eri environmental research institute

elements

Summer 2021 newsletter

North Highland College University of the Highlands and Islands

University of the Highlands and Islands Oilthigh na Gàidhealtachd agus nan Eilean

Bog "breathing" seen by satellite

New research has demonstrated the potential for using "bog breathing" to monitor the impact of peatland restoration efforts. The new insights result from successful collaboration between NatureScot, ERI, University of Nottingham, and Forestry and Land Scotland and were published on the 25th of July - International Bog Day.

"Bog breathing" also known as 'peatland surface motion' monitors movement of the ground's surface by Satellite Interferometric Synthetic Aperture Radar (InSAR). The technique was developed with Terra Motion Ltd., a spin-out company of the University of Nottingham.

The way in which bogs move, or breathe, can be influenced by many factors, including precipitation, water level, vegetation composition, micro-topography and land management. By measuring the motion over time, InSAR can assess the condition of the peatland, and the effectiveness of restoration techniques on a large-scale. If developed on a national-scale, the method could provide a better estimate of the amount, distribution, condition and associated carbon inventories of peatlands in Scotland. It could also help to identify areas at high-risk of peat instability, fire and erosion, and highlight where urgent restoration action might be needed.

May Shirkhorshidi, NatureScot's Peatland ACTION report manager, said: "Peatland restoration is a crucial nature-based solution to the twin crises of climate change and biodiversity loss, a key priority as we look towards the COP26 in Glasgow later this year". "While in the early stages of development, we are excited about the long-term potential of this research, which could help Peatland ACTION to target priority areas for restoration and offer a scientifically-proven way of monitoring changes in peatland condition following restoration".

"This is a really interesting development for all the Peatland ACTION partners as it could help us evaluate the success of different restoration techniques - putting us in a better position to share this knowledge with others. Crucially it could allow us to do this more quickly and on a far larger scale across Scotland. We look forward to working with partners over the coming years to develop the concept further."

ERI peatland scientist, and lead author of the publication, Chris Marshall said "peat surface motion gives a unique insight into the inner workings of the peatland including its landscape, hydrology and ecology. The high frequency of ESA sentinel-1 imagery and developments in InSAR processing techniques allow us to monitor peatland condition at a scale unimaginable a decade ago allowing peatland restoration progress to be measured in real time".

"The techniques developed will now be used to assess how resilient Scotland's peatlands are to extreme climate events such as wildfire, drought and extreme precipitation events, in order to guide management

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of these valuable ecosystems during this period of climatic change". This work is being funded by the Leverhulme Trust.

David Large, co-author and peatland specialist at the University of Nottingham, said: "This new tool allows us to see the landscape swell and contract in response to different environmental conditions. A healthy peatland is wet with lots of soft and spongy sphagnum mosses that swell and retain water. In contrast, drier peatlands are stiffer and unresponsive to the addition of water. The former moves like a beating heart, whereas a degraded peatland could be described as flatlining!

"This technique is really exciting because it enhances our understanding of peatlands, allowing us to see what we would not ordinarily be able to with the naked eye, making our peatlands more accessible and ensuring restoration takes place in the right place. In the future, it has the potential to be used to monitor carbon emissions."

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Access to the Report @ https://www.nature.scot/doc/naturescot-research-report-1269-using-peatland-surface-motion-bog-breathing-monitor-peatland-action

University of Nottingham
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NatureScot

LEVERHULME TRUST

Terra Motion

Forestry and Land Scotland
Coilltearachd agus Fearann Alba

Wick smolt tracking project

New insights into salmon migration have been published following joint efforts between the ERI, Marine Scotland Science and the Flow Country Rivers Trust. The work on salmon smolt tagging and tracking appears in the ICES Journal of Marine Science (McIlvenny et al., 2021; see publications).

Little is known of smolt movements after they leave for the marine environment. Learning more about their movements is important for their conservation and learning if interactions with tidal energy or other man-made structures in the marine environment is harmful to them.

The study was conducted in the Wick River and involved fitting smolt with tiny transmitters as they left for their migration to the open ocean. Receivers mounted on the sea floor in the bay were then used to 'listen' to the smolt-transmitters as they passed.

Subsequently 3-dimensional hydrodynamic modelling was used to compare how free-floating particles would act in the same currents that the actively swimming smolt had encountered. The results showed how smolt movements exploited the currents as they leave the bay. However, significantly they showed that smolt are only detected once as they leave the bay, whilst particles would be detected by the receivers on several tides (see image). This finding shows the smolt change behaviour as they move out and leave for deeper water after drifting with the tide as they initially leave the bay. This work is a first stage in understanding how and where smolt move in the marine environment.

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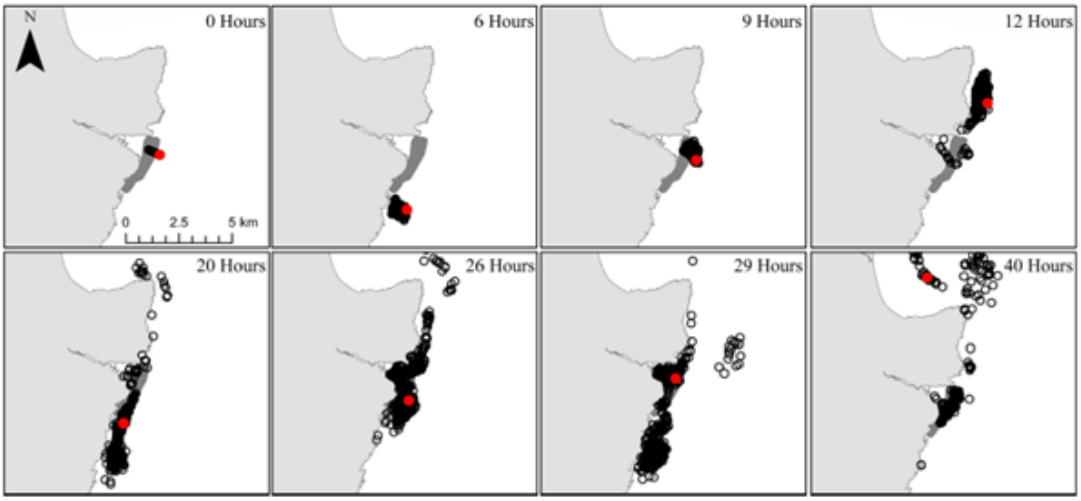

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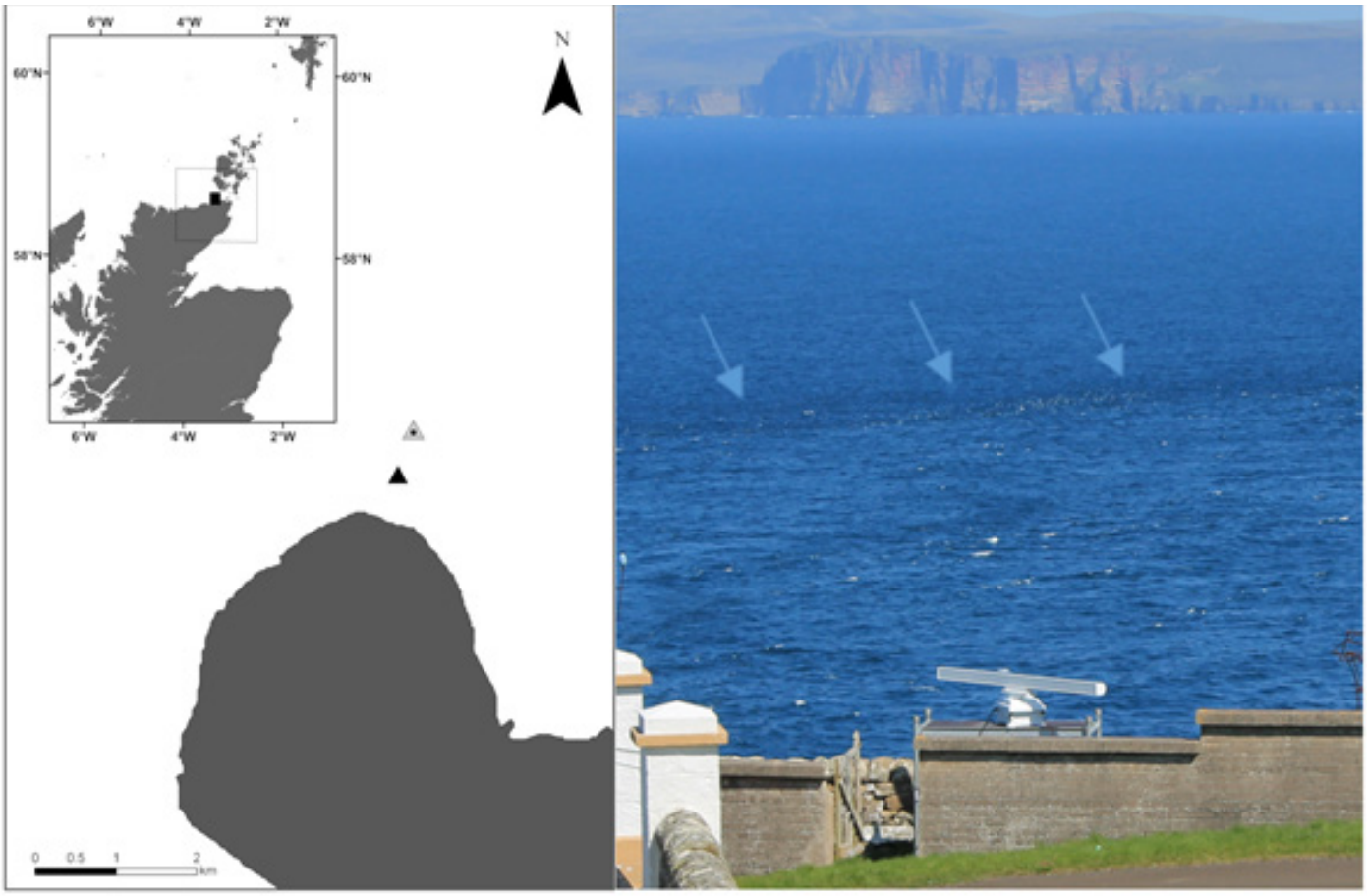
Beatrice Offshore Windfarm Ltd

A 48-h simulation of 500 particles released perpendicular to current in estimated position of first detection. Example point, single drifting particle (red) shows multiple interactions with tidal array.



The locations of the seabed instruments and a picture showing the tidal streak feature with lines of seabirds present.

Dunnet Head Tidal Streak

New observations have revealed that marine birds use a surface disturbance known as a 'tidal streak' when feeding in the Pentland Firth off the Caithness coast. The observations were made while studying the effects of wave and current interactions off Dunnet Head as part of a PhD project involving student Clare MacDowall, and her supervisory team.

Subsea instrumentation used to measure wave and currents revealed very strong vertical water currents in association with the tidal streak. The data showed the vertical currents reached a maximum of 0.22 m/s in a water depth of 76.74 m. Therefore, the entire water column within the streak feature is replacing itself in just over 5 minutes!

The ERI's Jason McIlvenny, Benjamin Williamson, Phillipe Gleizon and Clare MacDowall and Rory O'Hara Murray of Marine Scotland Science used a 3- dimensional model to re-create the phenomena to try to understand how it evolves spatially throughout the tide. The model was successful in recreating the feature. It is thought the feature is formed by water being forced around the headland, whereby water near the seabed is forced towards the headland, which causes it to rise vertically.

The streak feature can be seen best during a flood tide and is easily visible on a calm day from Dunnet Head. More work is planned by the ERI to undertake scientific bird observations and detailed measurements to understand the link between the bird's presence in association with the streak feature. The bio-physical coupling may be due to the availability of prey items for seabirds and marine mammals, allowing them to travel shorter distances to forage. Possible mechanisms for the increased availability of food at these sites may be the disorientation of mobile fish in strong three-dimensional flows and upwelling associated with the hydrodynamics increasing nutrient supplies.

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New report highlights impact of marine plastic pollution on seabirds

Photo credit: Dr Nina O'Hanlon

A new report has highlighted the threat marine plastic pollution poses to seabirds across Northwest Europe. Researchers examined 10,274 nests across the UK, Norway, Iceland, Sweden and the Faroe Islands, finding that 12% of nests contained plastic debris. Atlantic Puffins were found to be most affected by the issue, with 67% of the species' nests including plastic.

The four-year study was led by scientists at ERI. The team asked observers who were visiting seabird colonies for other monitoring activities to help gather data as a cost effective and environmentally friendly way to conduct the study. Information was collected from 14 seabird species in 84 colonies between 2016 and 2020.

Dr Neil James of the ERI, was one of the scientists involved in the project. He explained: "Marine plastic pollution is an increasing global environmental issue which poses a threat to marine biodiversity. Seabirds are particularly affected by because of the risk of entanglement or ingestion. Our study found that a significant number of nests included plastic debris, with some species more likely to incorporate it than others. As well as providing important information about our seabird populations, this type of study can also reveal valuable insights into the prevalence of plastic in the marine environment."

The results of the study have been published in the Marine Pollution Bulletin (O'Hanlon et al., 2021; see publications).

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BLUE CIRCULAR ECONOMY

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The Flow Country - from the ground to the sky in a day

On the 15th of July 2021, something extraordinary occurred in the Flow Country that required an incredible amount of coordination, collaboration and a bit of luck: an international team managed to simultaneously acquire data from airborne sensors, a drone and on the ground as part NASA's Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) mission.

The data collected through this international effort will be available for researchers involved in the Flow Country to use and explore the development of remote sensing options for monitoring of peatlands and other ecosystems.

AVIRIS is the first full spectral range imaging spectrometer dedicated to Earth remote measurement and seeks to advance NASA science by enabling the detection, identification, measurement and monitoring of processes of the Earth's surface and atmosphere. It is based on reflectance, absorption and scattering signatures of the different components of the Earth's surface including plants and water.

The mission is took place all over Europe between May and August 2021 and required a specific set of conditions to enable data acquisition including minimal cloud cover while the sun is near or at its zenith – hence the need for a bit of luck in this part of the world! In addition, the data acquisition from the plane required a co-incident acquisition of reflectance data from the ground on a series of "targets" i.e. homogeneous areas included in the flight path, covering a range of colours/texture.

The calibration requires provision of ground truthing data, and for the NASA team in the sky to work with a ground-based team. This is where the NERC Field Spectroscopy Facility (FSF) team stepped in together with the teams from the ERI and the RSPB's Forsinard Flows National Narture Reserve. As well as ground-based reflectance data from a hand-held spectro-

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radiometer, the FSF team brought their Unoccupied Aerial Vehicle (UAV) equipped with a hyperspectral imager to capture aerial images at an intermediate scale between the ground and the plane.

To complete the picture, the team also worked with Prof. Stuart Marsh and Prof. Doreen Boyd, from the University of Nottingham and involved in the European "Copernicus Hyperspectral Imaging Mission for the Environment" (CHIME) programme. This seeks to advance the use of continuous hyperspectral satellite data in environmental monitoring. In 2020 and 2021, data acquired from a range of sites, included the same area of the Flow Country that was targeted by the AVIRIS mission – just not on the same day.

The team is grateful to GMR Henderson for permitting access to the Melvich Quarry for the ground team as a potential calibration site.

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Field Spectroscopy Facility
NATURAL ENVIRONMENT RESEARCH COUNCIL

Photo credit: NERC FSF/ NCEO

New faces @ ERI

Marilou Jourdain de Thieulloy
Researcher

Hi everyone, I have joined ERI in August within the "Renewable Energy and the Environment" research theme led by Dr. Benjamin Williamson.

In my role I will contribute to on-going and new research projects for marine renewable energy applications. I will focus on new measurement techniques for flow characterisation as well as bio-physical and environmental interactions.

I have a background in electronics, and a Masters in Sustainable Energy. I moved to Scotland in 2017 to join the Wind and Marine Centre for Doctoral Training.

My PhD was based in the FloWave Ocean Energy Research Facility at the University of Edinburgh and focused on novel configurations of acoustic sensors for large scale high-resolution 3-D flow velocity measurements for tidal turbine applications. I am excited to contribute to the inspiring research taking place at ERI and I look forward to meeting you all in Thurso.

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New faces @ ERI

Michael Sinclair

Laboratory technician

Hi, my name is Michael Sinclair and I have been appointed the role of Laboratory Technician at ERI! Originally from Wick, I graduated from Heriot Watt University in 2018 with a BSc in Biological Sciences. I returned home and found part time work while taking up new outdoor activities – leaving me with spare time and a new means to explore Caithness for myself. Over this time I developed a new appreciation for my home county and a keen interest in its nature. I will be involved in the collection and analysis of water samples and hope to help the PhD students with their research. I am excited to learn all that I can!

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Finlay Kerr

Research associate

Hello everyone! I'm Finlay and I am joining ERI as a Research Associate working within the Environment, Economy & Society (ESS) and Renewable Energy & the Environment (REE) research themes. Over the last year I have been working within UHI and based at SAMS, as a member of the UHI Energy Knowledge Exchange team, and I will be continuing my KE activities on a reduced scale in my new role at ERI. In short, you can talk to me about anything from the role of old and new energy systems in society, just transition, community ownership and engagement, low carbon policy and any KE related queries.

For now I'm continuing to work remotely from Edinburgh but hope to be able to visit Thurso soon and regularly to get settled in at North Highland College. I'm excited to explore the stunning landscapes of Caithness and experience the strength of different communities. My interests sprawl across all different types of music and music history, film, cooking, social and cultural history studies, and politics. So if you ever get roped into a pint or a discussion with me, you're fair warned at the topics that might come up! I'm really looking forward to meeting and working with all at the ERI.

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Zhao Qunying

Visiting scholar

Hi, everyone. My name is Zhao Qunying and I will work as an academic visitor at ERI for one year. I come from China and currently work at Xi'an Technological University as the director of the Department of Water Science and Engineering. In 2013, I got my PhD in municipal engineering, my main research direction is wastewater treatment and reuse. I am very happy to come to the ERI and the University of the Highlands and Islands to start new research on water treatment.

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Bethany Copsey

Placement student

Hi everyone - I'm Bethany. I'm at the ERI for a couple of months for a research placement under the trusty guidance of Liam Godwin and Roxane Andersen. So far I've been out in the field and in the lab with Liam and Paula Fernandez which has been really great!

I'm from New Zealand, born in Yorkshire and have been living in the Netherlands for quite a few years now. I'll be doing my MSc after this in Belgium.

I'm looking forward to learning a lot and excited to bring that into my masters at the end of September.

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Publications

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