on real time thermal video imaging. It is developed for estimating the collision frequency between migrating birds and offshore wind turbines, and it has been tested for one year in 2004 at a Danish offshore wind farm. In general, it can be concluded that the TADS are capable of recording migrating birds approaching the rotating blades of a turbine, even under conditions with poor visibility. If the TADS is used in a vertical viewing scenario it would comply with the requirements for a set-up for estimating the avian collision frequency at offshore wind turbines.

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POSTER

VIGILANCE EFFICIENCY TO DECREASE GRIFFON VULTURE *GYPS FULVUS* MORTALITY AT WIND PARKS.

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From August 2000 to January 2001 it was carried out a continuous monitoring of Griffon Vulture *Gyps fulvus* population using the Tahivilla Wind Park, Tarifa (Cadiz) as a part of it's feeding area. This monitoring is used to establish possible correlations between the flight height and the different weather conditions (wind speed, wind direction, cloudiness, etc). A program of stopping wind turbines was also carried out when potential risky situations of collision took place. Later till now an experience with an environmental guard who is present during daylight has been carried out as well. This person can stop one or several wind turbines if necessary, due to the high risk of collision of Griffon Vultures.

It is estimated the Griffon Vulture population which uses this park to be 283 couples, although the global number of birds which fly over the park in a year would flow between 1500 and 2000 birds.

The main results of the current study were the following;

The higher the wind speed is the lower the vultures fly, so when there is not wind only 7.19 % of them fly lower than 50 metres high (high risk collision space), while when strong wind the percentage rises till 65.24 %. East and South winds were the most conflictive ones, 83.33 % of collisions tool place under these conditions. When it was cloudy 48.92 % of Vultures were observed lower then 50 metres high.

The presence of a guard, who was able to stop the wind turbines, in the area during daylight, reduced the number of collisions in a 45.45 %, according to the same period the previous year. The guard in case of risky situations warns the wind company who runs the wind park to stops the wind turbines as soon as possible. The coordination between the guard and those people who stop the wind turbines is essential for the correct use of this measure.

Along these years the presence of carrion has been pointed out as the most risky factor for the Griffon Vulture, because of its attracting role for these birds. In order to avoid this danger the guard covers or hides this carrion till the moment it is clear up, so the birds can't detect them.

The current study has been developed thanks to the help of Desarrollos Eólicos de Tarifa S.A. as well as Geolén Ingenierái S.L.

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POSTER

NOCTURNAL BIRD SURVEYS: A PROPOSAL FOR A NEW TECHNIQUE

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Currently ecological surveys for birds (winter and breeding) follow a standard set of methods based almost entirely on diurnal studies. Nocturnal surveys are rarely undertaken. Birds such as ducks, geese, cranes and waders move around in flocks at night and there is a growing recognition that there is a need to know about such movement and activity of birds at night. This information is essential in relation to identifying areas that are utilised by birds at night for feeding, roosting or flight paths from one site to another. This information is a critical consideration where bird strikes may occur for instance, in relation to location of wind farms, communication structures and airport (runway) developments. It is also of growing importance for transport developments (e.g. highways) in and around designated areas for birds (e.g. SPAs, SSSIs). This issue is not confined to the UK but is of international significance.

The consequences of failing to undertake nocturnal surveys could have serious implications for birds e.g. endangered species colliding with structures. Also the lack of information on birds using areas at night that are proposed for development can have costly results, either through delays in development, inappropriate/ineffective mitigation measures being implemented and development proposals being unsustainable.

Current methods used to observe nocturnal movement and activities of birds are mainly based on the use of thermal imaging or radar. These methods heavily rely on human operators, to operate recording equipment and/or to analyse the recordings and draw results. These methods can be costly and susceptible to human error and bias.

The aim of this project is to develop a system that will be able to collect bird movement data autonomously. The system will process the data and provide repeatable, meaningful results.

These aims would be met by the following objectives:
- Developing an appropriate trigger mechanism for turning a recording device on/off as required
- Producing a software solution to determine bird motion, bird direction of travel, bird altitude, bird size classification
- Producing table of results and graphs of the observations

The benefits of the project are expected to include:
- High quality repeatable data gathering that is efficient, effective and accurate
- High quality repeatable data analysis that is both efficient and effective.
- A fuller understanding of the nocturnal ecology of the target species, especially birds, leading to a complete assessment of the potential impacts of proposed developments.

The project will be implemented by RPS working in association with the School of Engineering and Design, Brunel University. RPS will work with a research engineer (EngD), over the 4-year period of the project.

Funded by: RPS, EPSRC.
Supervised by: RPS and School of Engineering and Design, Brunel University

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POSTER

WIND TURBINES AND SENSITIVE BIRD POPULATIONS: SPATIAL PLANNING FOR WIND TURBINES IN THE FENS NATURAL AREA

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The Fens Natural Area in eastern England is a key area for wind energy development due to it's flat landscape, commercially viable wind resources and sparse human population. However, the Fens also supports a number of internationally important wetlands as well as nationally and internationally important populations of birds considered sensitive to wind farm development.

To help avoid conflicts between wind energy developers, nature conservation organisations and local planning authorities, a spatial planning exercise was carried out to map the distribution of sensitive bird populations in the Fens. Guidance is also provided to enable wind energy developers and local planning authorities avoid proposals in areas of high bird importance and to identify the bird issues that are likely to require thorough assessment.

As the Fens is also a key area for wetland habitat creation projects, areas of high potential for wetland re-creation have also been mapped and it is hoped that developers will avoid these areas wherever possible.

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POSTER

WATERBIRDS & CLIMATE CHANGE: THE UK EXPERIENCE

Mark Rehfisch *, Graham Austin & Ilya Maclean
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The distributions of wildlife and plants are changing throughout the world (Root *et al*. 2003) and the fingerprints of climate change are clearly visible in the UK. Arguably, the UK's importance for birds lies in its internationally important populations of wintering waterbirds and these appear to be good indicators of the effects of climate change. On estuaries, the distributions of seven out of nine common species of waders (Charadrii) overwintering on estuaries have moved along the winter isotherms from the warmer west to the colder east in Britain since the mid-1980s (Austin & Rehfisch 2005). On open coasts, the distributions of eight out of nine species of wader have moved either eastwards along the winter isotherms or northwards towards their breeding grounds (Rehfisch *et al*. 2004). During this period, the average minimum winter temperature across the UK has increased by about 1.5ºC. Interestingly, it is the smaller species, Ringed Plover, Sanderling, Red Knot and Dunlin, which have changed their distribution most. This follows expectation as smaller species have a higher relative surface area and therefore are most affected by the cold.

Based on the scenarios for Britain's climate in 2020 and 2080, it is predicted that the distributions of the waders will continue to move away from the west and that several species presently found in internationally important numbers in Britain will continue to show major declines. These changes in distribution and numbers are likely to have major implications for the site-based approach to wildlife protection used in Europe and elsewhere (Rehfisch *et al*. 2004).

Before a major development can proceed it must go through the Environmental Impact Assessment (EIA) process that considers its likely impact on the environment. EIAs for major developments always include an assessment of their normally negative effects on wildlife of leading to habitat loss, of increasing disturbance at various spatial and temporal scales, and of acting as barriers to movement. We propose that EIAs for wind farms, tidal barrages, nuclear plants and other developments that have a net non-fossil fuel energy balance should include an assessment of their positive contribution to lessening the effects of climate change on wildlife.

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POSTER

THE UNITED KINGDOM WETLAND BIRD SURVEY WATERBIRD MONITORING SCHEME

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The UK Wetland Bird Survey is the monitoring scheme for non-breeding waterbirds in the UK which aims to provide the principal data for the conservation of waterbird populations and their wetland habitats. The data collected are used to assess the size of waterbird populations, determine trends in numbers and distribution, and assess the importance of individual sites for waterbirds.

For many key sites, long time-series of data are now available, sometimes in excess of 30 years. Around 3,000 volunteer counters participate in synchronised monthly counts at wetlands of all habitat types, mainly during the winter period. Additionally, at most estuaries a programme of co-ordinated low tide counts is also in place, providing greater definition to our knowledge of the way birds use these important sites.

The Wetland Bird Survey data are available to anyone upon request, and as such they are invaluable for environmental impacts assessments of proposed developments, including those related to renewable energy.

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POSTER

BIRD MIGRATION AND POTENTIAL WIND FARMS CONFLICTS IN MEXICO

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Conflicts between bird conservation and other human interests may arise in a variety of situations. Technological advancements and progress at large may conflict with maintenance of bird migration. Wind-farms as a form of alternative energy sources may create problems for some bird species. The impact of wind farms on wildlife is worth mention as the wind industry well knows there have been some disastrous consequences for wildlife. It wasn't until the late 1980s and early 1990s that the magnitude of bird kills at wind farms was discovered and this was because monitoring of impact on birds had generally been poor and removal of carcasses by scavengers meant few observations were made of kills. Raptor deaths, which have baffled researchers in USA and Europe, pose a problem for an industry that sells itself as an environmentally friendly alternative to conventional power plants. In Mexico this technology is new. Several foreign companies will develop the largest wind-farms in Latin-American in the Isthmus of Tehuantepec in Oaxaca, Mexico. During eight field work surveys in the last two fall bird migratory season more than 4 millions of migratory raptors mainly Turkey Vulture (*Cathartes aura*), Swainson Hawk (*Buteo swainsoni*) and Broadwing Hawk (*Buteo platypterus*) with a maximum of 70 m flying high were found around the potential site for the wind-farm corridor. There is a potential high risk that birds will collide with the wind turbines of 105 m high in operation because this area is one of the most important bird migration routes in the world.

It can affect population of migrant birds that over-flies the turbines area for long periods. This study will provide information of potential risk of birds colliding with wind turbines.

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POSTER

BIRD DETECTION RADAR AS A TOOL FOR MONITORING WHITE-FRONTED GOOSE *ANSER ALBIFRONS FLAVIROSTRIS* MOVEMENTS AROUND THE PROPOSED LARGIE WIND FARM, MULL OF KINTYRE

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Bird Detection Radar was used to assess the feasibility of monitoring wintering Greenland White-fronted geese flight lines in the vicinity of the proposed Largie wind farm, Kintyre, Scotland in November and December 2004. Daily commuting flights from three SPA roost lochs inland on the Kintyre (Loch Garasdale, Loch an Fhraoich and Loch Ulagadale) to coastal grazing marshes takes the geese across high ground. It is these commuting flights that are of concern to both the developer Ecogen/Eurus Wind and SNH.

The aims of this radar study were two fold:

1. Firstly to confirm the predominant flight routes across the high ground using vantage point surveys and Bird Detection Radar to track the geese skeins through the complex topography.
2. To provide guidance on the practicality of developing a permanent goose monitoring radar system for the Largie Wind Farm. This system would then operate throughout the Greenland White-fronted geese wintering period as a 'safeguarding' system. Wind turbines would be shut down if geese skeins were detected flying towards the wind farm.

The study included 4 days in November and 8 days in December 2004 totalling 288hours. Greenland White-fronted geese were very active on a number of nights in December 2004 with commutes taking place back and forth from the roost lochs throughout the hours of darkness. Previously commuting flights outside of the dawn and dusk flight windows and during occasions of very low visibility (hill fog <30m) had not been known. The use of Bird Detection Radar on this occasion was invaluable allowing 24hr continuous monitoring of goose commuting activity over the high ground. Bird Detection Radar allowed additional nocturnal goose movements to be identified, recorded and mapped to a GIS system. This study highlighted the importance of assessing goose flight behaviour over extended periods 24hrs a day to gain a true understanding of commuting behaviour and flight routes.

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