



‘Making an Environmental Difference’ with NHS Highland

NHS Highland and the Environmental Research Institute (UHI) have won a Scottish Knowledge Exchange Award in the “Making an Environmental Difference” category for groundbreaking work improving the quality of hospital wastewater. The seventh annual ceremony (held on March 17th) was organised by Interface and celebrated game changing innovation with 24 finalists representing academia, businesses, and third sector organisations in Scotland. This event marks the biggest celebration of business and academic knowledge exchange in Scotland, showcasing the achievements of collaborative partnerships and individuals alike.

ERI’s collaboration with NHS Highland investigated pharmaceutical pollution in hospital wastewater at Caithness General Hospital (Wick, Highlands), and examined how the health board could improve water use at the site. Through this

work, Caithness General Hospital was awarded the internationally-recognised Alliance for Water Stewardship accreditation – a world first for a hospital.

NHS Highland and ERI continue to collaborate through the One Health Breakthrough Partnership, involving Scottish Water and the Scottish Environment Protection Agency. The partnership aims to reduce the environmental impact of healthcare practices, address pharmaceutical pollution in the environment, and promote responsible water use in Scotland. You can find out more about the OHBP at their website: <https://ohbp.org>

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First comprehensive assessment of pharmaceutical pollution

A study carried out by researchers at the Environmental Research Institute (UHI-North Highland), with Glasgow Caledonian University and the James Hutton Institute, recently delivered the first national assessment of pharmaceutical pollution of Scotland's water environment. A globally recognised public health and environmental issue, pharmaceutical compounds enter wastewater following ingestion and excretion (between 30-100% of a dose is excreted) and when partially used or expired medicines are inappropriately flushed down the toilet. Wastewater treatment plants were not originally designed to treat pharmaceuticals and are unable to fully eliminate some compounds. As a result, compounds have a direct pathway into the environment through the release of effluent, where their environmental impact is not fully known.

The study was commissioned by the Centre of Expertise for Waters (CREW) and combined published and unpublished academic data with monitoring data from Scottish Water and the Scottish Environment Protection Agency (SEPA). Information on 60 pharmaceuticals was added to a database of over 3,000 data points representing 11 water media – such as river water, influent wastewater and treated wastewater. Results indicated that nine pharmaceuticals, including anti-inflammatories and antibiotics, may pose higher risks of ecotoxicity, driving the development of antimicrobial resistance (AMR) in surface water. Most data related to high-risk locations, such as down-stream from wastewater treatment plants in urban areas where elevated concentrations were expected due to point-source proximity. However, monitoring in the Highlands also revealed that pharmaceuticals are present in rural areas with low population densities. Recommendations in

the report include directing monitoring to areas where few data are available, and, similarly, for groundwater, lochs, and coastal and estuarine waters.

NHS Highland, Scottish Water, and SEPA were involved in the design and oversight of this study and will use the results to direct the activity of the One Health Breakthrough Partnership (OHBP)- a cross-sector initiative bringing together stakeholders and researchers to develop sustainable interventions to reduce pharmaceutical pollution in the environment. The partnership has adopted the One Health concept, which recognises that the health of humans, the environment, and animals are closely interconnected and interdependent – and pharmaceutical pollution is a key area of interest. Through cross-sector collaboration, the OHBP aims to drive research and innovation and influence policy to achieve optimal One Health outcomes in Scotland. This study will be used by researchers, environmental regulators, the water industry, and the health service as a baseline to assess whether, and to what extent, future interventions and OHBP activities help to reduce pharmaceutical pollution in the environment.

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Report available at:
<https://www.crew.ac.uk/publication/pharmaceuticals-water-environment-baseline-assessment-and-recommendations-0>



New renewable energy masters programme available!

The ERI, in partnership with Perth College UHI, is now offering a new Master of Business Administration degree with a focus on renewable energy – MBA (Renewable Energy). Across the world ambitious targets are being set for the provision of energy from renewable resources. Investment in new and existing renewable energy businesses will be key in tackling the dual threat of the climate crisis and energy security.

The new qualification builds on existing master's qualifications delivered by the ERI (MSc Sustainable Energy Solutions and MSc Net Zero

Communities) and the range of successful MBA programmes delivered by Perth College UHI. The new qualification is entirely online and can be taken on either a full-time or part-time basis.

For more information: visit the UHI website <https://www.uhi.ac.uk/en/courses/mba-business-administration-renewable-energy/> or contact our head of Learning and Teaching - Kenny Boyd (kenneth.boyd@uhi.ac.uk).



Credit Duncan McLachlan



UHI | NORTH HIGHLAND

Taming Ægir update

Taming Ægir project, an artist's residency in collaboration with ERI and Lyth Arts Centre, was featured in our Spring 2021 newsletter. The Environmental Artist in Residence, Morag Currie, supported by the Creative Scotland Performing Arts Venue Relief Fund, has produced an album available at the link below.

Charlotte Mountford from Lyth Arts Centre says "this has been a really transformational, important project for LAC and has paved the way for us working with researchers, academics to explore climate and environment."

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<https://peopleoceanplanet.com/album-to-come-from-taming-aegir-project/>



Remote sensing of marine litter and debris

ERI's Dr. Lonneke Goddijn-Murphy has been invited to join the International Ocean Colour Coordinating Group (IOCCG) Task Force: Remote Sensing of Marine Litter and Debris. Several semi-permanent "Task Forces" have been created by the IOCCG to address contemporary issues that need ongoing attention and to help facilitate inter-agency collaborations.

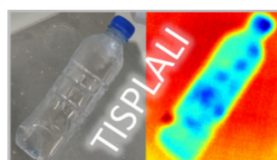
The objective of the Task Force on Remote Sensing of Marine Litter and Debris is to coordinate the advancement of remote sensing methods that are promising for observations of plastic litter over all aquatic environments, with a special focus on radiometric approaches. One of

the goals is to produce living guidelines on best practices in remote sensing of plastics. The Task Force includes 41 members, distributed over five continents and eighteen countries, already cooperating with the international community, including space agencies, research institutes, companies, foundations, and in international initiatives in the field of marine litter.

Dr. Goddijn-Murphy, who has recently been leading pioneering research in using thermal infrared sensors for marine plastic litter remote sensing in project TISPLALI, brings expertise in optical and thermal remote sensing to the Task Force.

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<https://ioccg.org/group/marine-litter-debris/>



Remote sensing is the science of obtaining information about objects or areas from a distance, typically from aircraft or satellites

3, 2, 1... Action!

In January, the ERI's "Carbon, Water, Climate" team hosted two undergraduate students from UHI's Contemporary film making in the highlands and Islands. Nicole Kowronska and Syrina Jobs sought to capture the essence of the team's peatland work in film, and to prepare a short promotional video - a key assignment in their first year's programme. The team joined Nicole and Syrina, taking turns in front of the camera despite the cold, windy and wet weather. For many, it was a new experience and a good practice for future media interviews!

Filming took place in the ERI Castle St. building and at three outdoor locations: Plantlife's Munsary Peatlands where the team has been investigating peatland functioning for over a decade; the river Forss, monitored as part of a collaboration with RSPB and the Flow Country Rivers Trust and an area within the West Halladale peatlands between Melvich and Strathy. This site had been impacted by a

large wildfire in 2019 and was studied as part of the NERC funded FireBlanket project between 2019-2021.

Once finalised, the films will be freely available on the ERI's website, showcasing both the work of UHI's film making students and ERI's peatland research: a win-win scenario!

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Early career researcher event highlights European collaboration

ERI staff and students have led an early career researcher to promote engagement and exchange between post-graduate and early career researchers in environmental science and analytical chemistry across Europe. The event was held under the auspices of the Association of Chemistry and the Environment (ACE) with Lydia Niemi and Szabolcs Pap from the ERI leading together with colleagues from the University of Ljubljana (Slovenia), University of Pardubice (Czech Republic), and the University of Belgrade (Serbia).

Held in March, the "Chem2Change" event, focussed on environmental chemistry and its application in addressing global challenges. It attracted 72 delegates from Croatia, France, Germany, Italy, Poland, Portugal, Russia, Serbia, Spain, Slovenia, and the UK. Opening the event, the current ACE President, Prof Albert Lebedev (Moscow State University) commented on the continued humanitarian importance of academic relationships and engagement across Europe, reflecting on the current situation in Ukraine.

Keynote presentations were delivered by Dr Nuno Ratola (University of Porto) on "Current challenges of waste valorisation", considering the importance of chemistry and circular economy principles in promoting sustainability globally and Prof Matthias Rillig (Freie Universität Berlin) on "Resilient labs, and how you can make your lab a better place", highlighting ways to promote positive, productive labs and adapt research methods in the pandemic recovery.

The scientific programme ran parallel sessions to accommodate the high-quality presentations

from 45 early-career researchers, under three sessions: Global challenges (Corona virus, climate, & nature); Instrumental analysis & method development; and Sustainability & the environment (circular economy and (waste) water treatment technologies).

To encourage active engagement an early-career researcher workshop was facilitated through Padlet software allowing technical research interests to be discussed, collaborations to be explored and a vote on new ways to promote and connect early-career researchers within the ACE scientific organisation. Keeping with the long tradition of ACE events – the conference ended each day with a social session, including a quiz "how to live greener everyday" and a sustainability challenge to choose a drink with least environmental impact.

The Chem2Change organising team thank the ACE Board for their support and contributions in bringing the conference together. The organisers thank the University of Pardubice (Faculty of Chemical Technology) and BASF for sponsorship of the event. For more information, and the Book of Abstracts, please visit: <https://www.eventcreate.com/e/chem2change/>

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Peatland restoration and water quality

New research between ERI and the RSPB has highlighted key differences in the short-term pore- and surface-water quality effects between 'forest-to-bog' restoration methods. Here, stem plus brash harvesting sites experienced sharper and larger increases in concentrations



Forest-to-bog restoration site which has undergone stem-only harvesting, with brash remaining on-site.

of dissolved organic carbon and nutrients (phosphate and ammonium) than stem-only harvest sites. This was likely due to additional surface passes of machinery collecting brash (tree-tops and branches) and is expected to be short-lived. Conversely, stem-only harvest sites saw slower and smaller increases in carbon and nutrient concentrations, but these continued for the duration of the study. Thus stem-only harvest sites may release more nutrients over time as brash left on site decomposes.

These results support the case for enhancing peatland restoration methods to remove brash and tree material from site to reduce potential water quality effects. As well as protecting downstream ecology, reducing additional nutrient release from tree material at 'forest-to-bog' restoration sites may also aid the restoration process by encouraging native blanket bog vegetation recovery. Future research at ERI will continue this theme through investigation of innovative brash management methods including circular economy- based solutions.

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Read the full publication here:
<https://doi.org/10.1016/j.ecoleng.2022.10656>



Developing biochar with Sustainable Thinking Scotland.



Over the past two years, ERI has been collaborating with Sustainable Thinking Scotland Community Interest Company (STS-CIC) to develop biochar for use in water treatment and horticulture. STS-CIC is a social enterprise, based in Falkirk, created to address a wide range of social and environmental issues. Through

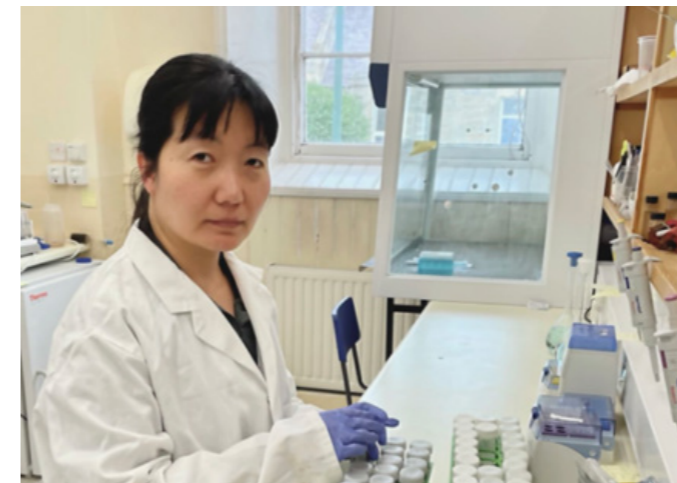
several phases, ERI has supported STS-CIC to create a biochar optimised for excess nutrient removal from water, with the aim of tackling nutrient pollution which causes harmful algal blooms. The next step will be to test the produced biochar at Scottish Water's Horizon Facility in Bo'ness to demonstrate a 'proof of concept'. The results from this research should help inform regulatory decisions regarding the licensing and regulation of biochar use in different scenarios. Recently, Jamie Hepburn - The Minister for Higher Education, Further Education, Youth Employment and Training, visited STS-CIC and showed his support for the multiple positive uses of biochar. STS-CIC's positive contribution to communities, the environment, and the economy was also recognised recently through winning a Scottish Charity Award 2022 – in the Climate Conscious category.



<https://interface-online.org.uk/news/minister-visits-innovative-companies>

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Building links with Xi'an Technological University



My name is Dr Qunying Zhao and I am a Lecturer from the Department of Water Supply and Wastewater Engineering at Xi'an Technological University in China where I am engaged in research and teaching related to wastewater treatment and reuse. I have undertaken a one-year Scholarship as visiting researcher at ERI funded by the Chinese Scholarship Council (CSC) between August 2021 and July 2022.

During this time, I worked closely with Dr Szabolcs Pap and Prof. Stuart Gibb on the use of biochar for nutrient recovery from wastewater. This research contributes to projects funded through Royal Society of Chemistry and Royal Society. The biochar has been generated from waste wood (e.g., brash) collected at restoration sites of afforested blanket bogs. Studies showed

that virgin biochars, produced from the Sitka spruce and Lodgepole pine branches, do not remove sufficient quantities of phosphate from water. However, when functionalised with metal oxides, the adsorption capacity of the biochars improved greatly (1000-fold). Biochars are not widely used on the Chinese market, but there is great potential for their future implementation in water and agricultural sector. I gained much experience and knowledge in my year of work at ERI, and after my return to China, I would like to continue research on in on this topic. I hope I will have the opportunity to collaborate with ERI through some joint projects in the future, which will build on my successful visit in Scotland, to promote the application of biochar technology.

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西安工业大学
XI'AN TECHNOLOGICAL UNIVERSITY

ERI included in the health, wealth and happiness exhibition

ERI's work in water quality and pharmaceutical monitoring will be showcased in the Health, Wealth and Happiness Exhibition at Inverness Museum, Thurso Gallery, and North Coast Visitor Centre this summer. This exhibition explores the unique history of healthcare in the Highlands and is the conclusion of a year-long project run by the collections team at Inverness Museum. The topics promoted will include hospitals, healthcare workers, and water quality. A reflection on the Covid-19 pandemic in the Highlands will also be featured in the exhibition.

ERI's contribution seeks to raise awareness on the environmental impacts of healthcare and

features the pharmaceutical monitoring work done at Caithness General Hospital (Wick) with NHS Highland, Highlands and Islands Enterprise, and the One Health Breakthrough Partnership. The exhibit will include fieldwork and laboratory images, a boiler suit used for sampling at the hospital, and laboratory equipment.

The exhibit will run at the Inverness Museum before travelling to the Thurso Gallery and North Coast Visitor Centre on 1 July to 13 August. Be sure to check out the exhibit right here in Thurso!

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New faces @ ERI

Rob Hughes
PhD researcher



Hi, I'm Rob Hughes. I work for the RSPB as a Conservation Scientist. I've recently switched from seabird related work, coordinating fieldwork for the recently completed National Seabird Census to Peatland related work. Lead by Roxane Andersen, and Mark Hancock from the RPSB, my combined work and PhD will focus on Peatland afforestation, it's impacts and restoration. I will be analysing large-scale forest to bog management trials at Forsinard; measuring

the extent at which waders return to adjoining bog once forestry has been removed; and investigating wider forestry impacts on breeding wildfowl communities. I've lived in Caithness for the last five years and can usually be found birding in Dunnet Bay or the surrounding area.

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Rob McHenry
PhD researcher



Hi Everyone, I'm Rob McHenry, I have just moved from Ireland to study a MRes at ERI, Thurso, with Roxane Anderson as my lead supervisor. I graduated from Trinity college Dublin with a BA in Environmental science, last year. My thesis was on training automated bird species recognisers to quantify changes in habitat generalist vs specialist species in response to a typhoon on the island of Okinawa, Japan. My MRes will look at the effect of active forestry roads vs abandoned

revegetated roads on the activity of mesopredators such as foxes and pine martens in the Forsinard flows blanket bog, using camera traps and scat transects. I have a passion for outdoor sport, cooking and travel and I'm looking forward to exploring this remote corner of Scotland.

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Jade Roberts
Laboratory technician



Hi, I'm Jade and I joined ERI as the new Laboratory Technician in June. I will be involved with the commercial work at ERI, mainly water quality analysis. I'll also be helping PhD students when needed and undergraduate students when the new semester starts. I graduated from Strathclyde University in 2019 with an MSci in Applied Chemistry

with Chemical Engineering. I'm excited to be back in the lab and to put the skills I learnt at university to use again. I grew up in the Highlands but a bit further down (near Invergordon) so I am looking forward to exploring this part of the country.

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Erin Stoll
Peatland Scientist



I started at the ERI as a Peatland Scientist in April after submitting my PhD at the University of Stirling. My research background is fairly diverse, and I have worked in a variety of ecosystems from tropical forests to high mountains. I studied the belowground impacts of climate driven alpine treeline advance in the mountains of Taiwan during my PhD involving a combination of fieldwork,

laboratory analysis and remote sensing. Before starting at the ERI, I worked as a ranger for the John Muir Trust and was involved with the ongoing mountain woodland restoration project at Schiehallion in Highland Perthshire. Outside of academic interests I am a keen runner and particularly enjoy mountain trail routes.

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PUBLICATIONS SUMMER 2022

Badmus, UO, Taggart, MA, Elbourne, P, Sterk, HP & Boyd, KG 2022, 'Effect of long-term storage and harvest site on the fatty acid profiles, mineral and antioxidant properties of selected edible Scottish seaweeds', *Food Chemistry*, 377, 131955. <https://doi.org/10.1016/j.foodchem.2021.131955>

Blanz, M, Stewart, S, Mainland, I, Ascough, P, Raab, A, Feldmann, J & Taggart, MA 2022, 'Trace element ratios in tooth enamel as palaeodietary indicators of seaweed consumption and coastal grazing, and their broader applicability', *Journal of Archaeological Science*. 139, 105551. <https://doi.org/10.1016/j.jas.2022.105551>

Bogdan, A, Robles-aguilar, AA, Liang, Q, Pap, S, Michels, E & Meers, E 2022, 'Substrate-Driven Phosphorus Bioavailability Dynamics of Novel Inorganic and Organic Fertilizing Products Recovered from Municipal Wastewater—Tests with Ryegrass', *Agronomy*, 12(2). <https://doi.org/10.3390/agronomy12020292>

Bradley, A, Andersen, R, Marshall, C, Sowter, A & Large, DJ 2022, 'Identification of typical eco-hydrological behaviours using InSAR allows landscape-scale mapping of peatland condition', *Earth Surface Dynamics*. 10. <https://doi.org/10.5194/esurf-10-261-2022>

Cocking, J, Narayanaswamy, B, Waluda, C & Williamson, B 2022, 'Aerial detection of beached marine plastic using a novel, hyperspectral short-wave infrared (SWIR) camera', *ICES Journal of Marine Science*. <https://doi.org/10.1093/icesjms/fsac006>

Chapman, PJ, Moody, CS, Turner, TE McKenzie, R, Dinsmore, KJ, Baird, AJ, Billett, MF, Andersen, R, Leith, F & Holden, J 2022, 'Carbon concentrations in natural and restoration pools in blanket peatlands', *Hydrological Processes*. 36, 3, e14520. <https://doi.org/10.1002/hyp.14520>

Gaffney, P, Taggart, M, Andersen, R & Hancock, M 2022, 'Restoration of afforested peatland: Effects on pore- and surface-water quality in relation to differing harvesting methods', *Ecological Engineering*, 177, 106567. <https://doi.org/10.1016/j.ecoleng.2022.106567>

PUBLICATIONS SUMMER 2022 - continued

Galligan, TH, Green, RE, Wolter, K, **Taggart, MA**, Duncan, N, Mallord, JW, Alderson, D, Li, Y & Naidoo, V 2022, 'The non-steroidal anti-inflammatory drug nimesulide kills Gyps vultures at concentrations found in the muscle of treated cattle', *Science of the Total Environment*, 807(2), 150788. <https://doi.org/10.1016/j.scitotenv.2021.150788>

Goddijn-Murphy, L, Williamson, BJ, McIlvenny, J & Corradi, P 2022, 'Using a UAV Thermal Infrared Camera for Monitoring Floating Marine Plastic Litter', *Remote Sensing*. 14(13), 3179. <https://doi.org/10.3390/rs14133179>

Hermans, R, McKenzie, R, **Andersen, R**, Teh, YA, Cowie, N & Subke, J-A 2022, 'Net soil carbon balance in afforested peatlands and separating autotrophic and heterotrophic soil CO₂ effluxes', *Biogeosciences*, 19(2), <https://doi.org/10.5194/bg-19-313-2022>

Lancaster, ST, Peniche, G, Alzahrani, A, Blanz, M, Newton, J, **Taggart, MA**, Corns, WT, Krupp, EM & Feldmann, J 2022, 'Mercury speciation in Scottish raptors reveals high proportions of inorganic mercury in Scottish golden eagles (*Aquila chrysaetos*): Potential occurrence of mercury selenide nanoparticles', *Science of the Total Environment*. 829, 154557. <https://doi.org/10.1016/j.scitotenv.2022.154557>

Marshall, C, Andersen, R, Gilbert, PJ, Large, DJ, Marsh, S, Sterk, HP, Sowter, A & Bradley, A 2022, 'Multiscale Variability and the Comparison of Ground and Satellite Radar Based Measures of Peatland Surface Motion for Peatland Monitoring', *Remote Sensing*, vol. 14(2), 336. <https://doi.org/10.3390/rs14020336>

Niemi, L, Landová, P, **Taggart, M, Boyd, K**, Zhang, Z & **Gibb, S** 2022, 'Spatiotemporal trends and annual fluxes of pharmaceuticals in a Scottish priority catchment', *Environmental Pollution*, 292(a), p118295. <https://doi.org/10.1016/j.envpol.2021.118295>

Pap, S, Gaffney, PPJ, Zhao, Q, Klein, D, Li, Y, Kirk, C & **Taggart, MA** 2022, 'Optimising production of a biochar made from conifer brush and investigation of its potential for phosphate and ammonia removal', *Industrial Crops and Products*, 185, p. 115165. <https://doi.org/10.1016/j.indcrop.2022.115165>

Pickard, AE, Branagan, M, Billett, MF, **Andersen, R** & Dinsmore, KJ 2022, 'Effects of peatland management on aquatic carbon concentrations and fluxes', *Biogeosciences*, vol. 19(5), pp. 1321-1334. <https://doi.org/10.5194/bg-19-1321-2022>

Shearer, L, Pap, S & Gibb, SW 2022, 'Removal of pharmaceuticals from wastewater: A review of adsorptive approaches, modelling and mechanisms for metformin and macrolides', *Journal of Environmental Chemical Engineering*. 10(4), 108106. <https://doi.org/10.1016/j.jece.2022.108106>

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environmental research from a new perspective

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