



Major grant expands peatland research

The Environmental Research Institute at North Highland College UHI has been awarded almost £1M to undertake a major new research programme into the peatlands of northern Scotland. The work led by Dr. Andersen will explore how climate change could affect blanket bogs, and to assess the effectiveness of restoration efforts.

The “Leadership Award”, funded by the Leverhulme Trust, will support Dr Andersen and a team of six researchers and three PhD students to conduct investigations over a five-year period. They will use cutting-edge technologies and techniques, including satellite remote sensing, to investigate how we can protect and restore blanket bog areas.

The Thurso-based scientists will benefit from access to the Flow Country, the largest blanket bog in Europe and a region which is under consideration for World Heritage Site status. The programme will also support new initiatives across the UHI’s research centres and foster national and international collaborations, including work with Canadian peatland research groups.

The programme will focus on three key areas of research. The team will design experiments to explore how climate and environmental conditions affect Sphagnum mosses, one of the building blocks of peat in blanket bogs. They will work to refine models that predict how blanket bogs may respond to different management approaches in future climate change scenarios.

The team will also continue to refine a method that uses satellite data to measure how the seasonal patterns of swelling and shrinking of the bog surface, known as ‘bog breathing’, change in response to climate extremes and restoration activities. This part of the programme will progress alongside another newly funded NERC-research project involving Dr Andersen and led Dr David Large from the University of Nottingham, which aims to develop the state-of-the-art statistical methods needed to interpret “bog breathing” patterns systematically over large areas, and long time periods.

Speaking about the research programme funded by the Leverhulme Leadership Award, Dr Andersen said: “Peatlands are the Earth’s most efficient terrestrial carbon

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store. They also regulate water and climate and support unique biodiversity. However, their degradation affects the delivery of these key functions. In the UK, the cool, wet climate supports a globally rare peatland type: blanket bogs. Most UK blanket bogs have been degraded by human activities and, left alone, they make a significant contribution to our greenhouse gas emissions from the land use sector. However, unprecedented efforts to restore our blanket bogs are underway, for example through the Peatland Action Programme in Scotland.

“Astonishingly, we do not know the extent to which these interventions work or how blanket bogs, restored or otherwise, will cope with the added threat of climate change. I am thrilled to have been chosen by the Leverhulme Trust for this Leadership Award. I look forward to working with my team to pioneer approaches from molecular to landscape scales to fill some of these gaps in our knowledge and to inform UK and global peatland management strategies.”

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LEVERHULME TRUST

Cotton on to Cotton Strips

Understanding the rates, and drivers behind, decomposition of organic matter in our aquatic systems is of prime importance for fully quantifying the carbon cycle. The ERI has been involved with several projects in recent years (e.g., LOCATE, FREEDOM, FIREBLANKET), which have involved regular studies of rivers and streams within the Flow Country. While these projects have been extremely successful, resulting in large quantitative datasets, they are resource and time intensive.

Recently, Dr Peter Gilbert (ERI) and Dr Amy Pickard (Centre for Ecology and Hydrology) have been involved in CELLDEX (CELLulose Decomposition EXperiment – led by the Norwegian Institute for Nature Research and Oakland University). The global project is seeking to implement a simpler method to compare organic-matter decomposition rates among streams and oceans of the Earth’s major biomes.

The method involves the placement of cotton strips within the aquatic habitat, and collecting a subset after 20, 40, 60 and 80 days. By measuring tensile strength, changes in nutrient content and stoichiometry of the cellulose fabric rates of organic-matter decomposition over time can be inferred.

The trial of these methods within the Flow Country has now ended, with results to follow soon. It is hoped that the comparably simplistic methods of the CELLDEX study may be applied as a relatively low-cost technique to measure organic-matter decomposition in future studies within the Flow Country.

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Cotton strips placed in Flow Country bog pool



Dr Peter Gilbert holding the cotton strips



Great Yellow Bumblebee



Fieldwork provided a much-improved data set of where a suitable mix of vegetation species occurs; the GYB forage mostly, though not exclusively, on Red Clover, Bird's-foot Trefoil, Vetches, Thistles, Burdocks, and Knapweeds.

Using walkover and point surveys, frequency of occurrence records of different flowering species in different locations were compiled. This helped us to build up a simple map of habitat suitability for the GYB and to identify which sites warrant bee surveys. In August and September bee surveys, and further vegetation surveys, were carried out, however no confirmed GYB observations were made. A combination of stronger winds and colder air temperature may have been the cause of fewer bees being observed during this time.

What was identified, however, was that most of the sites where GYBs have been observed in the past are in a good condition to support the bees into the future.

For further information on how you can help protect the bees, see the BBCT website <https://www.bumblebeeconservation.org/>

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During summer 2019 we reported on our work with the Bumblebee Conservation Trust (BBCT) in north Sutherland. The aim was to improve knowledge of localities that provide suitable habitat for the Great Yellow Bumblebee (GYB), a declining species, and to increase observation records.

Hydrogen Utilisation and Green Energy (HUGE)

The HUGE project, led by the ERI, is a €1.4 million, 3-year project that was launched in summer 2019. It is funded by the Northern Periphery and Arctic (NPA) Programme and aims to raise awareness of the use of green hydrogen as a viable energy vector for remote and rural communities in housing, transport and industry.

As part of this, ERI hosted a workshop in conjunction with the Highland Council, to investigate the utilisation of hydrogen by rural communities across the Highlands and Islands. Delegates from across the region, representing local authorities, consultancies, government agencies, charities, and NGOs met in Inverness at the end of November.

Project coordinator Desislava Todorova introduced the HUGE project to attendees whilst Magnus Davidson presented hydrogen as an energy vector to those new to the concept. Mark Walker used his expertise on life cycle analysis to lead discussion on the project's proposed Techno Economic Assessment Tool.

This workshop aimed to ensure that the project has direct input from regional stakeholders. All were supportive of a hydrogen economy for rural Scotland. However,

some voiced concern about the challenges involved in bringing down the associated costs. Part of this discussion focussed on the 'by-products' of hydrogen production such as oxygen as a potential key selling point for industry.

As with many workshops in the Highlands and Islands, the networking event led to a number of opportunities for ERI outwith the HUGE Project, including participation in a Horizon2020 project proposal with Comhairle nan Eilean Siar.

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Northern Periphery and Arctic Programme

2014-2020



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UHI Postgraduate Conference

Hosted by the ERI, postgraduate research students (PGRs) from across the UHI partnership came to Thurso to participate in their bi-annual conference. In all about 50 students attended the three-day event of presentations, networking, training and socialising held between the North Highland College UHI campus and the Thurso cinema. The programme included an icebreaker session at Dunnet Head Lighthouse; a poster session with curry; presentations from invited speakers, and from PGRs; a conference dinner and ceilidh and finally prizes for best posters and presentations.

Topics ranged from 'Using wildlife to biomonitor for antimicrobial resistant Escherichia coli in the Scottish Environment' to 'Gaelic township poetry of the Nineteenth Century!' The event was attended by several invited speakers, with a fantastic keynote address from Inverness College's Dr Melanie Smith, who shared the experience of her route into and through academia.

Thanks to all who supported this event, and particularly to Baillie wind farm community benefit fund, and Beatrice offshore windfarm Ltd, for sponsoring the event and helping to make it achievable. Among the postgraduate research students, word is this was the 'best' conference so far, hailing the event a success!

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Delegates at Dunnet Head Lighthouse



Baillie Wind Farm
Community Benefit Fund



Recognition for ERI Researcher

At an event held at the University of Novi Sad (UNS) in Serbia to celebrate the 20th anniversary of the establishment of the Environmental Engineering Department, Dr Szabolcs Pap was recognised as the Department's 'Best Researcher' over the last decade. Szabolcs, now working within ERI's Environmental Contamination and Ecological Health team, maintains close links with his former colleagues.

Szabolcs was accompanied to the event by Professor Stuart Gibb who has been developing UHI's links with the University of Novi Sad.



Over the years, Szabolcs' work has focussed on topics including adsorption technology in water and wastewater treatment for removal of emerging contaminants such as metals, metalloids and pharmaceuticals; and on the synthesis, functionalisation and characterisation of adsorbent mediums from biomass and other waste/raw materials.

Szabolcs also has an interest in scaling up water treatment technologies for industrial applications and has recently been running phosphorus adsorption trials using Veolia's FiltraPHOS™ pilot-scale unit at Scottish Water Horizon's Bo'ness experimental treatment facility. These experiments form part of the 'Phos4You' project (NWE 292) and receive financial support from the INTERREG V B Northwest Europe Programme.

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Using X-band radar at Dunnet Head to characterize the sea surface; Dr Philippe Gleizon (l) and Clare MacDowell (r)

Investigating wave-current interaction

Ongoing investment in marine energy in the Pentland Firth has generated interest in both the wave climate and the tidal conditions in the area. However, little is known about the effect waves may have on tides, or conversely, the effect tides and currents may have on waves - and hence on marine energy output. To this end, the ERI together with the Marine Scotland Laboratory in Aberdeen, have been conducting a study to collect wave and current data from the Pentland Firth.

It is known that currents can modify the shape and spectra of waves, and that waves can modify the velocity, and particularly, the velocity profile of currents. Any change to wave height directly affects the energy the wave contains, while changes to current velocity directly affect tidal energy generation. Hence the interaction between the waves and currents could be an important factor in marine energy generation. In addition, during wave current interaction, energy can be exchanged between waves and currents with implications for both energy generation and device loading.

Wave and current data were collected in the Pentland Firth over a wide range of wave and current conditions by deploying an Acoustic Doppler Current Profiler and an Acoustic Wave and Current Profiler on the seabed north of Dunnet Head at the western entrance to the Pentland Firth from February to May 2018. In addition, new technology in the form of an X-band radar was deployed on the cliffs, overlooking the area to monitor waves and currents over a 6 km radius. Waves with a maximum height of up to 11 m and current velocities of nearly 3 m/s were recorded, and the presence of previously unknown eddies and localised bathymetric effects were detected. These measurement data informed our understanding of the hydrodynamic characteristics of the area.

Our work so far has involved investigating how varying waves recorded in the Pentland Firth can affect current velocities and directions. We have also looked at how varying currents affect the wave height, period, direction and energy spectra of the waves, for waves propagating both with and against the flow. The next stage of the project is to consider how these effects may influence marine energy generation and to develop better predictions of energy yields under forecast conditions.

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EMEC20 Conference

December saw the annual European Meeting on Environmental Chemistry (EMEC) organised by the ACE (Association of Chemistry and the Environment - www.europeance.com). This year EMEC20 was held in Lodz, Poland and brought together scientists from all over Europe, including from the ERI, to discuss their work and advancing research in the field of environmental chemistry and environmental monitoring.

Lisa Shearer (PhD student), presented her research in the form of a poster on 'Sustainable Water Treatment of Pharmaceuticals using Functionalised Waste Materials as Adsorbents'. The poster was selected by a scientific jury to receive the 'Prince Sultan Bin Abdulaziz International Prize for Water' for outstanding contributions of young scientists. Lisa was awarded the prize for best poster communication at the EMEC20 conference, and was presented the award at the closing ceremony.

Dr Szabolcs Pap presented his current research "From Molecular to Large-Scale Phosphorous Recovery from Wastewater using Chitosan-calcite Adsorbent." This work is being carried out as part of the 'Phos4You' project funded through the EU Interreg North- West Europe Programme.

Meanwhile the Association of Chemistry and the Environment (ACE) elected its new President: The ERIs Professor Stuart Gibb. Stuart will act as President for 2020 including the 21st European Meeting on Environmental Chemistry which will be hosted by the University of Novi Sad (UNS) in Serbia. UNS and UHI already have a working Memorandum of Understanding in place, and a current Erasmus+ mobility project through the ERI, North Highland College.

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New faces @ ERI

Dr. Mark Walker Theme Leader



Hi, my name is Mark Walker. I started my new role as a Senior Research Fellow at ERI in late November 2019. I'll be leading the new research theme in 'Environment, Economy, and Society'.

Originally trained as a Mechanical Engineer, I spent my PhD working on the Anaerobic Digestion (AD) process for biogas production and organic waste management. In the subsequent 10 years as a researcher I continued to specialise in AD, but my work broadened to cover the development of a range of other environmental and energy technologies and their integration.

I apply process engineering tools in order to design, optimise and inform the implementation of these systems, and develop coupled models to understand their economic and environmental impacts.

Having recently moved up to Caithness from Yorkshire with a wife, kids, and dog in tow, we are currently settling into life in the North Highlands, making the most of the amazing beaches and outstanding natural beauty (weather permitting!).

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environmental research from a new perspective

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