Hutton Highlights
September 2019

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The James Hutton Institute

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The James Hutton Institute

The James Hutton Institute is a well-respected and globally recognised research organisation delivering fundamental and applied science to drive the sustainable use of land and natural resources.

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Introduction

Working together is the way forward

Professor Colin Campbell, Chief Executive of The James Hutton Institute

Welcome to our latest Hutton Highlights where we feature several new pieces of work reflecting Hutton's impact both in Scotland and Internationally.

We have just completed a summer of events, engaging with people from across Scotland at the Royal Highland Show and with the industry at our field events Potatoes in Practice, Arable Scotland and Fruit for Future. These are great opportunities to showcase our work, that of our SEFARI partners and to listen to others' ideas, problems and opportunities.

We are very proud of the way our colleagues interact with the general public, stakeholders and visitors at these events and get great feedback on them and what we do. It is also good to celebrate staff achievements too and share their success.

We aim to collaborate and share ideas even more actively. Our plans to operate as Open Access science campuses are gaining momentum with positive feedback on proposed developments and more partners and collaborators seeking to join us. More broadly, climate change problems are now the subject of mass protest and pan-global government action. At Hutton, we continue to promote solutions based on our science in several of the case studies featured here.

Enjoy the newsletter and as always, we are always pleased to get feedback and hear your perspectives on any of the issues or things we do.

SEFARI activity

SEFARI LEADING IDEAS FOR BETTER LIVES

SEFARI Gateway's new funding calls are outlined in a feature in this edition of Highlights and they have had a busy summer showing stakeholders what's going on within the Scottish Government's Strategic Research Programme.

Gateway's promotional activity around the Strategic Research Progamme extends to having exhibited over the summer at events spanning the breadth of Portfolio research including Arable Scotland, The Natural Capital Summit (London), the Rural Entrepreneurship Conference and an impact event at the Royal Highland Show.

Looking forward, the team will also be active at Science and Parliament on 20 November and are hosting a "Match" table to meet with sector stakeholders at Food Matters Live on 19-20 November. SEFARI is also sponsoring the SAGES Conference "Global Climate Challenges for a Blue Green Economy - Evidence, Relevance, Solutions" which is a superb opportunity for to engage with policy and wider stakeholders in response to the Climate Emergency.

Project Summary Pages for the Strategic Research Programme went live on the SEFARI website in July and link with the Directory of Expertise. They remain under active development but have already proved useful in promoting the SRP. Over the coming months work will further add functionality and greater accessibility.

News Highlights

Institute outlines plans for open science campuses

Ambitious plans to establish two open science campuses at the James Hutton Institute's sites in Dundee and Aberdeen were outlined by the Institute's Chief Executive, Professor Colin Campbell, at the Scottish Society for Crop Research (SSCR) AGM and Annual Lecture in May.

The next two years will bring significative milestones for the continued partnership of SSCR and the Institute, with SSCR marking its 100th anniversary in 2020 and the Institute turning 10 in 2021.

According to SSCR Chair Dr Keith Dawson: "As the Society moves closer to its 100th anniversary, there is no diminution in the relevance of its role to support, promote and influence the forward movement of science. Essential to such research support is our collaboration with the James Hutton Institute and we are hugely interested in the Institute's plans for the future."

In a nod to what the future holds for science and innovation at the Institute, Professor Campbell outlined the enormous potential of the planned open science campuses during his presentation at the SSCR AGM and Annual Lecture.

The science campuses will provide open access to the public, stakeholders and businesses and will house the International Barley Hub (IBH) and the Advanced Plant Growth Centre (APGC) innovation centres in Invergowrie, both funded by the Tay Cities Deal, and the Hydro Nation International Centre as part of the Craigiebuckler Campus Project in Aberdeen, plus new partnerships with business and industry.

"We have had a fantastic experience collaborating with Intelligent Growth Solutions in the development of disruptive technologies for the future of vertical farming. Hutton will be an even more open science institute facilitated by new investment on our sites and embracing many collaborators, stakeholders and the public.

"We are already discussing potential collaborations with commercial companies and have also developed a spin-out business arising from innovation developed at the Institute and its commercial subsidiary, James Hutton Limited" said Professor Campbell.

The IBH is set to be a centre of excellence linking industry-focussed research with innovation, to both deliver immediate impact and ensure the long-term sustainability of the UK and international agriculture, brewing and distilling, food and non-food sectors. It is backed by a £35m investment as part of the Tay Cities deal.

Similarly, the APGC has been supported with a £27m transformational investment from the Tay Cities Deal and it seeks to generate state-of-the-art research and innovation infrastructure associated with totally-controlled-environment agriculture. It will mean the UK can play its part in leading the science agenda around this rapidly expanding global market which is expected to be worth $10 billion by 2025.

Royal Entomological Society first female Honorary Secretary

Dr Jenni Stockan, a research scientist within our the Ecological Sciences group, has been distinguished by the Royal Entomological Society as the first woman to take the role of Honorary Secretary in the society's 186-year history.

The Royal Entomological Society was founded in 1833 as the Royal Entomological Society of London and is devoted to the promotion and development of entomological science. Its stated aims include promoting excellence in entomology and demonstrating the importance of studying insects to everyone.

The Honorary Secretary is one of four officers responsible for the scientific, social and financial affairs of the Society. Many eminent scientists of the past have served in this role, including Charles Darwin, renowned English naturalist and biologist responsible for major contributions to the science of evolution.

Dr Stockan has worked with the Society in various roles to date: Honorary Secretary for Scotland since 2011, Fellow since 2013, Trustee between 2016 and 2019, and Vice President from 2018 to 2019.

She commented: "It is an honour to be elected to the role of Honorary Secretary. The Royal Entomological Society is one of the world's most eminent Entomological Societies.

"I hope to play my part in supporting international collaboration and communication of insect science within the entomological community and to wider audiences."

Professor Deb Roberts, Hutton Director of Science and chair the Equality, Diversity and Inclusion committee, said: "I am delighted that Jenni has been appointed Honorary Secretary of the Royal Entomological Society, following in the footsteps of very distinguished scientists.

"Women remain under-represented in many science areas. I hope Jenni's achievement inspires future generations of female scientists."

"Women remain under-represented in many science areas. I hope Jenni's achievement inspires future generations of female scientists"

Awards, Accolades & Appointments

New Finance Director appointment

The James Hutton Institute has confirmed the recruitment of Hugh Darby as its new Director of Finance and Company Secretary, replacing Derek Leslie who is stepping down after almost three years' service.

Mr Darby is an experienced business professional who joins the Institute building on a successful career as Director of Finance and Acting Chief Financial Officer at the University of Strathclyde and with considerable experience in the legal and energy sectors. He will take up the post on a full-time basis in mid-October.

"It is a pleasure to welcome Hugh to the Institute and we look forward to working with him in furthering our ambitions to further diversify revenue sources and deliver our corporate objectives. His finance, research-sector and business experience is well-aligned to the initiatives and opportunities ahead of us.

"We are grateful to Derek for all the hard work and ideas he has contributed to the success of the James Hutton Institute, and wish him well. He leaves the Institute's finances in a more modern, well-organised and resilient state", said Professor Colin Campbell.

"I am excited to be joining the James Hutton Institute in this role and look forward to working with my new colleagues and contribute to the further success and growth of the Institute", commented Mr Darby on his appointment.

The James Hutton Institute's Executive team is now formed by Professor Colin Campbell, Chief Executive; Professors Deb Roberts and Lesley Torrance, Directors of Science; Alasdair Cox, Director of Operations; and Hugh Darby as Director of Finance and Company Secretary.

Hutton water innovation up for VIBES Hydro Nation Scotland award

Institute-led and Scottish Government-funded project to develop a novel decentralised wastewater treatment system in rural India that can be replicated in Scotland and beyond has been shortlisted for a VIBES – Scottish Environment Business award in the Hydro Nation Scotland category.

The Institute is a leading player in water-related research and innovation and hosts the Hydro Nation International Centre, a site of the Water Test Network for North-West Europe and the Scottish Centre of Expertise for Waters (CREW), all at its Aberdeen site.

"We are delighted to be named as finalists of the VIBES Hydro Nation Scotland award for the efforts of our multi-disciplinary team along with other Scottish and Indian partners. Together we have developed a system that can deliver low-cost wastewater treatment for rural schools and is easily adaptable to different sites and conditions, meaning more schools and communities can benefit" said Dr Rachel Helliwell, CREW manager.

Apart from being a finalist in the Hydro Nation Scotland category, the Institute is also a member of the One Health Breakthrough Partnership led by NHS Highland, which has been nominated for a VIBES award in the Partnership Scotland category. The partnership seeks to tackle the growing issue of pharmaceuticals in the environment and aims to work towards a non-toxic environment which recognises that the health of humans, animals and ecosystems is interconnected.

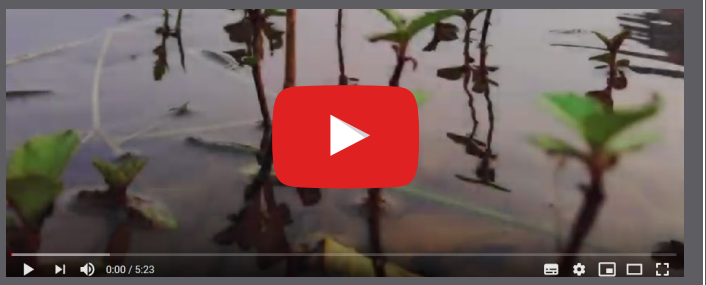
Vertical farm technology business Intelligent Growth Solutions Ltd, which opened Scotland's first vertical farm in August 2018 at the Institute's Dundee site, has also been shortlisted for a VIBES award in the Innovating Scotland category.

The Institute won a VIBES Adaptation to Climate Change award in 2018, on account of farming innovations to protect the environment, renewable energy projects and the International Barley Hub's efforts to ensure the long-term sustainability of barley supplies in a changing climate.

Environment Secretary, Roseanna Cunningham, commented: "My congratulations go to the businesses who have been shortlisted for this year's VIBES awards. We are all aware of the urgent environmental issues affecting our planet and business has a vital role to play in Scotland's continuing journey to a net-zero society.

"It is important that we recognise those who are leading on action to develop sustainable solutions and environmental practices while seizing the economic benefits of embracing a vibrant and innovation circular economy."

The winners will be announced at a ceremony on 14 November at the Doubletree by Hilton hotel in Glasgow. A full list of categories and finalists is available on the VIBES Awards website.



IUFRO Scientific Achievement Award for Professor Maria Nijnik

Professor Maria Nijnik has been distinguished with a Scientific Achievement Award by the International Union of Forest Research Organizations (IUFRO), on account of outstanding contributions to social science research on forestry, climate change and social innovation in forestry.

The award recognises Maria's input in the development of novel ways of stakeholder evaluation of landscape change, conceptualization of multi-functional forestry and assessing of the cost-effectiveness and social acceptability of woodland expansion.

"Innovation, including social innovation, is considered a driving force of sustainable forestry development. It helps regenerate the economy, improve the environment and advance people's quality of life. We believe that it is timely and worthy for scientists, the community of practice and local people to explore the opportunities arising from innovation" she said, commenting on the award.

The award will be presented to Maria in a special ceremony at the IUFRO headquarters in Vienna, which is planned for 28th October.

Hutton innovation shortlisted for British Farming Award

Euan Caldwell, Head of Farm, Field and Glasshouses, has been shortlisted in the Arable Innovator of the Year category of the British Farming Awards, organised by AgriBriefing. The winners will be revealed at a ceremony in Birmingham on Thursday 17th October.

Now in their seventh year, the awards celebrate the creative thinking, innovation and dedication of Britain's farmers across 14 categories including core sectors such as dairy, beef, sheep, arable and machinery, as well as the efforts of new entrants and rural businesses in tourism, textile, retail and wildlife, just to name a few.

Euan is an award-winning farm manager, previously recognised with an RSPB Nature of Scotland Award (2016) as well as accolades from the Royal Agricultural Society of England (2017) and a Scottish Business Environment VIBES Award in 2018.

He manages the Institute's farms as commercial farms, with a crop rotation including spring barley, winter wheat, winter barley, vining peas, winter oilseed rape, field beans and ware potatoes. These farms are an integral and important part of the Institute's science resources, vitally important for conducting experiments but also demonstrate Hutton science and carry out knowledge outreach.

Euan and his team have made a sustained contribution to farming innovation at the Institute through work on Magic Margins; the development of infrastructure for growing hops in Scotland; the protection of wildlife; the innovative use of GPS technology for plot grain drilling; and the design of a low-cost storage system for biomass, among others.

On being shortlisted, Euan commented that he was absolutely delighted to have been shortlisted for the Arable Innovator of the Year Awards. Competition for the British Farming Awards is always very strong therefore it is a huge honour to be included and to be formally recognised by the British Farming Awards in this way.

"None of these innovations and achievements would have been possible without the contribution of the dedicated, hard-working farm team that I work with."

Pea gin: how your G&T could help save the rainforest

The health impact of one too many is questionable, but what is the environmental footprint of that classically delicious aperitif? An international team of researchers has worked with a pioneering distillery manager to answer this question in a study published in the scientific journal Environment International.

The process of producing gin includes many steps. Firstly, cultivation of wheat includes ploughing and application of agricultural inputs such as synthetic nitrogen fertiliser. Secondly, following harvest, seed dressing (or cleaning) and transportation, there is the fermentation and distillation stage which includes milling, enzyme addition and heating. Finally, the flavoured gin must be packaged in bottles and boxes for distribution to consumers. The greenhouse gas (GHG) cost of all these steps was calculated to be 2.3 kg CO2 equivalent (eq.) per 70 cl bottle of gin, or 0.16 kg CO2 eq. per large measure (50 ml).

“In real tangible terms of climate change impact, sipping 2 units of gin is similar to consuming a small serving (150 ml) of milk, or to driving one km in a petrol car”, explains Theophile Lienhardt, lead author of the study.

However, what if that gin was made from peas? Arbikie Distillery in Scotland have run trials in which the kernels of dried, de-hulled peas (Pisum sativum L.) are milled and fermented in place of mashed wheat grain.

Kirsty Black, manager of Arbikie Distillery, provides reassurance to gin connoisseurs: “Following two distillations to produce a neutral base spirit, botanicals including juniper and coriander can be used to produce a final gin that retains the same sumptuous, aromatic flavour as gin made from cereal grain spirit.”

The study was part of the pan-European project “TRansition paths to sUstainable legume based systems in Europe: TRUE”, led by Dr Pietro Iannetta, an agroecologist at the James Hutton Institute’s Ecological Sciences group. “We found that the environmental footprint of pea gin was significantly lower than for wheat gin across 12 of 14 environmental impacts evaluated, from climate change, through water and air pollution, to fossil energy consumption”, noted Dr Iannetta.

Professor Mike Williams, from Trinity College Dublin, adds: “Peas fix nitrogen from the atmosphere, and therefore don’t require applications of polluting synthetic nitrogen fertilisers. Furthermore, pea hulls and distillery co-products provide protein-rich animal feeds that can replace soybean imported from Latin America, where soybean cultivation is driving deforestation”.

Co-products from one litre of pea gin substitute up to 0.66 kg of soybean animal feed, twice as much as from wheat gin, and could help to reduce Europe’s high dependence on imported protein. Amazingly, potential avoidance of GHG emissions from substituted soybean cultivation, deforestation, processing and transport can exceed the GHG emissions arising from production of the pea gin itself, making the gin from peas carbon neutral.

“Of course, if we wanted to dramatically shrink our environmental footprint and reduce deforestation, we could eat those peas directly to provide our protein and fibre requirements, instead of drinking gin and eating beef fed on the co-products”, adds Dr David Styles, lecturer in life cycle assessment at Bangor University and NUI Galway. Nevertheless, for those moments of social interaction sipping a delicious G&T, Arbikie Distillery are working to ensure that a responsible tipple need not cost the earth, literally.

Focus on barley can improve livelihoods in Ethiopia

Food security and livelihoods for a majority of Ethiopians depends on smallholder farming, and barley is an important crop grown by over 4 million smallholder farmers for multiple uses as food, feed and as a cash crop for an emerging malting and brewing industry. However, Ethiopian barley varieties achieve low yields and are susceptible to losses from lodging, pests, and diseases.

In the context of the International Barley Hub initiative promoted by the James Hutton Institute and the University of Dundee, Girma Fana, Ethiopia's National Barley Research Program Coordinator, has started a PhD in Dundee with the objective of improving on the current situation. He aims to characterise the genetic diversity within Ethiopian barley using modern genetic tools, to develop modernised breeding tools for use in-country and improve sustainable crop production and new varietal development in the East African nation.

Ethiopia is a centre of barley domestication and diversity, and barley has an important place in African dryland agriculture in general, resiliently producing stable yields under extreme temperature, drought, and salinity conditions, characteristics that will be increasingly important for food security under conditions of climate change.

Research organisations in Ethiopia are beginning to provide access to new varieties with increased yield, and brewers have also introduced a few European semi-dwarf varieties for the malting barley sector.

These emerging efforts could be greatly assisted by collaborations with researchers in Dundee to understand and characterise relevant traits in Ethiopian varieties, to identify the genetic diversity in Ethiopian barley, and to develop molecular markers for future breeding efforts.

Ethiopia is also the focus of work on a Royal Society Challenge grant to Professor Claire Halpin (University of Dundee), which aims to understand barley straw traits to improve sustainability and crop yields. Traditional Ethiopian barley varieties are tall and susceptible to lodging, causing significant yield losses. By combining datasets on stem strength and field lodging with genetic information on hundreds of barley cultivars, the research aims to identify genes and markers for lodging resistance that can be used in barley breeding programmes.

The International Barley Hub is an initiative of the James Hutton Institute and the University of Dundee which seeks to create a unique, integrated, open platform for the translation of barley research into economic, social, environmental and commercial impacts for the breeding, farming, malting, brewing, feed, food, health and related industries, and was recently awarded funding through the Tay Cities Deal. For more information on the Hub, visit www.hutton.ac.uk/ibh.

You can also watch the short video below:

Comments?

International research effort maps global distribution of soil nematodes

Ground-breaking research into the soil beneath our feet, just published in the journal Nature, transforms current understanding of life on land by revealing that the world's largest animal populations are found in high-latitude sub-arctic soils.

Hutton scientists have contributed to a study which maps the global distribution of soil nematodes. These tiny creatures make up an estimated four-fifths of all terrestrial animals and play a critical role in soil nutrient cycling, plant growth and the climate.

The research, led by the Crowther Lab at ETH Zürich, provides conclusive evidence that the majority of the world's animals live in high latitudes: 38.7% of soil nematodes exist in boreal forests and tundra across North America, Scandinavia and Russia; 24.5% in temperate regions; and only 20.5% in the tropics and sub-tropics.

It also calculates that the world's population of soil nematodes is far greater than previously estimated, with 57 billion for every single human. They have a total biomass of around 300 million tonnes – approximately 80% of the combined weight of Earth's human population of 7.7 billion people.

"There's an immense world hidden just beneath our feet that we barely understand. This study fundamentally changes our understanding of the distribution of life on land. We were amazed to find that nematodes are so abundant and that there are more animals in the arctic and sub-arctic than in the tropics – the opposite of what we see above ground" says study leader Dr Johan Van den Hoogen

Hutton nematologist and co-author of the study Dr Roy Neilson added: "Nematodes have key roles in soil processes that mediate soil-plant interactions which delivers multiple benefits to society, for example, food production and regulating soil carbon and nutrient dynamics. This study provides insight into the functional composition of global nematode populations and thus provides key baseline data to measure the impacts of climate change".

Nematodes are generally more active at higher temperatures, so the large nematode populations in the arctic and sub-arctic make these regions very sensitive to warming.

Professor Tom Crowther, senior author of the study, said: "Predicting climate change requires that we understand global carbon and nutrient cycles. We currently have a great understanding of the physics and chemistry of our planet, but we know far less about the biological organisms that drive these cycles. Improving our understanding of these organisms at a global level is critical if we are going to understand and address climate change."

Nematodes play a critical role in the cycling of carbon and nutrients and are essential to understanding biological activity in the soil. They feed on bacteria, fungi, plants and other soil organisms, fulfilling key roles in the food web. They play a significant role in influencing CO2 emissions from soils, determining whether carbon is locked up in soil organisms or released into the soil and the atmosphere. Their activity helps create healthy soils and conditions for plants to grow and capture carbon.

The paper *Soil nematode abundance and functional group composition at a global scale*, by Johan van den Hoogen et al, is available online here.

Land managers key to rewilding in the Scottish uplands

Rewilding in the Scottish uplands could take decades without the intervention of land managers, a new long-term grazing experiment at Glen Finglas has shown. The experiment, the first of its kind in Scotland, was set up in 2002 to explore how changes to Common Agricultural Policy, particularly decoupling of support from livestock numbers, might affect upland biodiversity.

The grazing experiment assessed the impact of intensification (tripling sheep numbers), abandonment (removal of sheep) and grazer diversification (partial replacement of sheep by cattle) on vegetation composition in a diverse area of grassland. It investigated how species respond to different grazing treatments and how responses at lower levels of the food chain affect those higher up.

“We were interested in how changes in grazing might cascade through a system from the direct impacts of the grazers on the plants to indirect impacts on other parts of the system (invertebrates, birds and voles). The responses of individual plant species to the experiment took a minimum of 12 years and often 15 years to become apparent, with some species showing no detectable changes. In contrast, the meadow pipits responded within a year of the treatments being imposed”, explained Professor Robin Pakeman, who was on the experiment’s research team.

The research can be used to explore the concept of rewilding, which refers to the restoration of an ecosystem, where nature takes care of itself. Rewilding aims to encourage natural processes and, if required, introduce missing species, allowing them to shape the landscape naturally.

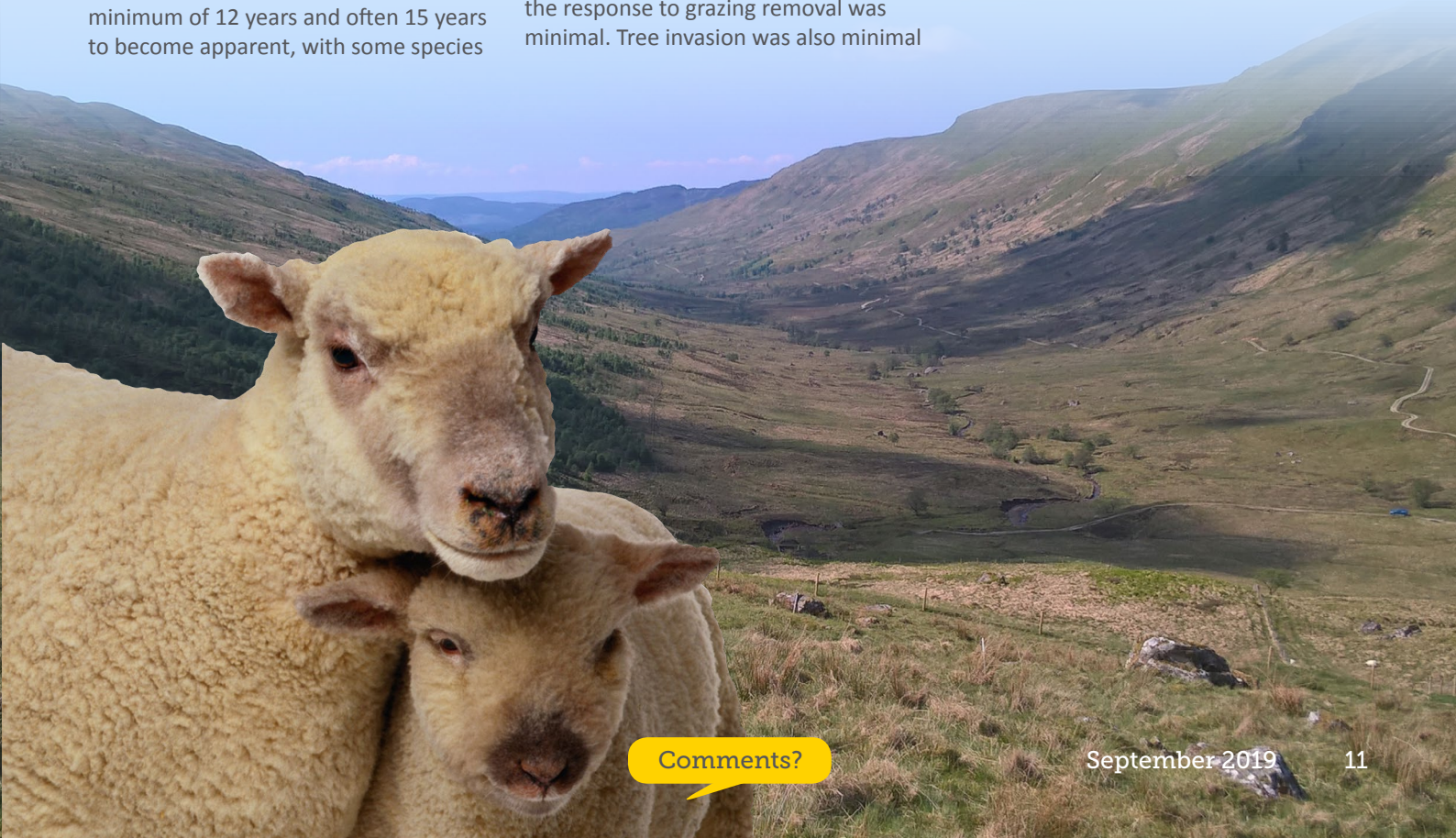
“We were interested in the impacts of grazing on birds, so plots had to be big enough to have multiple territories of the most common breeding bird – the meadow pipits. We established the experiment on a mixture of uplands habitats: wet heath, wet and dry grassland and sedge mire.

“Productive grasslands, such as those dominated by bents and fescues, which are the usual focus of grazing in these habitats contain few species capable of responding to reduced grazing, so the response to grazing removal was minimal. Tree invasion was also minimal apart from one no grazing plot near a wooded ravine. Some vegetation types responded quickly to the removal, for example wet heath and mat grass dominated grassland, indicating that these had species capable of adapting to change, such as heather.

“The vegetation types that responded fasted to increased grazing were the moderately productive purple-moor grass and sedge mires, indicating a broadening of sheep foraging from their more preferred bent and fescue grassland. Partial replacement of sheep by cattle had little impact on the vegetation apart from suppression of bracken and blaeberry” Robin added.

The experiment suggests that without the direct involvement of land managers vegetation change in these relatively infertile grasslands is extremely slow. This makes forecasting any developments very challenging.

For more information, the complete paper can be found here.



Is Scotland on target for 2030? More work needed to achieve SDGs

An independent report focussing on Scotland's progress against the United Nations Sustainable Development Goals has found that, despite some advances, the country is not on target to achieve a number of the goals and further action is therefore needed.

The report, produced by a partnership between the University of the West of Scotland (UWS) and Oxfam, reflects that whilst there is clear policy and political commitment on all the Goals in Scotland, more needs to be done in some areas to meet the 2030 targets.

The James Hutton Institute was asked to examine Scotland's progress with regard to Sustainable Development Goal 12: Responsible Consumption and Production. Professor Derek Stewart, Hutton agri-food sector lead, said: "Scotland is definitely on track to deliver on many of the SDG 12 targets such as sustainable management and efficient use of natural resources, substantially reducing waste generation and food losses along production and supply chains, including post-harvest losses.

"However, Scotland's national views on responsible production and consumption are not the same. The country is a land of dichotomies: fantastic produce, but terrible health related to multiple factors including dietary behaviours. It produces some of the world's best shellfish, but more than 95% of it is exported to Mediterranean countries. Scotland's most prolific crop, barley, besides being the base ingredient for whisky, also can be the basis of many very nutritious and health-promoting foods. However, besides soup very little is done with it.

"All that being said, there needs to be a solid political and governmental commitment to continued support for Scotland's responsible production and consumption of food. This could take the form of both support mechanisms (funding, advice, knowledge hubs, demonstration platforms) and legislation against irresponsible behaviours. Food is a major industry in Scotland. The food industry, via the Scottish Government, support the industry group Scotland Food and Drink, and have realised that they need to pull together to realise their ambition to double the turnover in farming, fishing, and food and drink to £30 billion by 2030.

"This national approach is driven by the desire to be 'champions of responsible and sustainable production' and 'change behaviours around food and drink consumption'. The James Hutton Institute has the pleasure of being part of this national process dealing with innovations to deliver these aims."

Professor Colin Campbell commented that the recent upsurge in interest in major action on climate change is very positive, but needs to be capitalised on with policy and consumer behaviour changes to match the rhetoric. Reduction and mitigation measures are no longer the issue: it's transformational changes that are needed.

"The SDGs are becoming more widely known now but the James Hutton Institute have had them into our strategic objectives since 2015, and have aligned all our work within them to help drive their delivery."

Other findings of the report suggest that the negative effects of slow progress on the Goals are felt disproportionately by low-income households. This undermines the cross-cutting commitment of all UN Sustainable Development Goals to 'leave no-one behind'.

Similarly, the report argues that improving progress is not just up to the government, and that Scotland need action especially from business and the third sector, as well as individuals to deliver the goals; and that the participation of citizens, consumers, and communities, is important for progress on the SDGs.

The report *On Target for 2030? An independent snapshot review of Scotland's progress against the United Nations Sustainable Development Goals*, can be downloaded from the UWS-Oxfam partnership website.

Wild potato genes may be key to stronger spuds

Potatoes have been a staple of Britain's diet for half a millennium, but new research suggests that limited genetic differences in potato lineages has left British and American spuds vulnerable to the disease that caused the Irish potato famine.

Plant scientists at the James Hutton Institute and the University of Dundee have revealed that commercial potato crops are under constant threat of late blight, the pathogen behind one of Europe's most devastating famines, but wild potato genes might be the cure.

Dr Ingo Hein, a senior scientist based at the Institute's Cell and Molecular Sciences group, says that by using tools his team has developed they could put potato breeders at ease, helping farmers produce fit fritters instead of the frail.

"By using the dRenSeq and PenSeq tools we have developed here in Scotland in collaboration with peers at the Sainsbury Laboratory in Norwich, they are able for the first time ever to track the historical and geographical patterns of resilient genes in American and British potatoes," Dr Hein said.

"Our preliminary data suggests that the most commercially valuable potato varieties grown in the UK and US contain a maximum of four genes already defeated by the late blight pathogen, P. infestans. Crucially, we have also been able to identify new genes that remain effective against this disease which are not current used in commercial potato production and so by combining these effective genes we can prolong the longevity of individual resistances to the disease and reduce the need for chemical sprays on plants.

"This is highly relevant for breeding as currently the control methods for late blight in most parts of the world are based mainly on the use of chemical sprays which can be environmentally hazardous and expensive."

Dr Hein has been awarded £625k in funding from the Biotechnology and Biological Sciences Research Council (BBSRC) to continue identifying the more resilient potatoes with industry partners McCain, Greenvale and James Hutton Limited.

Research consortium launches first UK Oat Growth Guide

Oats are an important crop in the UK – even more so due to their increasing popularity as a healthy breakfast choice. Yet unlike other staple cereal crops, such as wheat and barley, R&D investment to improve oat agronomy has been limited. Research by ADAS has indicated that in the UK there is a yield gap between average farm yield and optimal yields.

To meet this demand, and to ensure a sustainable pipeline of high-quality oats, a consortium of leading industry partners (PepsiCo, Environment Systems Ltd, James Hutton Ltd), academic partners (NIAB, Aberystwyth University, James Hutton Institute) and a major sub-contractor (ADAS), came together to form the Opti-Oat project (Innovate UK project 102128).

Under the leadership of PepsiCo and with co-funding from Innovate UK and BBSRC, this project has collected more than one million data points over four experimental seasons (harvests 2014 – 2017) from reference trials and commercial oat crops in England, Scotland and Wales to develop the first UK Oat Growth Guide for growers and agronomists, which is being launched today at Cereals 2019.

The Quaker Oat Growth Guide is designed to increase understanding of winter and spring oats through crop growth and development benchmarks with the aim of improving yield and quality to deliver a sustainable supply of high-quality oats and maximise grower returns.

Professor Derek Stewart, agri-food sector lead at the Hutton, commented: "This has been an excellent opportunity for the James Hutton Institute to collaborate with both leading industry and research organisations to deliver what was missing from the oat community: the Oat Growth Guide.

"It's been a major but extreme useful and satisfying endeavour delivering benefit straight to the oat growing community."

The Quaker Oat Growth Guide can be downloaded here.

Events Round-up 2019

Latest research showcased at Arable Scotland

Scientists at the Institute have outlined the latest research on arable crops as part of the launch of new event Arable Scotland, including renewed breeding efforts aimed at developing quality crops for defined markets, innovative crop management techniques and ways to create sustainable and healthy production systems.

Hutton barley geneticist Dr Bill Thomas told delegates about work to improve the quality of winter barley for malting purposes, in a bid to address the concerns of maltsters, brewers and distillers about the long-term sustainability of the barley crop.

The £2 million, six-year IMPROMALT project has carried out a 'targeted improvement' of winter barley in order to incorporate the better malting quality characteristics of the spring crop. The project has the potential to be the single biggest achievement in winter malting barley genetics since the breeding of the Maris Otter variety in the 1960s.

"Whilst plant breeders have previously tried to add spring quality attributes into winter barley, they have relied on chance events to assemble the right genes, which is like searching for a needle in a haystack when the crops differ at thousands of genetic loci. But we now have the knowledge and tools to introduce key spring malting quality attributes into winter barley in a highly targeted manner and improve winter malting quality. IMPROMALT lines have been tested in micro-malting by MAGB member companies and the results show a significant malting quality improvement", said Dr Thomas.

Similarly, Dr Pete Iannetta, an Institute agroecologist, argued the merits of planting peas and other legumes alongside cereal crops to make farming greener. Intercropping, as it's known, could cut greenhouse gas emissions by reducing dependence on fertiliser, as well as boosting biodiversity, food security and opening up new markets for local food and drinks businesses.

"In pea-barley crop trials, despite sowing the intercropped barley and peas each at a 50% rate and using no artificial nitrogen, total yield has exceeded that of barley grown alone. Nitrogen is essential for good crop yields, and cereals are usually grown with added man-made nitrogen at around 110 kg N per hectare. But artificial nitrogen comes from fossil fuels, so has a high carbon footprint," Dr Iannetta said.

Arable Scotland is organised and hosted by the James Hutton Institute in partnership with Scotland's Rural College and AHDB, is supported by the Farm Advisory Service, SEFARI and the Scottish Farmer, and sponsored by HL Hutchinson Ltd and the Scottish Society for Crop Research. See more information at www.arablescotland.org.uk.

Future of chemistry focus at Potatoes in Practice

As the potato industry faces up to the loss of major chemicals diquat and CIPC, this year's Potatoes in Practice focussed on what growers will be using in the future.

Potatoes in Practice is the largest field-based potato event in the UK. It is organised and hosted by the James Hutton Institute in partnership with AHDB Potatoes, SRUC (Scotland's Rural College) and Agrii and is also supported by Potato Review.

The loss of diquat was a major discussion point at the event; a number of plots demonstrated alternative desiccation methods, and Greg Dawson of Scottish Agronomy discussed current trials looking at alternative haulm destruction methods for high grade seed crops.

Russell Whiteford of Belchim Crop Protection also discussed desiccation, with a workshop on the subject. He reviewed current practice and the likely options post-diquat focusing on flail and non-flail options and the difficulties growers may face if flail/spray is not an option.

Out in the field there were also plenty of desiccation-related demos with many plots dedicated to how to destroy haulm without diquat, and two machinery demos also showcased kit currently available for mechanical desiccation.

Another challenge for growers, this time post-harvest, is the loss of CIPC, something that was covered by AHDB's Adrian Cunnington during the seminar sessions.

AHDB has been carrying out trials on potential replacements for CIPC, which have so far found that mixtures of products such as DNM and maleic hydrazide are the most effective in suppressing sprouting in store. However, no combination is as effective as CIPC and Adrian focussed on practical strategies to help growers maintain quality.

There were also seminar sessions focussed on potato health and marketing. Professor Derek Stewart outlined some of the newest evidence on the spud's impact on human health while Professor Ian Toth honed in on the health of the crop itself, chairing a session which encompasses PCN, new threats in pests and diseases (with Chief Plant Health Officer for Scotland Gerry Saddler) and potential changes to the Safe Haven Scheme.

Latest berry research on show at Fruit for the Future

The 2019 edition of Fruit for the Future included scientific presentations, outdoors demonstrations and walks through experimental plots, presented by the James Hutton Institute and the Scottish Society for Crop Research.

This year's event featured an official opening by Ben MacPherson MSP, the Scottish Government's Minister for Europe, Migration and International Development.

Highlights of the 2019 programme included a spotted wing drosophila clinic, as well as talks on automated mildew control, crumbly fruit syndrome, mobile apps, progress from the raspberry and blueberry breeding programmes, and the importance of soil health.

Fruit for the Future is one of the James Hutton Institute's most successful and long-running industry events and is aimed at farmers, agronomists, representatives of the food and drink industries, scientists and others interested in soft fruit.

Royal Highland Show

It was another brilliant Royal Highland Show (20-23 June 2019), with a steady stream of visitors of all ages to the Hutton marquee including farmers, families, schoolchildren and research partners, as well as a significant number of UK and Scottish politicians and elected representatives.

The Institute's cutting edge research was on display through exhibits covering integrated pest management; the future of agriculture including the International Barley Hub and the Advanced Plant Growth Centre initiative; soil research including peatlands in virtual reality; honeyberries; forestry and social science, along with stands from James Hutton Limited, Intelligent Growth Solutions and SEFARI. The Institute's presence at the RHET Centre offered young visitors hands-on experiences and a chance to reflect upon what our food plate will look like in 2050.

On Show Thursday, the Institute hosted a reception to celebrate the phenomenal Tay Cities Deal success with Secretary of State for Scotland David Mundell MP marking the occasion with a keynote address.

Show Friday's Superfoods Breakfast saw Lord Duncan, Under Secretary of State for Scotland, speak to attendees about the importance of the work carried out by the James Hutton Institute, and the value of research and innovation for British agricultural industries. We were then visited by First Minister Nicola Sturgeon MSP, and later by Ruth Davidson MSP, as well as by numerous other elected representatives over the course of the Show.

Later that morning, the press were out in force to cover the Best Soil in Show and NEWBIE prizegiving ceremonies, where the Best Soil in Show title went to Richard Gospel, of Hassiewells Farm near Rothienorman, and the Young Farmers trophy to Alistair

Brunton, of Balmonth Farm in Fife, who scooped it for a second time. NEWBIE award winners Lynbreck Croft collected their prize and were filmed by a crew from Spanish TV channel La Sexta for a programme focussing on Scotland's experiences with regard to rural depopulation issues. Numerous visitors were in attendance for both ceremonies.

All in all, the four days of the Show evidenced a real buzz about the range of content and interest in Hutton displays which seemed to appeal to kids, adults, experts and newcomers alike, with an impressive array of tech, more traditional science and interpretative activities available. The Institute also reached hundreds of thousands via social media during the event.

The ten individual displays and accompanying activities covered an even wider span of Institute work than has been portrayed previously, which is great for demonstrating the breadth of our relevance. Sustainability and climate challenges featured prominently across the board. Colleagues from Rowett and other SEFARI institutes complimented the quality of Hutton's activities and displays, and commented on how favourably they compared to other science exhibits.

Research team targets stability of maize crop in southern Africa

Maize is the most important cereal crop in southern Africa but without new management practices and with the increased risk of drought, yields which are already low are predicted to further decline. It is therefore critical that new approaches are developed to ensure food security and help alleviate poverty of smallholder farmers.

A research project, funded by BBSRC through the Global Challenges Research Fund (GCRF), aims to explore interactions between the crops genetic make-up (genotype), soil microorganisms and the processes they undertake. The project hopes to discover a viable approach to introduce future maize breeding programmes in southern Africa to help ensure yield stability.

To achieve this the research team first needed to understand how these crops interact with the soil. Dr Eric Paterson of the James Hutton Institute and Dr Lumbani Mwafulirwa, of the Institute and University of Edinburgh, were part of a group that visited Zimbabwe. The UK team, which also included Professor Liz Baggs of the Global Academy of Agriculture and Food Security at the University of Edinburgh, interacted with their in-country partners, visited field trial sites and engaged with farmers, extension workers and other local scientists.

The team gave seminar presentations at an event co-organised by the Zimbabwe Plant Breeders Association (ZPBA), University of Zimbabwe Crop Science Department and the International Maize and Wheat Improvement Center (CIMMYT, Zimbabwe), with participants drawn from local universities, maize seed companies and CIMMYT among other institutions/ companies.

Dr Lumbani said: “We have been investigating the extent of variation within maize germplasm (over 100 varieties/lines) relevant to cultivation in southern Africa, with respect to shaping root-associated microbial communities and impacts on soil functions underpinning productivity. We have quantified the impacts of maize cultivars on soil carbon and nutrient cycling processes, and how the cultivars interact with agricultural management and the environment.

This work could benefit nutrient use efficiency through cultivar selection/ breeding and soil organic matter management, and help ensure maize yield stability, resilience to low nutrient availability and, in turn, improve food security within the region. Thus, our engagement with ZPBA and seed companies is a key impact pathway”

By working closely with CIMMYT and other local organisations, the project hopes to maximise the likelihood of positive discoveries from their research being taken forward into future maize breeding programs. In turn increasing the possibility of new maize varieties, or varieties proven to thrive in challenging environment being created.

Before this project, the potential for plant trait informed selection of genotypes especially for genotype microbiome interactions had not been tested in the field. Given the specific pressures of climate change, low income levels and food insecurity in southern Africa, the outcome of the project could prove vital.

Comments?

Human activity means peatlands contribute to climate change

A major new study has shown that the UK's peatlands are making a significant contribution to our greenhouse gas emissions because of the way they are managed.

Peatlands occupy 12% of the UK's land area and store vast quantities of carbon. Healthy peatlands capture carbon dioxide (CO2) from the atmosphere and so can help to offset the effects of human activities such as fossil fuel burning that are raising CO2 levels in the atmosphere, leading to climate change.

However, around 80% of the UK's peatlands have been significantly affected by the way they are managed, including activities such as drainage for agriculture and forestry; livestock grazing, managed burning and wild fires; and extraction of peat for fuel, gardening and horticulture. As a result, many of these areas are now emitting CO2 to the atmosphere.

The study, led by the Centre for Ecology & Hydrology (CEH) and the James Hutton Institute, found that the overall greenhouse gas emission from peatlands could exceed the equivalent of 20 megatonnes of CO2 emissions each year – around 4% of the UK's total annual greenhouse gas (GHG) emissions.

The estimates mean the UK's land area as a whole may be emitting more carbon as CO2 to the atmosphere than it is removing from it. GHG emissions from peatlands are currently not fully included in the UK's annual national greenhouse gas inventory and would need to be addressed if the UK wanted to become 'carbon neutral'.

"Our work shows that the unsustainable use of UK peatlands is making a major contribution to our greenhouse gas emissions, but it isn't all doom and gloom – in recent years the UK's national and devolved governments, charities and private sector organisations have all invested significantly in peat restoration, and this is helping to bring down emissions", said Professor Chris Evans of the CEH, lead author of the report.

"Our study helps to demonstrate the value of these investments, and should support future efforts to return as many of our peatlands as possible to their natural role as CO2 sinks, and to manage peatlands that continue to be used for agriculture and forestry in a way that minimises their contribution to climate change."

Dr Rebekka Artz of the James Hutton Institute, one of the co-authors of the report, added: "This report highlights that the current overall condition of our peatlands contributes to climate change, so there is significant merit in further stepping up of peatland restoration efforts from a greenhouse gas mitigation perspective."

Dr Amanda Thomson of the Centre for Ecology & Hydrology, who is responsible for compiling the land-use sector of the UK's National GHG Inventory, added: "This report is a step-change in our knowledge of GHG emissions from UK peatlands. It's more specific to the UK, we have complete coverage and we can now capture the impact of peatland restoration and climate change mitigation efforts, which we couldn't do before."

The report, titled *Implementation of an Emissions Inventory for UK Peatlands*, was carried out for the Department for Business, Energy and Industrial Strategy (BEIS), and was compiled by scientists from the Centre for Ecology & Hydrology, the James Hutton Institute, Crichton Carbon Centre, British Geological Survey, Earthy Matters Environmental Consultants, Biostatistics and Biomathematics Scotland, and University College Dublin. It can be accessed here.

Green cover benefits yield, soil and water quality

A ground-breaking research trial conducted by the James Hutton Institute and Kings Crops, a division of Frontier Agriculture, into the impact of green cover crops in Scotland has demonstrated notable benefits for spring barley yields, soil and water quality, biodiversity and soil resilience.

The three-year trial assessed ongoing soil conditions and compared yield results from Concerto spring barley. Concerto was grown on plots previously planted with either green cover crop mixes or control stubble from another barley crop. Over the trial period, as well as improved organic matter and overall soil conditions, the seven cover crop options led to barley yield increases of up to 0.6t/ha by the third year.

This particular trial took place at the James Hutton Institute's Balruddery Farm in Dundee, with the first cover crops drilled in September 2015 following the spring barley harvest. Kings Technical Advisor for Scotland, Alan Johnson, explained: "The conditions for planting and growing cover crops in Scotland are very different to the rest of the UK. Cooler temperatures and late harvests mean the window for successfully establishing green cover is much smaller than in other areas, which can make some growers reluctant to grow it.

"As a result, it was important that this trial replicated realistic conditions and timings so that we could gather accurate results, assess the outcomes and identify the benefits. We see plenty of examples in other areas of the UK where cover crops improve the outputs of cropping rotations and bring about significant environmental benefits, so it's important for us to better understand the options available to growers in Scotland so they can capitalise on these benefits too."

The cover crops were ploughed in April and the fields drilled with Concerto spring barley shortly afterwards. In the first year, tests showed that the soils were already more resilient. The risk of erosion had reduced and there was an increase in organic matter content where a cover crop had been. In the second year, these benefits continued alongside notable differences to the following Concerto barley crop, with the mean yield increased by more than 450kg per hectare between 2016 and 2017.

Hutton soil scientist Dr Blair McKenzie noted that the established cover crops faced three very different winters. "2015-16 was one of the wettest on record, while 2016-17 was nearer average and 2017-18 had a very cold finish with the 'Beast from the East' in late February. This meant that the state of the cover crops into March also differed between years. Despite this, the soil conditions and barley yield were consistently better under the cover crops than in soil that had been left with cereal stubble over-winter."

As well as improving yield for the following crop, the cover crop options would also help growers to meet potential Ecological Focus Area requirements, grazing demand and agri-environment schemes.

Kings Sales Manager, Richard Barnes, also commented: "The fact that we have been able to achieve these results in Dundee means this knowledge is transferable throughout the whole of the UK, something which would have been difficult to do had we undertaken the work in East Anglia for example. We've been able to show positive, realistic, worthwhile results in an area with some of the harshest conditions."

Most of Scotland from the air

A large outdoors model of Scotland, showing where our vegetables are typically grown, was unveiled at the James Hutton Institute's Living Field in Invergowrie on Open Farm Sunday 2019.

The map was created by Institute researchers to highlight the diversity of Scotland's vegetable and fruit production and help people understand where these crops are grown, where our food comes from, how much is grown locally and whether we can grow more of our food within Scotland's borders.

The Institute's Invergowrie site is not just a farm: it's an open-air, full-scale laboratory for cutting-edge crop trials, innovative farming techniques and research projects. It's home to crop breeding and applied science, particularly for potatoes, soft fruit and cereal crops.

At Open Farm Sunday, visitors can try a range of free activities to show how farming and the environment can work better together. The event is managed by Linking Environment and Farming and has become one of the farming industry's biggest success stories.

Since the first Open Farm Sunday in 2006, over 1600 farmers across the UK have opened their gates and welcomed 2.2 million people onto their farm for one Sunday each year. A LEAF Innovation Centre from 2003, the James Hutton Institute and its forebears have taken part in Open Farm Sunday since 2006.

SEFARI Gateway – opportunities aplenty

SEFARI
LEADING IDEAS FOR BETTER LIVES

SEFARI Gateway's funded programmes continue to see increasing demand from stakeholders and researchers. While Fellowships remain the most popular, both Responsive Opportunity Fund (RoF) and the Think Tank -'Spark' are increasingly popular and have exceeded projected uptake for the year. Consequently, a small-award RoF scheme was introduced over the summer to maintain a flow of opportunities to researchers prior to Gateway's new operational plan commencing in October 2019.

Of the current Fellowships, those on "Integrity Monitoring Technologies for Food Supply Chains" and an "Audit of research in the area of the Cairngorms National Park" are entering their reporting phase so there will be news on their outcomes shortly. Current and recently-begun projects support the Just Transition Commission (within the net zero initiative) and work with NFUS on the challenging issue of agricultural greenhouse gas emissions.

Gateway's latest Fellowship call "Woodland Creation" with Loch Lomond and Trossachs National Park Authority was very well subscribed and at least two more Fellowships are planned before Christmas. Topics are being defined for a range of remits including the Scottish Government's Arctic Policy Framework and so please lookout for the calls and the next Think Tank and Responsive Opportunity calls will be mid-October and mid-November respectively. Further social media training sessions will open bookings shortly, too, as demand has been strong in the past.

Impact monitoring by the Gateway is revealing diverse benefits including a strong desire across agendas for knowledge partnerships with researchers. In June SEFARI was invited to facilitate a workshop as part of the Scottish Government's (Ministerial) Science and Research Summit - Collaborating for Excellence. Gateway Director Charles Bestwick subsequently joined the Scottish Science and Research Working Group convened following the Summit.

Some dates for your diary

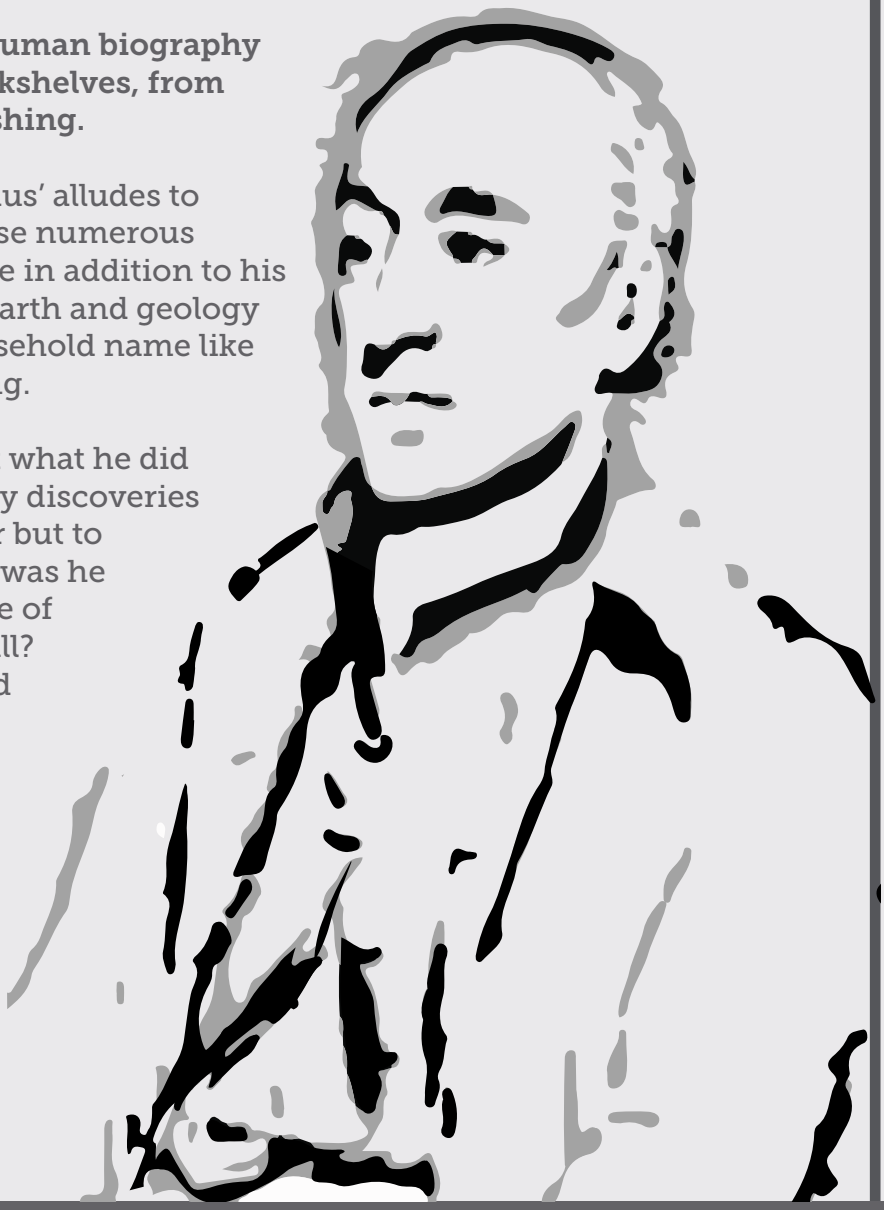
Date	Event	Location	Who should come and why?
2 October 2019	**42nd TB Macaulay Lecture**	Dynamic Earth, Edinburgh	Political/policy/academics/stakeholders/general public - Designed to stimulate thinking and dialogue about contemporary environmental issues. This year's globally-recognised speaker is Oxford Prof Dieter Helm CBE.
7 November 2019	**Hutton Research Symposium**	West Park Conference Centre, Dundee	Staff, students, Board members get a chance to hear from selected colleagues about their work, with the aim of sparking more internal collaborations and joined up working within the Institute
19-20 **November** 2019	**Food Matters Live – Reception and Speakers in programme**	ExCeL Centre, London	Food industry and general public – public exhibition in London ExCeL bringing together hundreds of exhibitors and speakers to visitors interested in the global food and drink industry. Unique event dedicated to creating cross-sector connections focusing on the future of food, drink and sustainable nutrition
13 February 2020	**SSCR/Bulrush Soft Fruit Open Day**	Dundee, venue TBC	Anyone in the soft fruit industry
April 2020	**SSCR Potato Winter Meeting**	James Hutton Institute, Invergowrie	Primarily SSCR members but also anyone in the potato industry
11-13 May 2019	**Pint of Science 2020**	Locations across the UK, TBA	Join us in the pub to hear from some of our researchers about what they're working on and why
2 July 2020	**Arable Scotland**	Balruddery Farm	Highlights from this year's event can be found here, click here to look ahead at what can be expected in 2020.
July 2020	**Fruit for the Future**	James Hutton Institute, Invergowrie	Anyone in the soft fruit industry
13 August 2020	**Potatoes in Practice**	James Hutton Institute, Balruddery Farm	Anyone in the potato industry

Comments?

James Hutton:
Scotland's forgotten genius

In 2020 a new, more expansive and human biography of James Hutton is due to hit the bookshelves, from author Alan McKirdy and NMS Publishing.

The subtitle 'Scotland's forgotten genius' alludes to the relative obscurity of the man whose numerous innovations in agriculture and science in addition to his revolutionary theories on the age of Earth and geology should have established him as a household name like John Logie Baird or Alexander Fleming.



The book will look in broader terms at what he did during his life, why, and how his many discoveries and ideas not only link to one another but to modern practices and concepts. How was he able to work across such a broad range of subjects? Why did he die without a Will? How come he had no gravestone? And how come someone who achieved so much was and is remembered so faintly? In answering those questions and 'colouring in' some of the remarkable contemporary context for Hutton's life and work, it's hoped that his contributions and his impact will become much more widely appreciated and that his recognition and reputation grow accordingly, ahead of his 300 year anniversary in 2026.

The James Hutton Institute

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