



Issue 1

The Royal Highland Show—SPECIAL EDITION  
JUNE 2022

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**Healthy Soils for a green recovery**—Roy Neilson (The James Hutton Institute), project lead

Healthy soils provide many benefits to society, from growing food and trees to less obvious functions such as filtering water, regulating water flow and storing carbon. However, soils are threatened by several factors such as a changing climate, intensive agriculture, a loss of soil biodiversity, erosion, compaction, and loss of organic matter which have wider consequences for the environment, society, and the economy. These functions are affected by complex interactions between biological, physical, and chemical components of the soil. Understanding these interactions and their consequences for soil function provides insights into the health of soils.

Soils are integral to several policy areas including climate change, agriculture, biodiversity, water quality, flood risk management, land use, and development planning and protecting. Furthermore, enhancing soil health is key to achieving national net zero greenhouse gas emission targets. Thus, policymakers and other stakeholders require robust analyses to understand the environmental, economic, and societal benefits we derive from soils. Indicators of soil health are therefore required that robustly measure the im-



part of land management practices and a changing climate.

As part of Scottish Government's 2022-27 Strategic Research Programme, Healthy Soils for a Green Recovery, is a 5-year programme of soils research delivered in partnership between the James Hutton Institute and SRUC. This innovative programme of research aims to strengthen the evidence base to support and inform decision-making, practice and uptake for sustainable management and minimization of degradation and loss of Scotland's soils. Using laboratory, controlled environment, and long-term field experiments at gene to landscape scale, Healthy Soils will deliver new insights and knowledge on the role of Scottish soils, and the benefits that they confer.

As well as identifying and developing strategies to mitigate degradation, reduce loss and to enhance soil health. This will be achieved through gaining a deeper understanding of which soil functions are regulated by intrinsic soil properties in several Scottish ecosystems (agricultural, agroforestry, forest, grassland, urban) and how land management can drive changes in function and ecosystem service delivery. Assessment of existing and new indicators of soil health, establishing thresholds and their applicability, will be crucial for evaluating their suitability for a future national soil monitoring framework to support land-based businesses in managing soil sustainably across land use sectors and providing practical management interventions.

**Who are we?**

**Healthy Soils is a 5 year project funded through Scottish Government** and a collaboration between SRUC and the James Hutton Institute who form part of the Scottish Environment Food and Agricultural Research Institutes (SEFARI). The Soil Sentinel will be produced every 4 months highlighting the project and its work with input from other Scot-

tish Government funded projects and stakeholders.

**Meet the team will be a regular feature in the bulletin** where you can learn more about those involved in the project. In this edition we'll introduce you to the co-leads of this regular newsletter and the wider knowledge exchange work package – Kenneth Loades and Paul Hargreaves who

understand that communicating outputs from the projects is key for a range of audiences, from policy and stakeholders, such as SEPA and NatureScot, to industry and the public.

**For more information on any of the articles in The Soil Sentinel please email : [healthysoils@sefari.scot](mailto:healthysoils@sefari.scot)**



## Meet the team — Paul Hargreaves from SRUC and Kenneth Loades from The James Hutton Institute and SEFARI Gateway

**Kenneth Loades**—All information is valuable but it's about disseminating the right message to the right audience. Prior to working in science as a soil physicist I was a fish farmer having started working on a trout farm when I left school at 16. I was a mature student when I went to university to study environmental sciences after 12 years in aquaculture and I am not afraid to admit that academia and science was a little intimidating. During my studies I learnt a lot about the wider landscape and how complex and interlinked the environment is, I also learnt that science can be intimidating due to the complexity of language rather than the 'stories' themselves.

Understanding science and research outputs shouldn't be a barrier due to poor communication, we just need good communication practices,

with language everybody can understand. This philosophy is one that I bring to communicating messages from research and I am always looking for new approaches to get messages across, from computer games and comedy shows to sandcastle building competi-



tions! In addition to my role within the Healthy Soils project I am also a knowledge broker within the Scottish Environment, Food and Agriculture Research Institutes (SEFARI) Gateway.

**Paul Hargreaves**—After completing an Honours Degree in

Environmental Biology at Liverpool University I moved to Cambridge and worked for NIAB. However, I was still more interested in soils and soon moved to Rothamsted Research, the home of the longest continuously running arable experiment in the world – Broadbalk – along with the Park Grass grassland experiment, which was to be the main focus of my work. This helped sustain my interest in soils and allowed research into other areas, leading to a successful PhD with Nottingham University on modelling the effects of atmospheric nitrogen deposition on woodlands. After working for a London council as their Scientific Officer, dealing with air pollution and contaminated land I started work at the SRUC Dairy Research and Innovation Centre in Dumfries and for

the last 10 years have covered research such as effects of soil compaction on grassland yield and quality. Work on controlled traffic systems and the expanding area of soil quality with involvement in the development of a scorecard as part of an AHDB research partnership. I look forward to more exciting developments in the coming years and sharing the outcomes of new research with the readers of Soil Sentinel.



## Working together at the World Congress of Soil Science (31st July—4th August, Glasgow) - Patricia Bruneau (NatureScot)

**'Soil supports all of nature and through soils, nature governs the global carbon cycle, and hence climate'.** NatureScot recognises the central role that healthy soils play in addressing the twin crisis of climate change and biodiversity loss. Shaping a nature-rich and resilient future for all will require changes to how we use, manage, and restore the land, with soils taking a more prominent place in the development of nature-based solutions that deliver multiple benefits for nature and people.

There remain multiple challenges in how we will monitor the state of soils and nature, make land use change and management decisions and

direct interventions and investment. Working in partnership with Scotland's research community within the Scottish Environment, Food and Agriculture Research Institutes (SEFARI) offers multiple opportunities to expand our understanding of soil and develop tools to respond to the growing challenges.

Building upon the success of COP26, NatureScot has become a key sponsor of the World Congress of Soil Science (<https://22wcsc.org/>)



to be held Glasgow SEC be-

tween 31st July and 5th August. This event occurs every four years and brings together world leading researchers, practitioners, and policy makers to share knowledge on the critical role of soils in addressing

the nature-climate crisis. Alongside attendance at the event, we are also collaborating with SEFARI to link to additional resources on Scotland's soil website (<https://soils.environment.gov.scot/>). The Glasgow event provides an opportunity for Scotland to showcase both its policies and good practice in healthy soil management to address the twin climate-nature crisis and contribute to Scotland's green recovery. Representation at the congress from the Healthy Soils project will allow demonstration of collaboration between NatureScot and SEFARI with combined effort to showcase the value of Scotland's soil and its world leading research and knowledge.

## Achieving Multi-Purpose Nature Based Solutions (AiM NBS) -

Mark Wilkinson (The James Hutton Institute), project lead

In the context of the climate and biodiversity emergencies, there is a need not only to mitigate against these changes (e.g., reduce CO<sub>2</sub> levels) but also adapt to current and future water-related environmental pressures (e.g., flooding, drought, water quality); action (based on evidence) is needed now. Nature-Based Solutions (NBS) have been promoted as a way to help address these emergencies and support Scotland's Green Recovery. NBS are defined by the European Commission as "solutions to societal challenges that are inspired and supported by nature".

NBS are central to global debates about sustainable natural resource management. In particular, they have been identified as one solution to many water related

environmental pressures. They are being considered more by many policy, industry, and practice sectors but the widespread rollout of NBS is slow to address the pressing emergencies and mitigate water-related pressures. Scientific evidence and guidance are needed to support implementation through the Scottish Government's 'Green Recovery'. Coupled with this, greater focus must be given so that these solutions can provide many more ecosystem services with many ways to maximise these benefits further in managed landscapes. We must assess the conditions of some of our core land units (e.g., riparian zones next to rivers) and look at ways to protect these systems.

Consideration is needed of

the wider benefits, how to value these, and promote these to catchment planners, industry, and practice. However, getting beyond small-scale pilots and isolated best practices rarely occurs; we need to explore how to work at scales and across sectors to deliver NBS that make a significant contribution to meeting society's needs. To this end AiM NBS seeks to: Develop a multi-scale empiri-

cal understanding of the impact of NBS based on hydrological, hydro-geomorphic, biogeochemical and ecological observations; Assess the water-related ecosystem services of a selection of NBS approaches on our landscapes and suggest ways in which the benefits can be enhanced; Assess the state of river corridors and their role in combating climate change; Understand how to achieve transformative change via NBS that deliver multiple benefits and works across multiple sectors and scales. The challenges over the next 5 years will be great and as the project develops you will be able to hear more through the SEFARI Gateway and this bulletin.



## Field laboratories and how we use them

To understand the wider environment and the impacts of changing management and adopting new practices it is critical to use field laboratories. Here we outline some of these sites and what they deliver.

At the **James Hutton Institute's centre for sustainable cropping (CSC)** near Dundee we are testing an integrated cropping system that aims to meet multiple environmental and economic goals by combining best practice management options and nature-based solutions to benefit in-



field agro-ecosystem function. The resulting improvement in soil quality and biodiversity has enabled a re-

duction in agrochemical inputs required to maintain crop productivity, thereby delivering to both food security and environmental targets. Longer term the living laboratory allows us to minimise the reliance on inputs, improve the efficiency of inputs, and reduce losses from the field including nutrients and soil itself. The platform is set within Balrudery farm and catchment where implications of wider nature-based solutions for biodiversity and flood risk management are being assessed within multiple projects funded through Scottish Government. To find out more on the platform please visit <https://csc.hutton.ac.uk>. (Article written by Cathy Hawes)

The **SRUC Dairy Centre at Crichton and the Barony** offers a variety of research opportunities but as this is a dairy centre the main focus is on intensive grassland production. However, there are other crops grown for

forage such as maize and cereal wholecrop as well as red clover and spring beans. It is hoped to move toward more mixed lays in the coming years to allow a richer diet and provide more protein grown on farm. More emphasis on studying how the intensive dairy system can reduce its carbon footprint especially by utilising a more mixed rotation of crops.



There are a variety of soil types from the majority free draining silty loams to imperfectly drained clay loams to alluvial soils. Greenhouse gas analysis from past experiments has ensured detailed

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data sets that include nitrous oxide (N<sub>2</sub>O), carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) fluxes. (Article written by Paul Hargreaves)

The **Hutton Institute's Grieves House Tillage Platform** (established in 2017) is designed to explore the effects of traditional inversion plough vs. no-till in a long-term trial. The two soil cultivation methods produce distinctly different soil conditions for cropping, over short and longer-time scales. The trial includes two four year crop rotations, one concentrating only on spring sown crops with no winter cover, and one focusing on winter and/or spring crops including winter cover crops to ensure soil coverage in winter. We





are using the trial to investigate long-term changes in soil physical and chemical dynamics, differences in crop variety performances, and differences in soil biological activity. Further information

can be found at <https://virtual-tours.hutton.ac.uk/grieveshousetour/>. (Article written by Tracy Valentine)



## Monitoring and optimising the value of Scotland's peatland, CentrePeat—Rebekka Artz (The James Hutton Institute), project lead



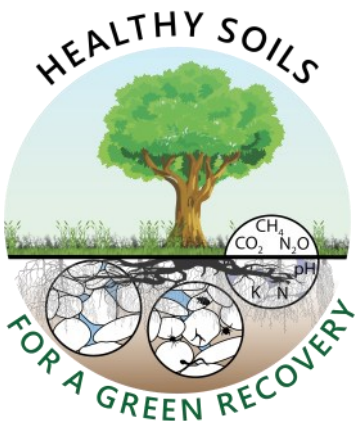
The RESAS Strategic Research Programme 2022-27 includes a major new project on peatlands (CentrePeat) which aims to inform the protection and restoration of peatlands across Scotland. Peatlands store nearly 50% of all Scotland's soil carbon, and getting our national peatland resource into good condition is key to reaching Scotland's net zero target by 2045.

Peatland condition is dependent on physical, hydrological, and ecological factors, which influence each other in various self-regulating feedbacks to produce resilience over millennial timescales to climatic variation. Much of Scotland's peatland area, however, has been damaged to such a degree that this self-regulation no longer functions. The Scottish Govern-

ment's Climate Change Plan has a 250,000-ha restoration target by 2030. As the majority (more than 70%) of Scotland's approximately 2.4 million ha of peat is degraded, early targeting of the most cost-effective and most climate vulnerable sites for restoration is necessary.

CentrePeat will provide information about where and when restoration should be considered, and how much benefit could be achieved across all of Scotland to achieve net zero by 2045. Wider than just restoration issues, we still do not have clear estimates of how degraded our peatlands are, or how to cost-effectively monitor the overall health or condition of our 2.4 million hectares of peatland. The CentrePeat project will provide underpinning and integrated research for more accurate reporting on peatland

greenhouse gas emission in the UK Greenhouse Inventory. Additionally, we will develop a specific Peatland Monitoring Framework, that will aid national scale peatland condition mapping and monitoring via Earth Observations, improve wider Natural Capital accounting, and evaluate the Peatland Code as a means to increase and diversify investment into Nature-based Solutions. Finally, we will improve the reliability of carbon audit tools to measure the benefits from improved peatland management, inclusive of future climate sensitivity. Peatland management is key to achieving our net zero targets by 2045 with the CentrePeat project providing critical information over the next 5 years in optimising its natural capability.



### Comments

*The Soil Sentinel was produced as part of the Healthy Soils (JHI-D3-1) project with input from CentrePeat (JHI-D3-2) and the Achieving Multi-Purpose Nature Based Solutions (AiM NBS) (JHI-D2-2) project. We acknowledge funding through the Rural & Environment Science & Analytical Services Division of the Scottish Government.*

*This is the first edition of The Soil Sentinel and we would welcome suggestions for articles, or requests for more information on any soil and plant interactions topics. If you would like to propose a contribution to the bulletin please don't hesitate to get in touch through [healthysoils@sefari.scot](mailto:healthysoils@sefari.scot)*