Postgraduate Research Symposium 2019

12th September 2019
Stormont Hotel, Belfast

A living, working, active landscape valued by everyone.

Department of
Agriculture, Environment and Rural Affairs
www.daera-ni.gov.uk

INVESTORS IN PEOPLE

Contents

Foreword from Dr. Denis McMahon, Permanent Secretary, DAERA

The Department of Agriculture, Environment and Rural Affairs (DAERA) Postgraduate Research Symposium provides a platform for DAERA-funded PhD students to disseminate their knowledge and research to a wide group of industry stakeholders. The Symposium is now in its 11th year.

DAERA annually awards 12 full time Postgraduate Studentships for a three year period of research. The investment in this programme has helped develop the people who are the front-runners to research, education, policy development and innovation. Additionally, the knowledge and skills that the students develop during this time are attributes that are highly valued by employers.

Our agri-food industry faces significant and rapidly evolving challenges. High quality scientific research and monitoring, including that delivered through the Postgraduate Research Programme, allows DAERA to address issues and make sound evidence-based decisions and policies. The Department's support for this Programme demonstrates our ongoing commitment to strengthen the scientific expertise available to the wider agri-food sector.

DAERA's Vision is for 'a living, working, active landscape, valued by everyone'. As these research projects are directly aligned to the Department's key priority research areas, I am confident that outcomes of the research presented here today will contribute strategically to that Vision.

I would like to thank all the PhD students and staff who have worked tirelessly to make this event a success. I would also like to thank you all for supporting this event and the supervisors for their invaluable guidance to the PhD students.

I wish you all an informative and stimulating day as DAERA PhD students present their research findings and display their research on posters. I hope that you will also take the opportunity today to engage in discussions with the postgraduate students either over lunch or at the end of proceedings.

Dr. Denis McMahon

Postgraduate Research Symposium 2019

09.30	**Registration, tea/coffee** **Slido Log in - assistance by First Year PhD students**
09.45	**Welcome** Dr. Denis McMahon, Permanent Secretary, DAERA
09.50	**Chair's Introduction and Ice breaker Slido** Dr. Sara McGuckin, Head of Natural Science, NIEA
10.05	**Guest speaker** Dr. Sam Strain - Programme Manager for Animal Health and Welfare Northern Ireland **Programme Management Board (PMB) 1: To help the agri-food industry prepare for future market opportunities and economic challenges.**
10.35	**Final Year: Naomi Rutherford:** Development of systems to improve the health and performance of dairy-origin beef youngstock.
10.50	**Tea & Coffee and Poster Viewing - poster voting open on Slido**
11.20	**Final Year: Joanna Shooter:** High value functional dairy products from low value whey proteins: proving the concept.
11.35	**Second Year: Jessica Pollock:** Using novel precision technology to measure individual dry matter intake (DMI) of dairy cattle at pasture
11.40	**Second Year: Paul Cottney:** Maximising the benefits of cover crops through optimising the management of organic manures, rotations and nitrogen fertilisers.
11.45	**Second Year: Samuel Hawe:** Identifying, understanding and harnessing the beneficial impact of genotype by nutritional interactions to optimise the performance and carcase quality of low weight pigs.
11.50	**Final Year: Clare Maguire:** Remediation of agricultural wastes to grow Algal biomass for nutritional supplements in animal feed.
12.05	**Second Year: Tara Meeke:** Effects of sheep grazing strategies on animal performance and grass production, utilisation and quality.
12:10	**Second Year: Amy Arnott:** Investigating species of conservation concern to predict ecosystem service delivery and its impact on production value of sheep hill farms in Less Favoured Areas (LFAs) in NI post-Brexit.
12.15	**Second Year: Holly Milne:** An exploration of how small agri-food businesses can exploit big data market information to innovate with their products and create competitive advantage.

PMB2: To improve the lives of farmers and other rural dwellers, targeting resources where they are most needed.

12.20 **Final Year: Ryan McGuire:** Rural poverty and social isolation: an analysis of policy effectiveness using natural experiment within Northern Ireland.

12.35 **Second Year: Suzanne Johnston:** Measuring the impacts of Social Farming on participants and farming families in Northern Ireland.

12.40 **Second Year: Lorraine Holloway-McCarney:** Emotional geographies of 'Belonging' in Northern Ireland: challenge for 'remaining in & leaving' family farming.

12.45 **Lunch.**

Afternoon session:
Chaired by Louise Millsopp, Deputy Director (Acting) Sustainable Agri-Food Development Division, DAERA.

PMB3: To enhance animal, fish and plant health and animal welfare on an all Ireland basis.

13.45 **Final Year: Emma Brown:** Development of a dynamic mathematical model to assess spread and control of Bovine Tuberculosis (bTB), integrating both domestic and wild host dynamics.

14.00 **Second Year: Sophie Redpath:** Understanding the epidemiology of bovine TB and potential routes of infection by elucidation of fine-scale badger movement and behaviour.

14.05 **Final Year: Emma Campbell:** Cattle and badger dynamics in relation to the potential transmission of *Mycobacterium bovis*.

14:20 **Final Year: Rebecca Stevenson:** How can Northern Ireland more effectively deliver plant health protection to contribute to the DAERA vision of a thriving and sustainable rural economy?

14:35 **Second Year: William K O'Neill:** Biostimulant strategies to enhance grass growth.

14.40 **Second Year: Lauren Chesney:** Development of systems to improve the utilisation of grass and forage in beef production systems.

14.45 **View posters - poster voting closes at 14.55**

14.55 **Symposium Evaluation on Slido** available until 16.00.

PMB4: To help deliver improved sustainable environmental outcomes

15:05 **Second Year: Gavin Grant:** Estimating the relative importance of apex predator and mesopredator interactions for the provision of marine ecosystem services.

15:10 **Closing Remarks**

Award of prizes: **Year 1: Poster**
Year 2: Poster
Year 2 Talk
Year 3: Presentation

For further information on the DAERA Postgraduate Studentships:
www.daera-ni.gov.uk/articles/postgraduate-study

Slido

Today we will be using Slido to:

- collect questions during the presentations;
- vote for the best first and second year poster (10:50 - 14:55); and
- evaluate the event (14:55 - 16:00)

Go to https://www.sli.do/

Enter event code: #postgrad

Event title: 2019 Postgraduate Symposium

Stormont Hotel WIFI code: Hastings1066

Development of a dynamic mathematical model to assess the spread and control of Bovine Tuberculosis (bTB) integrating both domestic and wild host dynamics

Emma Brown

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Email: ebrown99@qub.ac.uk

Supervisors: Prof. Adele H. Marshall, Mathematical Sciences Research Centre, QUB; Dr. Andrew Byrne, Department of Agriculture, Food & the Marine (DAFM); and Dr. Hannah Mitchell, Mathematical Sciences Research Centre, QUB.

Background

Bovine Tuberculosis (bTB) is endemic to Northern Ireland (NI) with a herd incidence rate of 9.22% in 2018 (DAERA, 2019). Not only has incidence increased steadily since 2010, but costs associated with the control of bTB have also risen, totalling £44 million in 2017-18. Using mathematical models to manage bTB may assist in lowering incidence rates, their corresponding costs, and improving animal welfare. Officially Tuberculosis Free (OTF) status can be assigned if incidence is lowered to 0.1% of all operational herds for 3 consecutive years.

Aim

The project's main aim is to create a mathematical model that describes bTB in NI by using information and assumptions specific to NI. Data provided by DAERA was used to estimate the model parameters. This model was then used to simulate how bTB in a herd will change under varying scenarios.

Research Findings

A model was created that incorporated within-herd transmission with 2 key risk factors for externally sourced transmission: cattle movements and wildlife interactions.
This model estimates, on average, that 0.0154 cattle become infected per infectious animal per herd per year and 0.038 infected animals become infectious per herd per year; highlighting how bTB is a slowly progressing, chronic disease. There is also variation in the level of bTB across NI's 10 District Veterinary Offices (DVOs) with parameter estimates in the model varying to reflect this heterogeneity. Changing scenarios in the herd will be simulated by perturbing parameters in the model and their effectiveness will be presented.

Key Message

The disease system of bTB is complex and interlinked between interacting cattle herds and wildlife reservoirs across NI. There is no one clear transmission route and control strategies will need to account for this complexity.

Cattle and badger dynamics in relation to the potential transmission of *Mycobacterium bovis*

Emma Campbell

Queen's University Belfast (QUB).

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Supervisors: Dr. Fraser Menzies, DAERA; Dr. Andrew Byrne, Department of Agriculture, Food & the Marine (DAFM); Dr. Mike Scantlebury, QUB and Dr. Neil Reid, QUB.

Background

Bovine Tuberculosis (bTB) is caused by *Mycobacterium bovis*. In N. Ireland in 2018 the herd incidence was 9.22%. bTB is spread predominantly through aerosol transmission among cattle; infection between herds is thought to occur at shows, markets and when grazing beside a neighbouring herd. A recent study in N. Ireland found 66.8% of fields allowed contact between cattle from different herds.

The European badger *Meles meles* is a wildlife reservoir of *M.bovis*. Both species can be infected via the respiratory route, although close nose-to-nose contact between cattle and badgers is thought to be rare. Recent research has been investigating the potential of indirect contacts between cattle and badgers and the transmission of *M. bovis*.

Aims

This research investigated indirect contacts between badgers and cattle and examined the management of cattle during the grazing system to identify potential risk factors in the transmission of bTB.

Cattle sniffing set.

Research Findings

Results have shown that cattle visited badger locations three times as frequently as badgers visited cattle locations. Badgers were not recorded in any of the farmyards in this study. In recordings of 18 farms there was a median of 17.8% of days spent grazing in fields beside neighbours. There was no difference in the amount of time cattle spend in fields with setts and latrines, indicating they are not being actively avoided. There were 991 moves during the grazing season in the 18 farms with a median of 44 moves per farm.

Badger sitting on water trough.

Key Message

There are potential management changes that can be implemented on some farms to help decrease the chances of indirect contact between cattle and badgers. Herd owners should evaluate contact with neighbouring herds and seek to reduce this as much as possible.

Early detection of plant diseases using remote sensing

Ciarán Carlin

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Supervisors: Dr. Katrina Campbell (QUB), Dr. Fuquan Liu (QUB), and Dr. Colin Fleming (AFBI).

Background

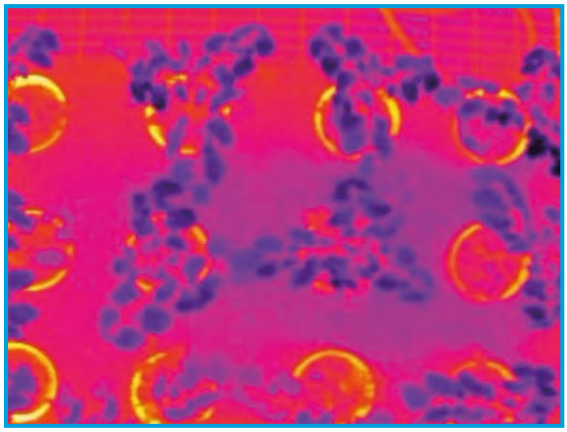
Plant stress is the term used to describe the condition wherein a plant becomes unable to carry out its vital functions correctly due to a loss of form and physiological integrity as result of pathogenic attack or other environmental factors. Plant disease, also known as biotic stress, is distinct from the abnormal functioning which results from adverse environmental factors (abiotic stress). Stress affects the growth and development of both cultivated and naturally growing plants, resulting in the destruction of plants or the failure of crop yield. Destruction through plant stress accounts for 30-40% of all cultivated crops grown for food or feed annually.

Aims

This project aims to study and categorise the changes in reflected infrared light through induced stress before mapping a calibration path for the technique to be applied to other plant and pathosystems.

Research Findings

When a plant is impacted by stress, it undergoes various physiological and gene expression changes in response to and adapt to the stress. Over time, these changes produce visible morphological changes, resulting in damage and possible destruction of the plant. My research has found that when a plant has physical damage, reduced water intake or when infected with a pathogen, these changes result in alterations to the levels of infrared light reflected from the foliage which are distinguishable from healthy plants through radiometric thermal infrared imaging before visible symptoms occur.



Key Message

Plant stress causes changes that are invisible to the naked eye and standard detection methods. I hypothesise that these changes occur before visible symptoms of stress occur, therefore indicating infrared imagery as a potential early detection method for plant stress and a tool for the plant management processes using radiometric thermal imaging.

Perception predominates preparedness: how perceived climate change effects affect agriculture practices in Northern Ireland

Emma-Louise Kells

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Supervisors: Dr. Roy Nelson (QUB); Prof. George Hutchinson (QUB) and Dr. Simone Cerroni (QUB).

Background

Sustainable food production is essential to provide food security for a growing world population and create a stable economic base. Along the supply chain, there are many areas where continuity can be disrupted. This affects availability, quality and saleability of end products via numerous dynamics relating to packaging, storage, transportation, consumer demands/trends and pricing. However crucially the entire chain fails if primary production fails in the first instance, and there is increasing evidence that the effects of climate change are affecting agricultural activities ranging from crop and animal selection, increasing 'exotic' and novel disease burdens, timings for planting and harvesting of crops, as well as the creation of physical structures to alleviate the extremes of weather patterns.

Aims

Scorched earth in a failed potato plantation.

The varying agricultural enterprises face numerous and differing degrees of challenges and risks; and there is the need to develop a managed response to climate change. This research focuses on how farmers are adapting and planning to mitigate the effects of the overarching challenge of climate change on farm production. The perceptions farmers have of the issues, and the affect these have on their decisions to make behavioural changes to their production will enable a predictive model to be developed that will allow future interventions to be targeted more effectively. Recognising the need for science communication to be tailored and trust to be developed is key to the success of the developed model.

Key Findings/Message

At this stage, data analysis is yet to be completed. Discussions illustrate both an increasing awareness of climate change and adaptation needs, and a gap in specific knowledge of appropriate, sustainable techniques that integrate with environmental targets, and forego the reach of other autonomous adaptation barriers, such as the current geopolitical environment.

Remediation of agricultural wastes to grow Algal biomass for nutritional supplements in animal feed

Clare Maguire

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Supervisors: Gary Sheldrake, School of Chemistry & Chemical Engineering, QUB; Jaimie Dick, Biological Sciences, QUB; Matt Julius, Biological Sciences, St. Cloud State University, St. Cloud, MN, USA; Pamela Walsh, School of Chemistry & Chemical Engineering, QUB.

Background

Microalgae is a very attractive biomass as it has a short growth rate and can be grown easily in large amounts. They are known to contain many commercially valuable compounds such as fatty acids, sterols and carotenoids. This research investigates the potential of growing microalgae from an alternative biofertiliser produced as a by-product during anaerobic digestion.

Aims

The first objective of the work was to quantify and analyse the nutrient value of the anaerobic digestate including analysis of the metals, nitrites, nitrates and phosphorus, through various methods, such as inductively coupled plasma (ICP) and high-performance liquid chromatography (HPLC). These nutrients are vital for the cultivation of microalgae and can affect the lipid content, both positively and negatively. Cultivation of microalgae species native to Northern Ireland using this biofertiliser is ongoing and the chemical profiles of the biomass will be compared to that of microalgae grown from commercially available media. The chemical signatures under investigation include fatty acids (mainly Eicosapentaenoic Acid (EPA) and Docosahexaenoic Acid (DHA) and amino acids. *P. Tricornutum* was grown using a 1% solution of the digestate under investigation with a variety of phosphate levels and was cultivated with a control group using F/2 as a media. The lipid content of the microalgae was extracted and the fatty acids profiled using gas chromatography (GC). Conventional solvents (i.e. methanol and chloroform) have also been used to extract the same compounds to provide a baseline for the extraction efficiency and analysed using Nuclear Magnetic Resonance (NMR) spectroscopy.

Key Findings

The resultant microalgal grown on anaerobic digestate (AD) as a fertiliser has been shown to have a rich fatty acid profile similar to that of microalgal grown in F/2 media.

Key Message

This project aims to show the value, both nutritional and commercial, of growing native microalgae with locally sourced anaerobic digestate. I have been able to cultivate microalgae with digestate in the Queens Marine Laboratory (QML) that has comparable fatty acid content to that grown with a commercially available fertiliser.

Rural poverty & social isolation: an analysis of policy effectiveness using natural experiment within Northern Ireland

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Supervisors: Prof. Alberto Longo (QUB) and Dr. Erin Sherry (AFBI).

Background

DAERA's Tackling Rural Poverty and Isolation (TRPSI) Framework (2011-2017) aimed to mitigate rural deprivations in NI. Within this framework the Maximising Access in Rural Areas (MARA) programme (2012-2014) aimed to do this through improvements in home energy efficiency, home safety, transport, benefit entitlement checks and occupational therapy assessments. This research project evaluated the impact of MARA in rural NI.

Aims

There are three primary aims within the current study:

i. Evaluate the impact of MARA and identify which MARA supporting mechanism(s) has had the biggest impact on health and social isolation.

ii. Analyse the spatial Impact of MARA; with specific emphasis on NI/ROI border areas.

iii. Measure the relationship between social isolation and rural poverty, are they a product of each other?

Key Findings

The results illustrate MARA's beneficial impacts on rural health (due to home safety and energy improvements) and social isolation (due to improved transport) of specific groups, predominantly: the disabled, elderly, females and low-income individuals. Importantly, these impacts were greatest in western NI (Derry, Strabane, Omagh, Fermanagh etc.) and border areas - areas where levels of rural deprivation tend to be greater. Furthermore, this study found that rural health improvements are highly reliant on one's social connectivity, with poor living conditions and poor health tending to increase social exclusion.

Key Message

MARA's accurate and 'boots on the ground' approach was extremely effective and should provide an incentive to increase funding for similar schemes in NI, with local communities helping to identify what they need to tackle issues linked to rural poverty and social isolation. It is important that Government continues to recognise the importance of funding rural development, through effective and targeted schemes and programmes, particularly post-Brexit.

Evaluating the role of sediment and physical catchment characteristics on aquatic ecosystems and their impact on the recovery of biological water quality in Northern Irish river systems

Andrew Rice

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Supervisors: Dr. Rachel Cassidy, AFBI; Dr. Maria Snell, AFBI; Dr. Joerg Arnscheidt, UU and Prof. Phil Jordan, UU.

Background

In 2018, 68.7% of 450 river water bodies in Northern Ireland did not meet requirements for the good status category of the EU water framework directive. Fine sediment transfers contribute to widespread and persistent failure of biological elements in this classification, because siltation clogs spaces between sediment particles and thus impedes the water exchange, which would otherwise sustain natural regenerative filtration processes in streambeds.

However, the scarcity of quantitative studies on source attribution, fine sediment transfers and their impact on stream ecology, and the lack of robust rapid assessment methods have remained impediments to progress in surveillance monitoring of streambed siltation and targeting of mitigation measures.

Aim

1) Identification of critical source areas for transfers of fine solids to streams.
2) Impact assessment of fine sediment transfers on stream ecology.
3) Quantitative assessment of stream bank erosion at cattle access points.
4) Categorisation of streambed siltation by digital image analysis of induced sediment resuspension.

Research Findings

i. Fortnightly data of land use and from passive sampling of suspended sediments improved the identification of critical source areas for erosive loss of fine solids.

ii. The low biodiversity of investigated headwaters presented severe constraints in the use of monitoring data from benthic diatoms and macroinvertebrates for the assessment of ecological effects of fine sediment transfers.

iii. There was a strong positive correlation between frequency of cattle access from real-time camera surveillance and erosive volumetric stream bank change as documented through high-resolution terrestrial 3D laser scans (Fig. 1).

iv. A proof of concept for image analysis of streambed siltation from video footage enables an advance over conventional visual assessment methods.

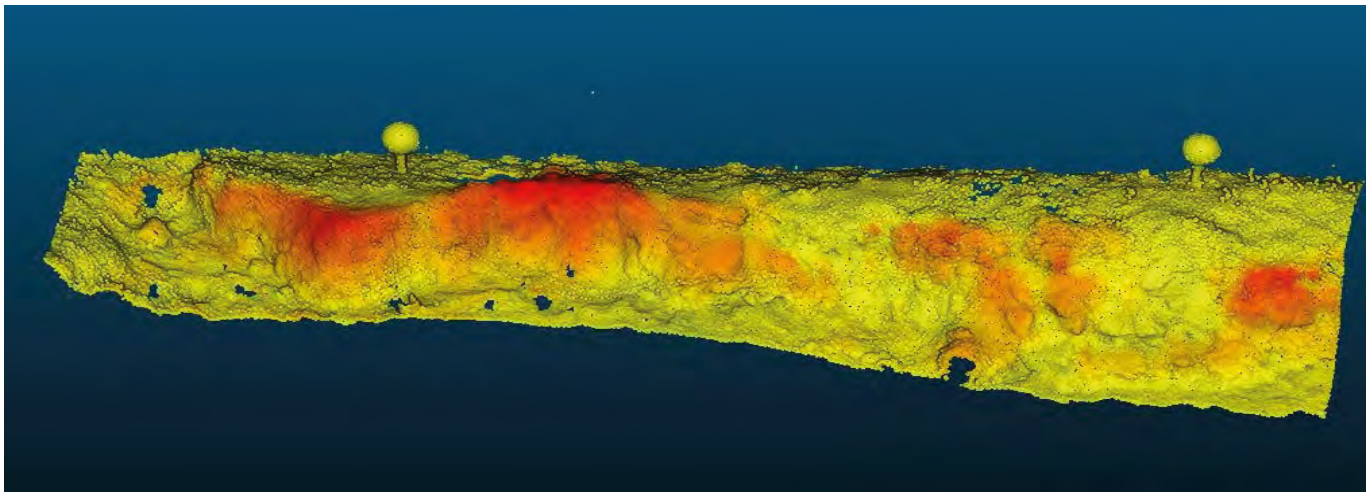

Fig. 1: 3D scan of a changing stream bank. Red indicates erosion due to cattle access.

Key Message

Maximal semiannual bank erosion at a cattle access point exceeded 1m^3.

Development of systems to improve the health and performance of dairy-origin beef youngstock

Naomi Rutherford

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Supervisors: Dr. Francis Lively, AFBI & Dr.Gareth Arnott, QUB.

Background

Dairy-origin beef production is a key component of the UK beef industry accounting for 57% of the total prime beef supply. However, only 51% of the total UK prime beef meets target market specification. This is predominantly due to cattle not meeting the target age, weight, fat cover and/or conformation requirements at slaughter. Therefore, optimising health and performance is vital to maximise profitability and ensure market specification is met.

Aims

This project aims to:

1. Investigate the effect of calf jackets on health, performance and skin temperature during the rearing period.
2. Compare the effect of four production systems on health, performance, carcass characteristics of Holstein bulls.
3. Examine the effect of behaviour on rumen temperature in young bulls.
4. Explore the use of rumen temperature as a novel welfare indicator during the pre-slaughter phase and subsequent indicator of meat quality.

Research Findings

Results show that calf jackets had no effect on calf health or performance. However, jacketed calves did have a 3.25°C greater skin temperature, with less diurnal variation. Therefore, providing a barrier to adverse environmental conditions. The inclusion of a grazing period within a bull beef production system resulted in a lighter carcass weight than those housed on ad libitum concentrate feeding. However, reduced feed costs associated with grazing, meant these bulls had a higher margin over feed costs. Behaviour had a significant effect on rumen temperature, however the observed temperatures were all within the normal range. Finally, rumen temperature was elevated during the pre-slaughter phase and was correlated with meat quality.

Key Message

This project highlights that maximising the proportion of grazed grass in the diet can help to control production costs. The novel technology (rumen temperature) showed potential to provide broader insights into an animal's stress response and its impact on meat quality.

High value functional dairy products from low value whey proteins: proving the concept

Joanna Shooter

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Supervisors: Dr. Brian Green, IGFS, QUB and Prof. Michelle McKinley, CPH, QUB.

Background

Research indicates that whey proteins may be most beneficial in terms of stimulating GLP-1 (Glucagon like peptide-1) release when they are not digested by the stomach. Thus, providing whey in a form that protects its journey through the stomach, such as in the form of an enteric coated capsule, may enhance its potential effects on appetite suppression, body weight and glycaemic control. Enteric coatings are used to coat medications that have an irritant effect on the stomach, such as aspirin, as the enteric coating will only dissolve in the small intestine. A human intervention study has been designed to test this hypothesis on a healthy population.

Aims

The aim of this human intervention study is to investigate the effect of whey protein isolate (WPI) on secretion of GLP-1, appetite, body weight, body composition and glycaemic control when it is delivered in an enteric coated capsule compared to delivery in a standard gelatin capsule.

Research Findings

There are three main research questions being addressed in this study.

1. How does WPI affect GLP-1 secretion in the 2-hour period following consumption?
2. Does WPI affect GLP-1, appetite, weight and glycaemic control when consumed for two weeks?
3. Is there a difference in the effect of WPI when it is delivered in an enteric capsule compared to a standard gelatin capsule?

My hypothesis is that the enteric coated capsules will protect the WPI from digestion in the stomach and so will enhance GLP-1 secretion and have a greater effect on appetite, body weight and glycaemic control compared to the WPI delivered in the gelatin capsules. Data analysis will not begin until everyone has completed the study.

Key Message

Whey proteins are highly beneficial for enteroendocrine cells and they are most beneficial when they are not digested by the stomach. I hope that by encapsulating the whey protein in the enteric coated capsules, the whey will reach the intestine intact and increase the secretion of GLP-1.

How can Northern Ireland more effectively deliver plant health protection to contribute to the DAERA vision of a thriving and sustainable rural economy?

Rebecca Stevenson

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Supervisors: Dr. Brian Jack, QUB and Dr. Dieter Pesendorfer, QUB.

Background

The threat posed by new and emerging plant health pests, such as *Chalara Fraxineus* (Ash Dieback), has increased as global markets have expanded and the volume of international trade has grown. These plant pests and pathogens have the potential to cause serious damage to Northern Ireland's economy, landscape and environment.

Chalara Fraxineus (Ash Dieback)

Aims

This research examines how the application of Better Regulation principles could enhance the delivery of Plant Health Protection in Northern Ireland, specifically in implementing the requirements of the Plant Health Regulation 2016. The research examines the concept of Better Regulation in depth and explores how the concept can deliver more effective regulation. The research also reviews current policy and legal requirements for plant health protection in the UK and Ireland and identifies how Better Regulation principles could be applied to Plant Health protection. It reviews how DAERA and other United Kingdom plant health authorities currently implement plant health protection measures.

Research Findings

Data collected through the use of semi-structured interviews has examined current practices in Northern Ireland and across the United Kingdom. This information has been used to identify areas in which Better Regulation principles can be applied to achieve enhanced plant health protection whilst minimising regulatory costs for the agri-food sector.

Key Message

The Better Regulation principles provide a regulatory framework for the delivery of Plant Health protection in Northern Ireland. The research has shown that these principles can be more thoroughly embedded within both decision making mechanisms and regulatory processes and that this would make a positive contribution in assisting DAERA to achieve its goals under the 'Going for Growth' Strategy.

Investigating species of conservation concern to predict ecosystem service delivery and its impact on production value of sheep hill farms in Less Favoured Areas (LFAs) in NI post-Brexit

Amy Arnott

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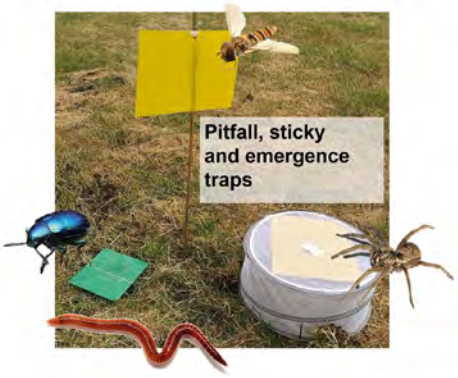
Supervisors: Dr. Neil Reid (QUB); Prof. Mark Emmerson (QUB) and Dr. Aurélie Aubry (AFBI).

Background

- Upland farmers rely on EU-subsidies, e.g. agri-environment schemes (AESs).
- Invertebrates are well suited to monitor AES efficacy.

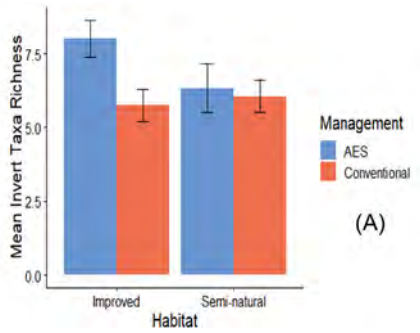
Aims

To test the efficacy of the Northern Ireland Countryside Management Scheme (NICMS) in enhancing upland invertebrate biodiversity in grasslands providing an evidence-base to inform future AES reformulation post-Brexit.

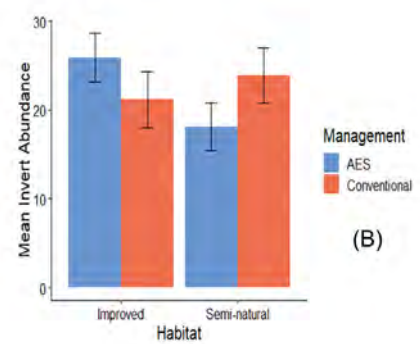


Initial Key Findings

2036 invertebrates from 74 families identified from pitfall traps.



Significant effect of AES on mean invertebrate taxa richness but only in improved grassland (A).



No effect on mean invertebrate abundance (B).

Key Message

NICMS associated with higher invertebrate diversity in upland improved grasslands.

Development of systems to improve the utilisation of grass and forage in beef production systems

Lauren Chesney

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Supervisors: Dr. Francis Lively, AFBI and Prof. Nigel Scollan, QUB.

Background

- Low profitability is a threat to the sustainability of the Northern Ireland (NI) beef industry.
- Grazed grass is the cheapest form of feed available for ruminant livestock, with 90% of the agricultural land used for grass production in NI.
- However, only 5t DM/ha of grass is being utilised on farms so there is significant scope to increase profitability through improved grass utilisation.
- An increase in grass utilisation by 1t/DM/ha increases margin over feed costs by £239/ha.

Aims

- To evaluate the response of N on grass growth and quality.
- To investigating the effects of grazing weaned suckler calves outdoors during the autumn/winter period.

Initial Key Findings

Table 1: The effect of the post weaning strategy on the performance of weaned suckled calves

Production System	Grazed calves	Housed calves
Weaning Weight (kg)	228	228
Live Weight at Housing (kg)	294	300
Live Weight at Turnout (kg)	339	339
***Weaning to Housing Cost (£/d)**	1.14	1.76

*Costing grazed grass at £100 t DM, grass silage at £140 t DM and concentrate at £240 t DM.

Fig. 1: Graph showing grass growth rate (kgDM/ha) for each nitrogen treatment level (kgN/ha) across the season

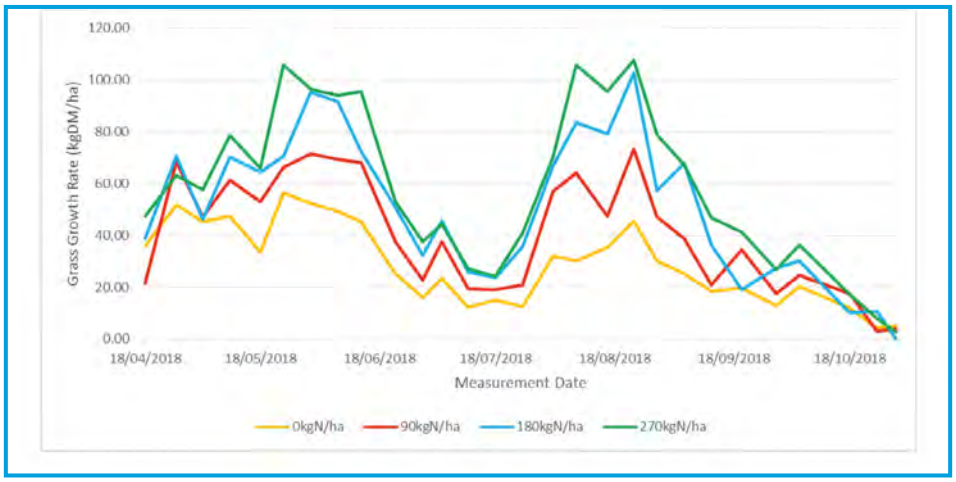

Table 2: Equivalent yield and response to nitrogen (N) for each N treatment.

	0kgN/ha	90kgN/ha	180kgN/ha	270kgN/ha
Equivalent Yield (t/ha)	6.71	8.80	10.88	12.06
Response to N	**1.00**	**1.31**	**1.62**	**1.80**

Key Message

- For each increase of 90kgN/ha, grass production increased by 30%. Except between 180kgN/ha and 270kgN/ha were it only increased by 18%.
- It cost 62p a day less to keep the calves outside post weaning compared to housing. This equated to a saving of £1,280 for 24 calves over 86 days.
- Those calves that were grazing outside performed similarly to those housed and once housed had a substantial improvement in daily live weight gain.

Maximising the benefits of cover crops through optimising the management of organic manures, rotations and nitrogen fertilisers

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Background

Cover crops are grown between two subsequent crops where the land is temporarily fallow. They are planted to invest in soil health and to contribute to sustainable crop production.

Aims

1) Identify species suited to Northern Ireland.
2) Evaluate the potential interaction between organic manures and cover crops.
3) Identify species best suited to later sowing dates.
4) Measure effect on soil health.
5) Evaluate effect on cash crop yield.

Research:

Field trials - 2 years replication

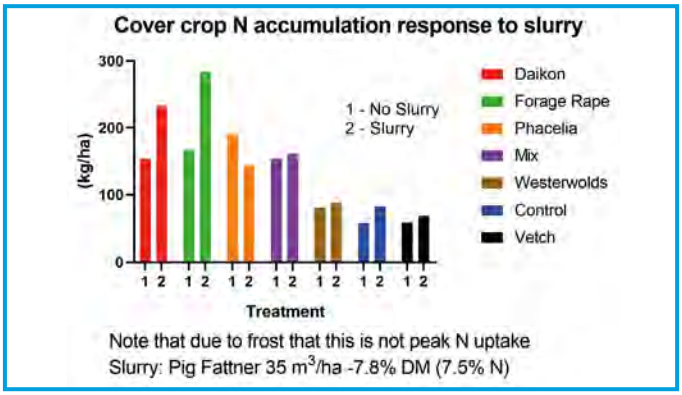
Pot experiment

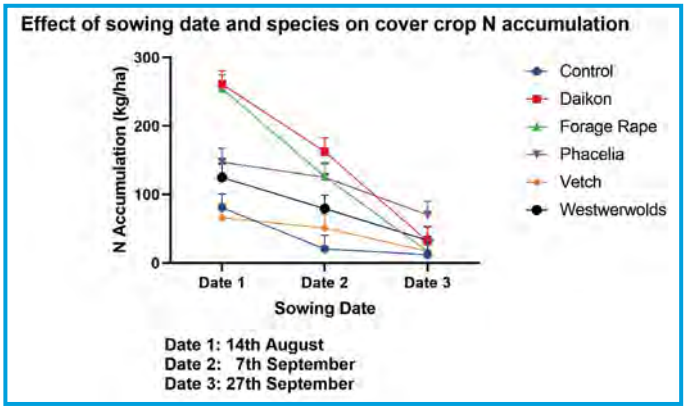
Farmer survey

Initial Key Findings

Significant effects over bare fallow:

- Increased nutrient cycling.
- Increased nutrient efficiency compared to control.
- Reduced nitrogen (N) loss over winter.
- Reduced soil moisture.
- Almost total weed suppression with some cover crops .
- Reduction in nitrogen fertiliser input in subsequent crop.
- Increased cash crop yield.





Key Messages

Cover crops offer clear benefits for economic and environmental sustainability when the correct species and management practices are used through:

1) Reduction in subsequent crop Nitrogen fertiliser inputs.

2) Capitalising on slurry through increased efficiency and synergy when integrated with cover crops.

3) Diversification of rotations and improving soil health.

Cover crops have clear potential for environmental schemes.

Estimating the relative importance of apex predator and mesopredator interactions for the provision of marine ecosystem services

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Background

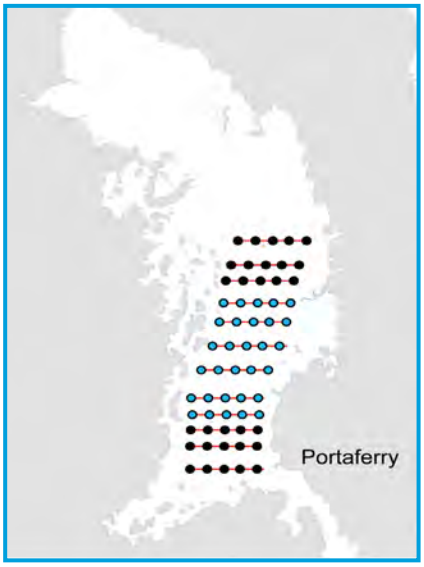
- Pot fishing is currently banned in the No-take zone (NTZ).
- Call for more pro-active Marine Protected Area (MPA) management strategies.

Aims

- Track movements of crab inside and outside the NTZ.
- Impact of NTZ on crab movement and densities.

Key Findings

- 1 month tagging (non-invasive) and recording recaptures.
- Size, weight, sex and species.




Necora puber


Cancer pagurus


Carcinus maenas

Key Message

Mark-recapture techniques can be used to assess NTZ effectiveness.

Identifying, understanding and harnessing the beneficial impact of genotype by nutritional interactions to optimise the performance and carcase quality of low weight pigs

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Background

- Increase Litter Size = increase number low birth weight (BW) pigs = decreased welfare and £'s.
- Effective intervention strategies will reduce the impact of these pigs on herd performance.

Aims

- To investigate the effect of lactation feed allowance (FA) on sow and piglet performance.

14 piglets < 1kg < mother with low FA / mother with high FA

14 piglets 1.25 - 1.75kg < mother with low FA / mother with high FA

Key Findings

- Feed intake was lower for sows on the Low FA (174kg) than sows on the high FA (217kg).
- Sows receiving a High FA lost less body condition (P2 loss = 2.2mm vs 3.1mm).
- Increasing sow lactation feed intake reduced suckling frequency but increased average suckling duration in week 3 of lactation.
- Low BW litters reared by sows offered a High FA recorded almost 50% less mortality, and weaned 1.5 extra piglets per litter, than those of low BW reared by sows offered Low FA.
- Low BW pigs reared by mothers offered high FA had:
  - > a wean weight almost 1kg greater than low BW pigs reared by mothers offered Low FA.
  - > a wean weight similar to average BW pigs reared by sows on a low FA regimen.
  - > a relative growth three times that of average BW pigs reared by sows on a low FA.

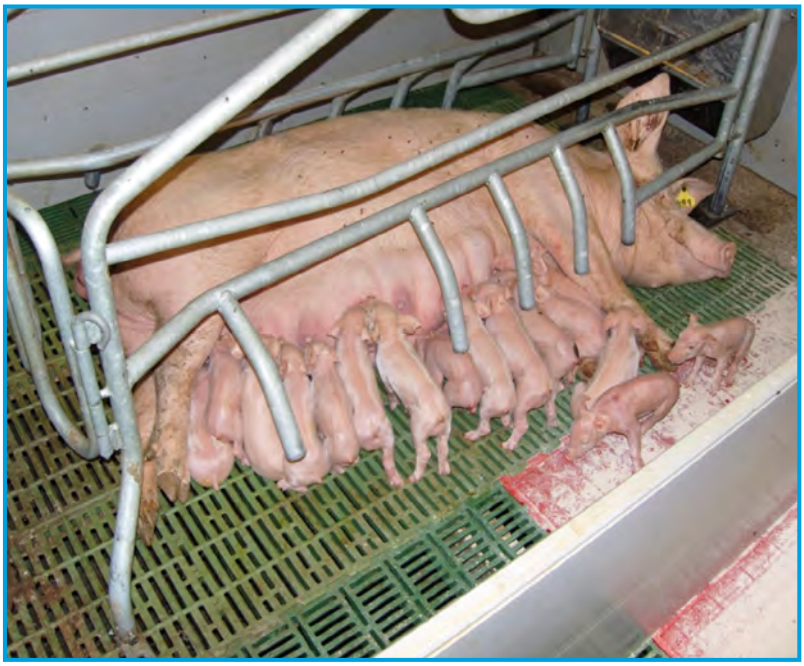
Fig. 1: Effect of treatment on piglet pre-weaning mortality.

	Low BW		Average BW			Significance (P-value)		
	Low FA	High FA	Low FA	High FA	SEM	BW	FA	BW x FA
Piglet birth wt (kg)	0.93	0.92	1.51	1.51	0.01	<0.001	0.92	0.846
Piglet wt week 4 (kg)	7	7.9	7.9	8.6	0.36	0.003	0.01	0.715
Relative growth (kg/kg)	6.48	7.5	4.28	4.71	0.25	<0.001	<0.001	0.105
Litter size weaned	10.9	12.4	13.1	13.1	0.49	0.006	0.14	0.144
Suckling Freq wk 3	43.4	36.2	48	37.8	2.51	0.240	0.01	0.561
Av. Suck. duration wk 3 (mins)	3.04	4.19	2.77	4.65	0.23	0.693	<0.001	0.131

Table 1. Effect of treatment on piglet pre-weaning performance.

Key Message

- Compromised pigs influence herd physical and financial performance with mortality rates almost three times greater than heavier littermates.
- Higher feed intakes by sows during lactation will help correct the weaning weight of compromised pigs.



Emotional geographies of 'belonging' in Northern Ireland: challenges for 'remaining in & leaving' family farming

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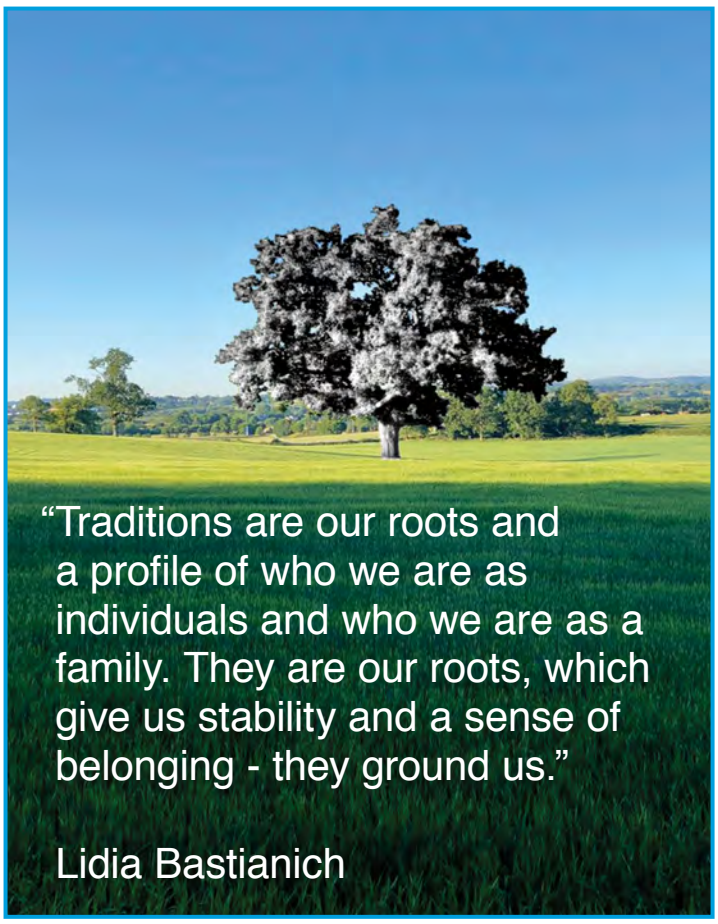
Research Background

There are over 500 million family farms across the developed and developing world, which are mostly managed by farm families (FAO, 2014).The EU is reliant on family farming for economic sustainability, where in Northern Ireland the family farm and the agri-food industry plays a more significant economic role than in the rest of the UK, with an annual turnover overall of £4.5bn (DAERA, 2017).Family farming, which remains patrilineal in the UK & NI, is also more than just an economic advantage; it is the 'heart of rural communities'.

Research Aims

The economic repercussions regarding a lack of retirement planning can be viewed through vital statistics, but what of the emotional effects that could ultimately affect the patrilineal farmers' decision making in Northern Ireland? This research therefore aims to go 'beyond the farm gate' to apply an emotional, rather than an economic framework, to explore how a 'sense of 'belonging' within changing rural communities contributes to the retirement decision-making in Northern Ireland.

Emotions will be key to this research as it motivates people in 'place'.In today's ever-changing world 'place' is better understood if explored through feelings or how it is 'felt' through emotions (Davidson & Milligan, 2007).



Initial Key Findings

The agricultural and rural landscape has endured many challenges over the last 100 years and is consequently policy

driven. Government interventions from the EU and European Rural Development Policies have influenced the rural countryside and have been successful in most cases. However, there have also been shortcomings evident concerning ageing farming men, retirement decision-making to 'remain in or leave' family farming and a confusion of terms regarding perceptions of 'belonging' in rural Northern Ireland.

Key Message

The premise here is to give not only patrilineal farmers a 'voice' to communicate their emotive issues pertaining to current retirement policies, but also to inform future rural development policies, to ensure that rural Northern Ireland remains competitive in this increasingly changing and pressurised industry.

Measuring the impacts of social farming on participants and farming families in Northern Ireland

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Background

Social farming is a complex intervention which originated as a grass roots movement in the Netherlands and has spread throughout Europe, the UK and the USA. The purpose of the intervention is to promote positive physical and mental health of individuals through the performance of agricultural tasks in a farm setting, which is financially supported by health services.

Aims

- Scope current peer reviewed evidence on the effects of social farming on health to identify gaps in research.
- Synthesise evidence to identify the 'active ingredients' of the intervention.
- Conduct process evaluation of Social Farming in Northern Ireland, to determine how social farming works, for whom, and in what circumstances.

Map displaying distribution of NI Social Farms (Rural Support 2019).

Initial Key Findings

Current Social Farm participant groups:	Important Outcomes:
• Adults with mental illnesses	• Reduced symptoms of depression, and anxiety
• Dementia patients	• Reduced symptoms of dementia
• Long term unemployed	• Improved subjective quality of life
• Adults and adolescents with substance addictions	
• Offenders	
• Veterans	
• Adults with intellectual disabilities	
• Children with mental illnesses	

Key Message

Social farming represents an important opportunity to provide meaningful therapeutic experiences for our most vulnerable rural dwellers in a rural setting. Social farming also represents a potentially sustainable diversification measure for farmers if funding from the NHS can be secured. The research produced will attempt to fill the evidence gap which prevents proliferation of this complex intervention, which is particularly suited for application in Northern Ireland.

Effects of phytogenics on intestinal pathogenic bacteria and microbiota of livestock non-ruminants

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Background

There is a reported link between antibiotic use in the agricultural industry and increased antibiotic resistance. Phytogenics may provide an alternative to antibiotics.

Aims

To screen antimicrobial activity of a range of natural botanical supplements (phytogenics).

Initial Key Findings

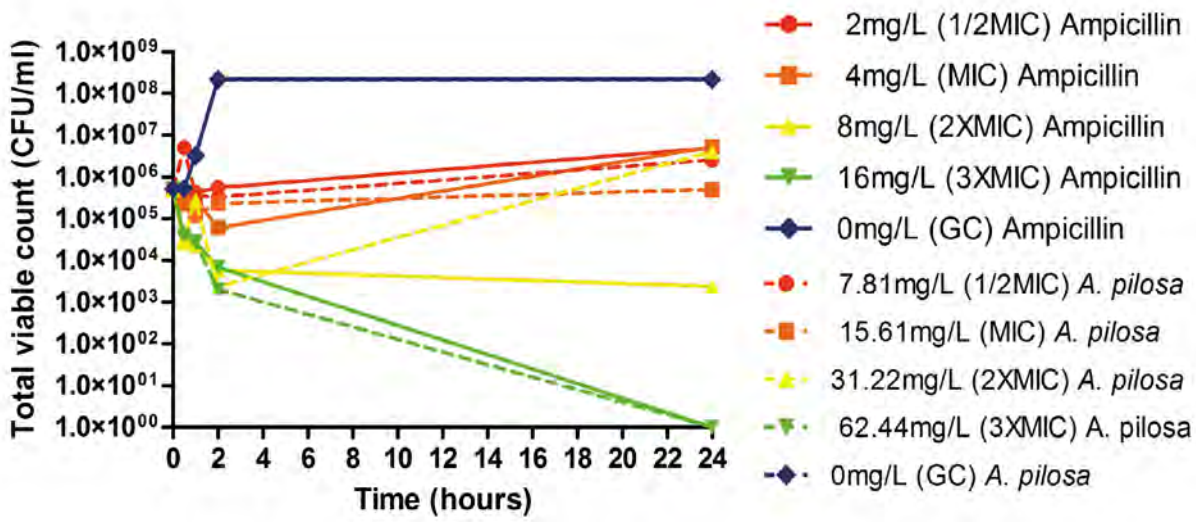
- The phytogenic concentrations that inhibited and killed bacteria were minimum inhibitory concentrations (MICs) and minimum bactericidal concentrations (MBCs).
- A large proportion of phytogenics inhibited growth of *C. jejuni* ((64%) 25 of 39), *L. monocytogenes* ((56%) 22 of 39), *S. enterica* ((62%) 24 of 39) and *E. coli* ((56%) 22 of 39) at MICs ≤1000mg/L.
- *A. pilosa* inhibited *C. jejuni, L. monocytogenes* and E. coli and *P. chinensis* inhibited *S. enterica* at the lowest MICs of phytogenics tested (Table 1).

		MIC (mg/L)	MBC (mg/L)	MIC (mg/L)	MBC
Campylobacter jejuni	NCTC 11322	31.25	500	62.5	250
	RC152	31.25	500	62.5	250
	RC104	125	>1000	62.5	250
	RC179	31.25	500	62.5	250
Listeria monocytogenes	NCTC 11994	31.25	250	125	500
	CM191	31.25	250	125	500
	OT11320	62.5	1000	125	500
	CP102	31.25	250	125	500
	CP11320	125	1000	125	500
	QA1018	31.25	250	125	500
Salmonella enterica	NCTC0074	500	1000	62.5	250
	QA60	125	1000	62.5	250
	J116	125	1000	62.5	250
	QA76	125	1000	62.5	250
Escherichia coli	ATCC 25922	7.8125	31.25	125	500
	UM004	7.8125	31.25	125	500
	UM011	7.8125	31.25	125	500
	UM012	7.8125	31.25	125	500

Table 1. Susceptibility of C. jejuni, L. monocytogenes, S. enterica and E. coli isolates to A. pilosa and P. chinensis.

- 3xMIC (62.5mg/L) A. pilosa showed similar rate and extent of killing as 3xMIC (2mg/L) ofAmpicillin with a ≥3 log10 CFU/ml reduction in bacteria by 24 hours (Figure 1)

Fig. 1: Time kill of E. coli UM004 in the presence of Agrimonia pilosa and Ampicillin



Key Message

A. pilosa showed bactericidal activity highlighting its significance as a replacement for antibiotics.

Effects of sheep grazing strategies on animal performance and grass production, utilisation and quality

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Background

- Grass, our cheapest feed resource, can supply up to 95% of the energy requirements of sheep (Davies & Penning, 1996); thus, the efficient production and utilisation of herbage in lamb production systems is the key to profitability.
- Currently, there are inefficiencies in the level and quality of herbage utilized per hectare within sheep production systems (Earle et al., 2017).
- Utilisation rate is a major factor affecting the cost per kg of grazed grass consumed thus it is imperative that strategies to improve herbage utilisation are investigated (Keady et al., 2009).

Aims

The objective of this study was to examine the effect of 4 versus 8 paddock rotational grazing systems on animal and grassland performance, and grazing behaviour.

Fig. 1: Aerial View of Rotational Paddocks.

Fig. 2: 8-Paddock Rotational System.

Fig 3: Ewe and lamb collars.

Study 1 (April 2018 - September 2018):

- 2 treatments - 4 paddock vs. 8 paddock systems.
- 1.57 hectares per treatment.
- 22 ewes and their twin lambs per treatment.

Study was also implemented on 2 commercial sheep farms (total of 292 ewes).

Table 1: Animal and grass data for Study 1

Animal Data	Grass Data
Ewe live weight and body condition score	Pre and post grazing heights/covers
Lamb live weight gain	Samples for Dry Matter and quality analysis
Parasite burden	
Grazing behaviour and GPS collars	

Initial Key Findings

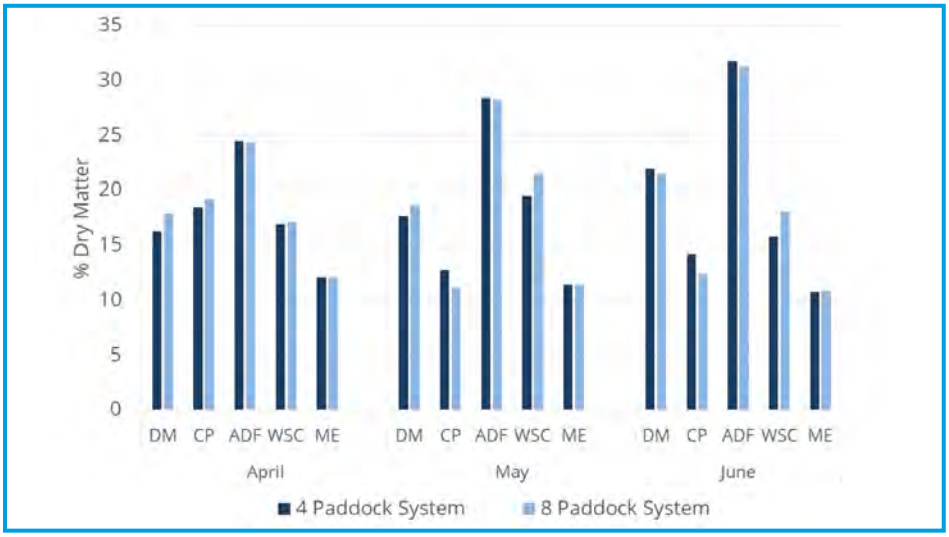
- No significant effect of grazing treatment on changes in ewe live weight or body condition score.
- Lambs grazing the 4-paddock rotational system had higher average daily gains (ADG) from birth to weaning (P<0.01) compared to those grazing the 8-paddock system (Table 2) and this was driven by higher ADG from 10 to 14 weeks of age (P<0.001).
- No significant effect of grazing treatment on grass quality parameters (Fig. 4).

Table 2. Lamb performance from birth to weaning.

Variables	Paddock System		SED	P	Sig.
	4	8			
Birth weight (kg)	5.0	4.8	0.253	0.474	NS
ADG (g/day);					
Birth to 6 weeks	243	247	0.014	0.777	NS
6 to 10 weeks	314	290	0.015	0.112	NS
10 to 14 weeks	267	202	0.014	<0.001	***
Birth to weaning	257	232	0.009	0.007	**
Weaning weight (kg)	30.2	27.5	0.973	0.008	**

* Preliminary Results

Fig. 4: Grass quality analysis from April to June 2018.



Key Message

Preliminary data indicates that an 8-paddock rotational grazing system produces higher levels of herbage production and utilisation but results in lower lamb live weights at weaning possibly due to higher parasite challenge.

An exploration of how small agri-food businesses can exploit big data market information to innovate with their products and create competitive advantage

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Background

- Small businesses need big data to prepare for future market opportunities and economic challenges, however they typically do not have access to big data.
- This research provides small businesses with access to big data consumer analytics from Tesco Clubcard, to help them innovate and build a competitive basis.
- How small businesses manage and use market information and its role in the new product development process is unknown.

Aims

- Explore how market information can be transformed into market knowledge to support new product development.
- Explore whether formalised market information can support small business knowledge processes and complement their informal approach to doing business.
- Identify characteristics within small businesses that influence the management of internal knowledge and the absorption of external knowledge.

Research

- For small businesses to realise the potential of big data it needs to be filtered and presented as market relevant information.
- Small businesses need to develop capabilities in managing internal knowledge and absorbing external knowledge, in order to use big data market information for new product development.
- Semi structured interviews with small business owner managers and relevant stakeholders are being conducted to uncover best practices associated with using big data market information.

Key Messages

- Businesses need to look at real consumer behaviour, real motivation and link all that knowledge to make informed business decisions.
- Small businesses can use formal market information to support their existing informal knowledge and gut instinct behaviour, to minimise risks in innovation.

Biostimulant strategies to enhance grass growth

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Background

One of the main limiting factors in germination is soil and air temperature. Grass seed germination is restricted to periods when soil temperatures are consistently at >6°C or mean air temperatures >5.6°C. Investigations have focused on biophysical manipulation of *Secale cereale* (winter rye) to enhance metabolism and growth at low temperature. This project will test the hypothesis that chaotropic solutes enhance metabolism and growth at low temperature using germination, callus and cell suspension studies to establish chaotropic biostimulation proof-of-principle at the cellular level.

Aims

To (i) determine seed coat permeability and embryo metabolism at low temperature, (ii) seed imbibing levels at low temperature, (iii) quantify electrolyte leakage during imbibition, and (iv) develop a callus induction and cell suspension initiation protocol.

Initial Key Findings

(i) Initial germination studies found Secale cereale a hardy annual crop can germinate at low temperatures thus was used as an experimental model.

(ii) Seed permeability and embryo metabolism are significantly effected by low temperature.

(iii) Determination of imbibing levels indicated how long seed should be primed with active solutes before germination. Imbibition of active solutes were slower than imbibition of water at 12 °C.

(iv) Conductivity of the seed priming solution gives an estimate of seed vigour. Electrolyte leakage was observed in all priming solutions.

(v) Germination assay of non-primed, water-primed and glycerol-primed seeds at 12 °C. Seeds primed for 24hrs in 0.5M glycerol enhanced germination at 12°C (Fig. 1).

(vi) Successful callus induction which will be used in further studies and to initiate cell suspension (Fig. 2).

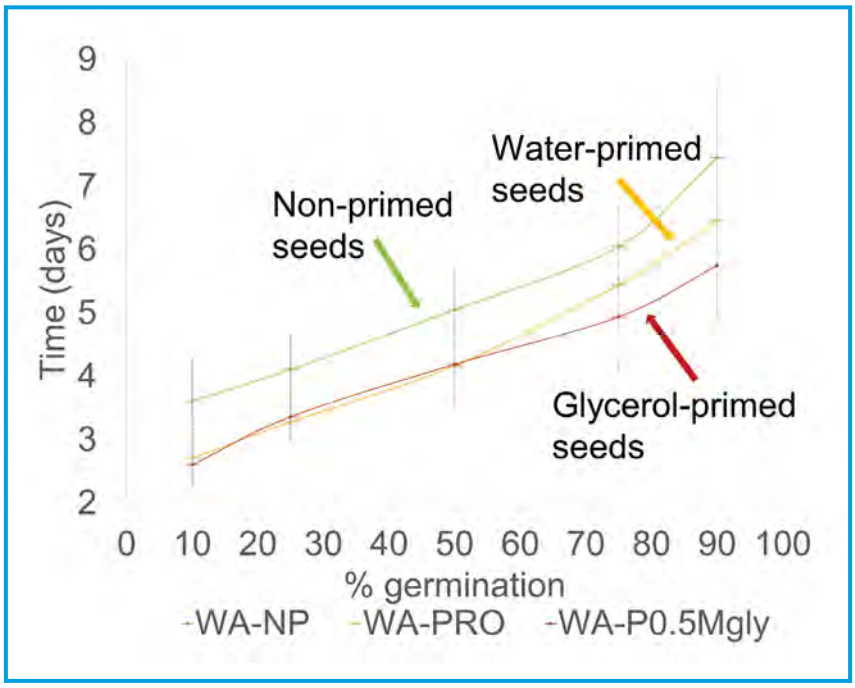

Fig. 1: Germination assay of non-primed, water-primed and glycerol-primed seeds at 12°C.

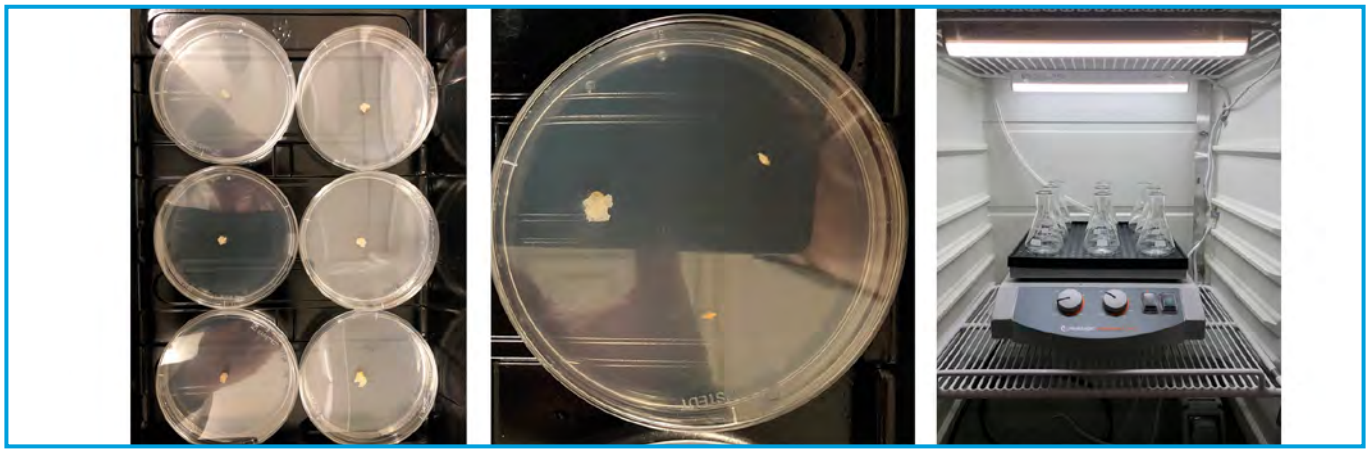

Fig. 2: Callus and cell suspension initiation.

Key Message

Although growth is inhibited by low temperatures, photosynthetic activity can be maintained. Therefore, inhibition of cell expansion and division is primarily responsible for reduced growth. Seeds primed with 0.5 M glycerol for 24 hrs enhanced germination compared to that of water-primed and non-primed *Secale cereale* seeds.

Using novel precision technology to measure individual dry matter intake (DMI) of dairy cattle at pasture

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Background

- There is a direct correlation between the proportion of grass in dairy cows' diet and the cost of milk production.
- NI grazing dairy herds often group animals into one grazing group.
- Indoor studies suggest separating parity one animals into a separate group will improve their performance.
- Limited research on frequency of fresh pasture allocation and the closely aligned times of 12, 24 and 36 hour that are commonly practiced on dairy farms.

Aims

- Understand the effect frequency of fresh pasture allocation (every 12, 24 and 36 hours) on grass utilisation, animal performance and behaviour.
- Understand the effect of frequency of fresh pasture allocation on the performance of parity one animals.

Key Findings

- Frequency of fresh pasture allocation did not affect grass quality or utilisation.
- 12H allocation had a significantly lower milk fat plus protein yield (Fig. 1).
- Parity one animals in the 36H allocation had the highest energy corrected milk yield (Fig. 2).
- 12H allocation increased rumination time and grazing time of parity one animals, resulting in greater energy expenditure in these activities (Fig. 3).

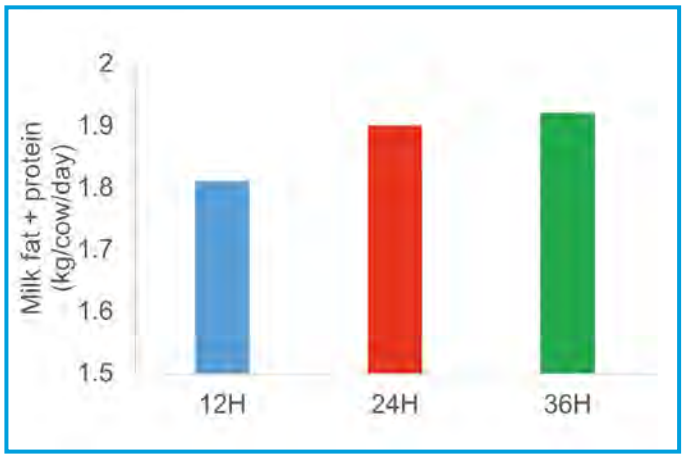

Fig. 1: Impact of pasture allocation on milk fat plus protein yield.

Fig. 2: Impact of pasture allocation on energy corrected milk yield of parity one animals.

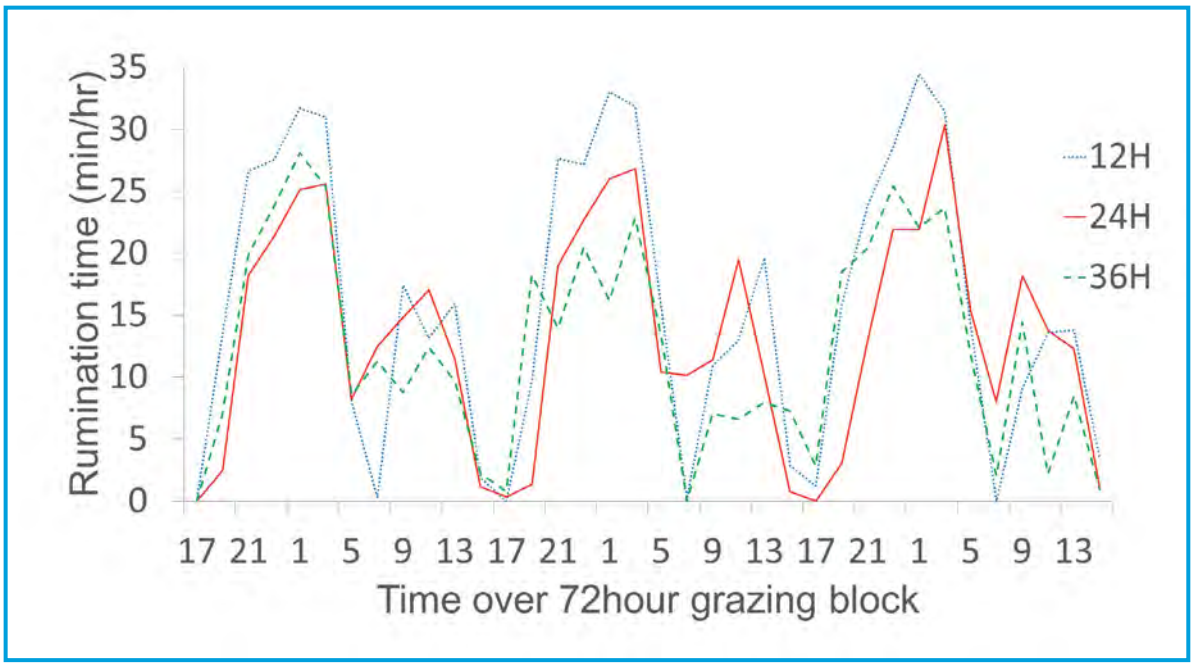

Fig. 3: Impact of pasture allocation on the rumination behaviour of parity one animals

Key Message

- Overall 12H allocations resulted in poorest animal performance.
- Decreasing the frequency of fresh pasture allocation to 36H allocations improved the performance of parity one animals through more efficient energy expenditure.

Understanding the epidemiology of bovine TB and potential routes of infection by elucidation of fine-scale badger movement and behaviour

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Background

- Bovine Tuberculosis (bTB) is a serious zoonotic disease affecting cattle in the UK and Ireland.
- Badgers are a reservoir host of bTB. Previous efforts to control bTB have included badger culling.
- Results of culls have been mixed with reported increases in home range, and ineffectual reduction in disease.
- Nonetheless, the relationship between badger movement, behaviour and disease spread, and effects of culling remains unclear.
- Research is needed to provide detail on how badgers interact with the landscape, and how this could influence bTB transmission.

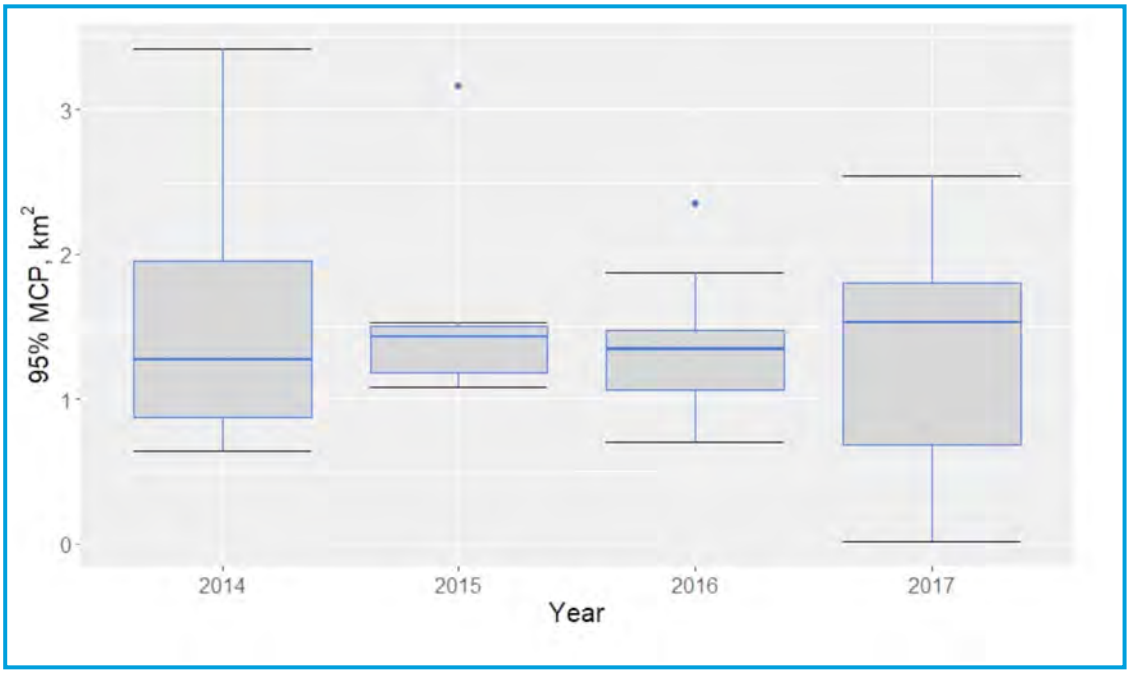
Aims

- Determine badger home range size in a Northern Ireland lowland area.
- Determine if badger home range and nightly distance change after culling.
- Establish how badgers utilise different land types, particularly those associated with cattle.

Key Findings

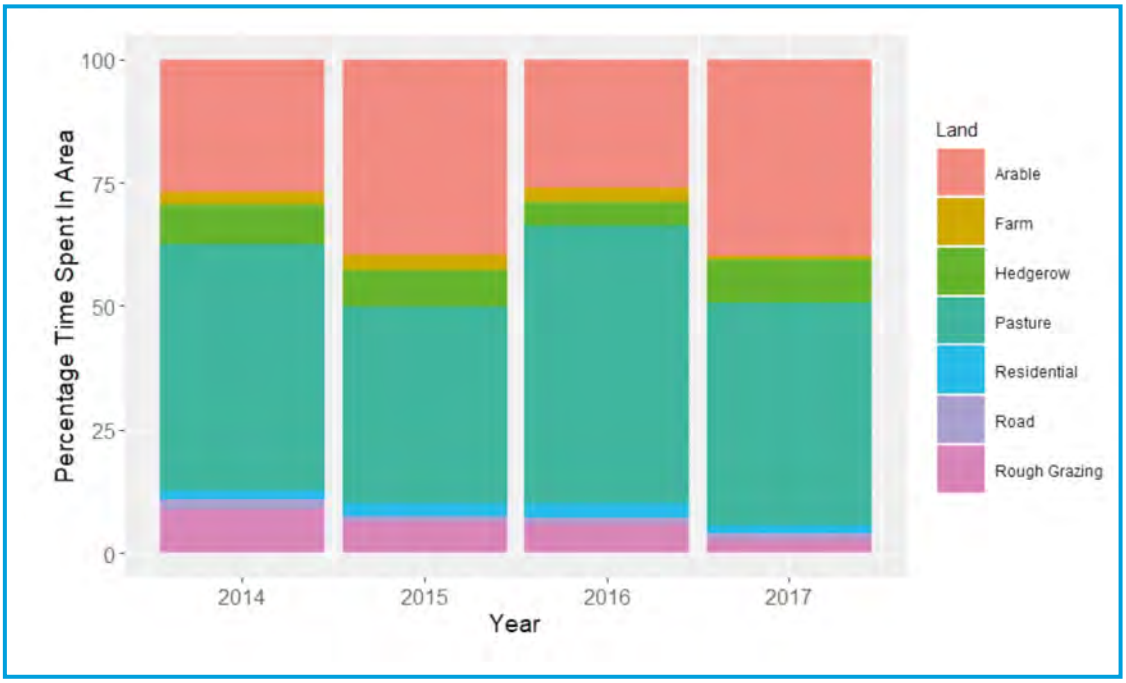
- Badgers travelled up to 7.5km a night, with home ranges up to 4km^2.
- No apparent increase in badger movement as a result of culling (2015-2017) were noted when compared to control year (A).

A



- Badgers primarily utilised pasture and arable fields, with certain individuals occasionally using rough grazing areas, farmyard and woodland (B).

B



Key Message

- Badgers interact with farmland areas frequently, with large home ranges and nightly distances travelled when compared to other UK studies.
- Culling did not significantly impact home range size and nightly distance travelled.
- Biosecurity such as fences should be employed to reduce badger contact with cattle inhabited areas.

Innovative housing and environment management to promote calf health, welfare and performance

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Background

Early life management of dairy heifer calves has long term effects on their health, performance and maturation (Heinrichs et al., 2005). The environment can impact calf health and growth by reducing energy efficiency, causing physiological stress and exposing the calf to a high pathogen burden. The association of housing on thermal environment and subsequent pre-weaned calf health and performance is relatively unstudied, particularly within the UK climate.

Aims

- Catalogue environmental conditions and management of pre-weaned calf rearing in commercial dairy farms.
- Investigate associations between housing design and environmental conditions with calf health and performance.

Initial Key Findings

66 dairy farms were surveyed (January - May 2019).

- 91% of farms housed pre-weaned calves indoors, whereas 6% used hutch systems until weaning.
- 59% of farms had more than 30 animals within the calf house airspace, 51% had post-weaned animals sharing airspace.
- 18% of farms only wash calf milk feeding equipment once the calf is weaned (washing methods varied).

Table 1. Calf house hygiene factors.

	% Farms in each category		
	Poor	Moderate	Good
Calf pen clean frequency	26.2	38.5	29.2
Calf pen ease of cleaning	4.5	53.0	42.4
General cleanliness of calf house	1.6	67.2	31.3
Adequate pen drainage	3.2	38.7	58.1
Bedding Kneel test	12.5	-	85.9
Bedding condition	1.5	19.7	78.8
Water access	3.1	57.8	39.1
Water hygiene	1.6	87.5	10.9
Water drinker ease of cleaning	10.9	54.7	34.4

Table 2. Calf house thermal environment (logged during Study Period)

Average farm data	Average	Max	Min	SD
% of time spent below 15°C	91.85	100.00	66.16	10.41
% of time spent below 10°C	56.32	96.55	9.09	23.36
% of time spent above 80% RH	63.94	98.67	18.30	21.74

Key Message

- Large variation among current calf rearing systems on dairy farms (Table 1).
- Preliminary data suggests calves experience a high percentage of the pre-weaned period in sub-optimal thermal conditions (Table 2).
- Hygiene management is a major issue.

A platform for precision phenotyping of farmed animals

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Supervisors: Dr. Nikki Marks, QUB and Dr. Michael Scantlebury, QUB.

Background

The expected rise in global human population has resulted in an increased demand for food production. Dairy farm enterprises often strive to improve production through intensification, but this is often associated with negative impacts on animal health and welfare. Increased intensification presents challenges such as reduced slaughter weight, increased disease transfer and instances of lameness, and making the best use of the available land.

The rapid evolution of electronic sensor technologies has hastened the drive for so-called 'precision farming'; that is, improving the ability to monitor behaviour of livestock to provide early warning systems for health and disease status, as well as optimising yields.

Aims

This study aims to:

- Assess the level of lameness prevalence and its impact on Irish Dairy Farms.
- Detect and grade early stage lameness remotely, removing human subjectivity.
- Determine the energy expenditure of set behaviours, and thus determine whether lame, ill, diseased or otherwise compromised animals expend more energy or have impaired welfare.
- Utilise remote sensing technologies to analyse animal movement patterns in order to improve farm animal and pasture management.

Initial Key Findings

Dairy cattle fitted with movement sensors and GPS loggers, provided data that allowed for more precise animal movement paths to be determined using a process known as 'dead-reckoning'. The relative costs of activity (Fig. 1), as well as the behaviours exhibited (Fig. 2 & 3) by the cattle have also been illustrated. The data obtained can be used to identify key areas within the field which would benefit from more water and food troughs, as well as any areas that cattle are observed to be actively avoiding which may warrant cause for further investigation. Disease status and lameness will also be investigated using this approach.

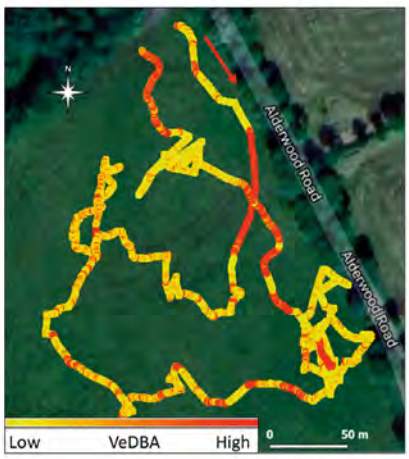

Figure 1: Cow movement path (*Bos taurus*) showing energy expenditure (VeDBA).

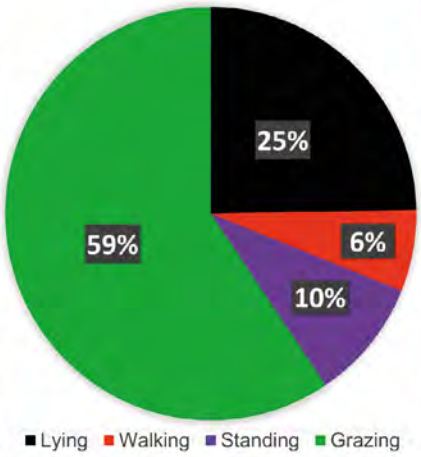

Figure 2: Cow behaviours at pasture.

Figure 3: Cow movement path showing recorded behaviours at pasture.

Key Message

This type of research can be used to improve animal monitoring. The ability to rapidly identify subtle changes in livestock would provide commercial enterprises with a competitive advantage by optimising management, and responding earlier to emerging clinical problems.

The impact of microplastics on commercially important fishery species in Northern Ireland

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Background

Microplastics (<5 mm) are now ubiquitous. Laboratory trials have reported negative effects on aquatic species when exposed to microplastic pollution; however, certain studies have used excessive dosages with little real world relevance.

Aims

Determine global environmental plastic levels using 180 published values. Analyse 128 published studies for dosage and impact.

Key Findings

82% of studies used dosages higher than environmental values (Fig. 1) - as high as 1 million mp / L. 24% studies used incomparable units.

I propose unified units of mp / L for pelagic species and mp / L for benthic (Fig. 2).

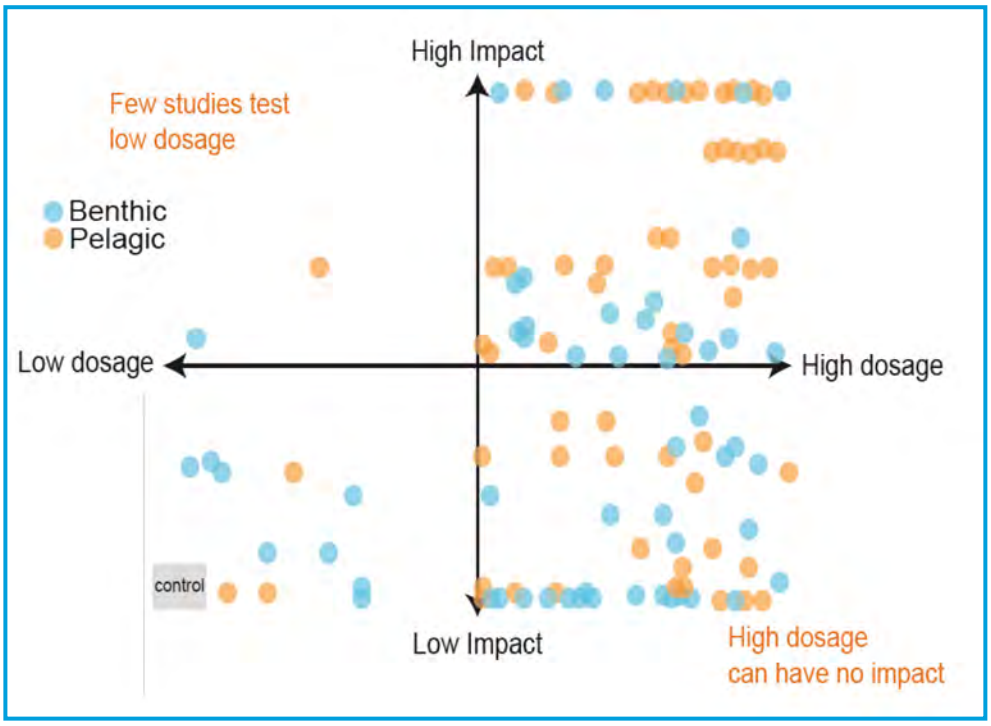

Fig. 1: Schematic diagram displaying the dosage and associated impact when exposing aquatic species to microplastics.

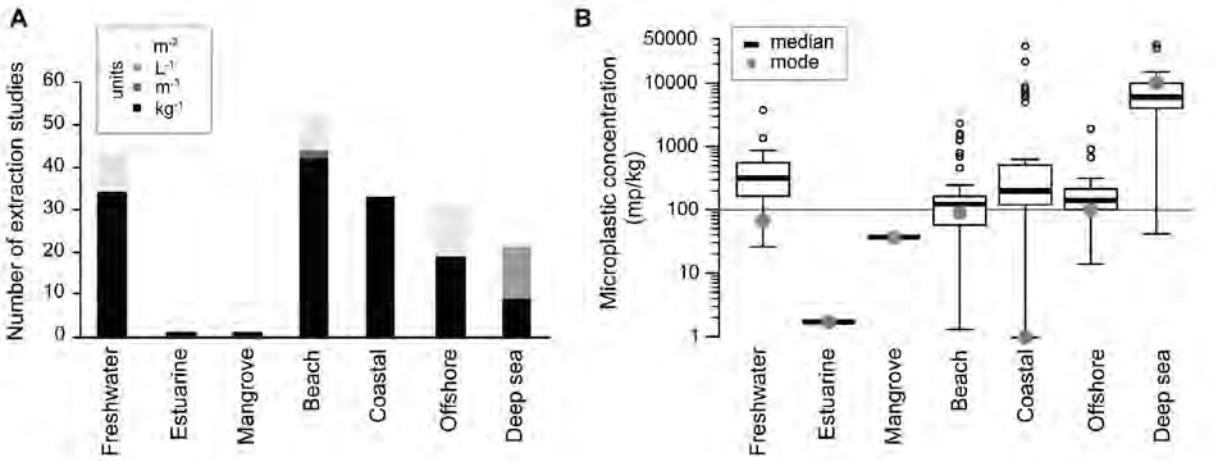

Fig. 2: The number of aquatic sediment studies showing the range of units used (A) and the concentrations of microplastics found in each environment (B).

Key Message

In future, laboratory exposure trials should aim to use more environmentally relevant microplastic dosages. This will help determine the true impacts of microplastics on aquatic species.

Cunningham & Sigwart (2019). Environmentally accurate microplastic levels and their absence from exposure studies on aquatic taxa. Integrative and Comparative Biology. DOI: 10.1093/icb/icz068.

Assessing the effectiveness of blue whiting protein on satiety and its use as a functional ingredient within the diet

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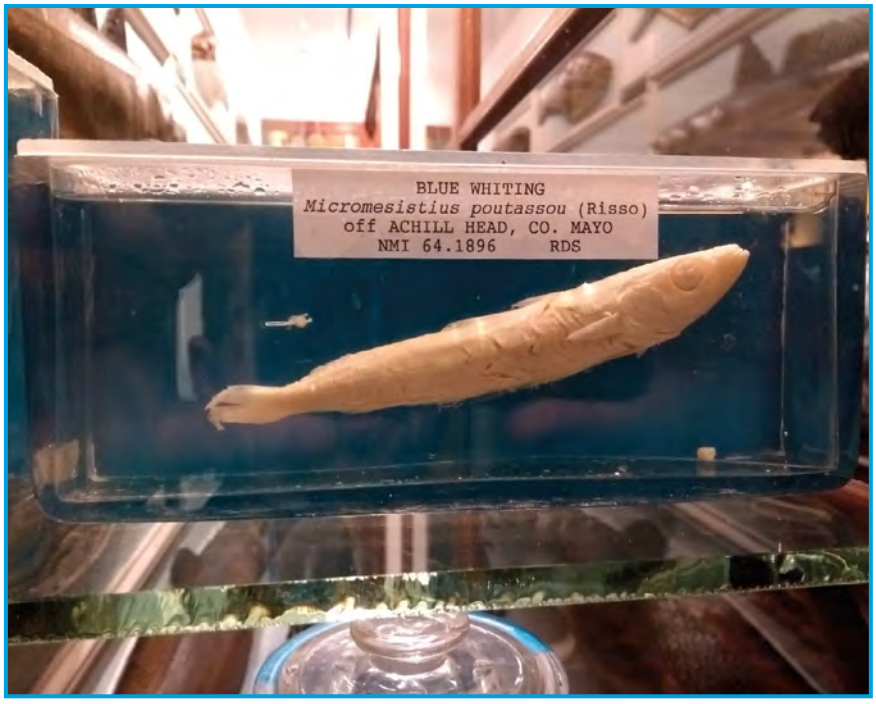
Background

- 4.6 million people in the UK have been diagnosed with diabetes: 90% have Type 2 (T2D) & the other 10% have Type 1.
- A lack of insulin production in combination with tissue insensitivity to insulin i.e. insulin resistance, is characteristic of T2D. Insulin reduces blood glucose levels after a meal.
- Obesity is a major risk factor for developing T2D as obesity leads to insulin resistance.
- In the UK 59% of women and 68% of men are either overweight or obese.
- Novel products are required to reduce the detrimental impacts of T2D and obesity.

Aim

- To investigate the possible health benefits of blue whiting protein hydrolysates (BWPH) for the development of novel food products to alleviate obesity and/or T2D.
- To assess the consumer acceptability of BWPH.



Key Findings

- BWPH has no apparent stimulatory effects upon insulin secretion (Figure 1A).
- Heat treatment of BWPH however can lead to a reduction in insulin secretion from BRINBD11 pancreatic beta cells (Figure 1B).

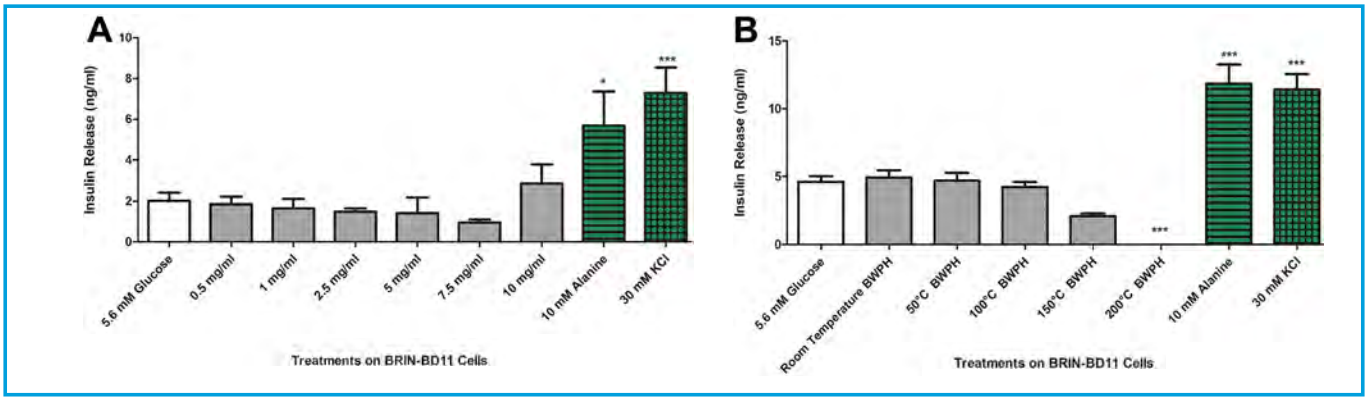


Fig. 1A & B: The effects of BWPH at different concentrations (A) and the effects of 10 mg/ml BWPH heat-treated at various temperatures (B), on insulin release from BRINBD11 pancreatic beta cells. 5.6 mM glucose is the comparative control.

- BWPH has no toxic effect on cultured BRIN-BD11 cells and may also have a proliferative effect on these cells. If beta cell growth is encouraged this could lead to an increase in the production of insulin and provide overall improved glucose control within the body.
- BWPH is also an acidic hydrolysate meaning it can provide a greater intensity of a sour flavour to food products.
- BWPH has a safe shelf-life of up to 18 months post-production before the low fat content may begin to break down and encourage more harmful levels of microbial growth (Table 1).

Test/Parameter	Month 1.	Month 2.	Month 3.	Month 4.	Month 6.	Month 8.	Month 10.	Month 12.	Month 14.	Month 15.	Month 16.	Month 17.	Month 18.	Month 19.
TBC @ 22° C.	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail
TBC @ 37° C.	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail
Esch. Coli	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail
Enterobacteria	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Salmonella spp.	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail
Coag. (+) Staph.	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail
Listeria Mono.	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Clostridium Per	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Kries Test	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail
Headspace Test	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
T.V.B. Nitrogen	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail
Iodine Value	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail
Free Fatty Acid	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail
Peroxide Value	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail
Anisidine Value	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
TBA Rancidity	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail
Hydroxyl Value	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail
TOTOX Value	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

Table 1: The safe shelf-life parameters of BWPH

Key Messages

- BWPH has the potential to become a novel functional ingredient if integrated within the correct food and/or drink products.
- Future work will further investigate the potential of BWPH as a functional food ingredient for alleviating obesity and T2D.

Behavioural modification of Nephrops and whiting through artificially light adjusted capturing processes

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Background

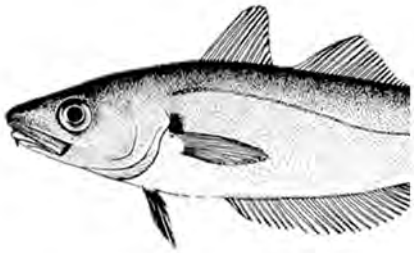
- Approximately 1000 tonnes of whiting fish are caught per year as bycatch in the Irish Sea 82% are caught by demersal trawls fishing for Dublin bay prawn.

Bycatch: "The proportion of a commercial fishing catch that is caught unintentionally":

- Regional stocks of whiting declining rapidly since the 1980s.

International Council for Exploration of the Sea (ICES): "Below safe biological limits"

- Technical measures to reduce whiting bycatch have not been successful.
- Artificial light has been demonstrated as a highly effective method for reducing fish bycatch.
- Light affects fish species in different ways i.e. some are attracted or repelled.
- Differences in behavioural reactions of fish species can be exploited for bycatch reduction.



Whiting (*Merlangius merlangus*)

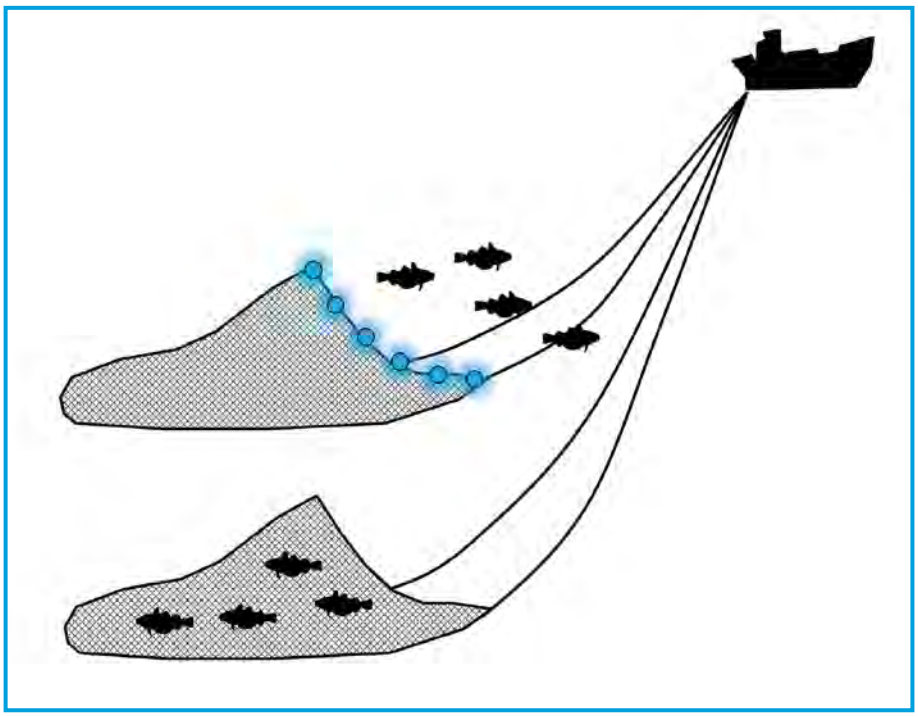
Aims

- Examine the effects of artificial light on catches of whiting and other fish bycatch.
- Identify common behavioural responses to artificial light sources (attraction/repulsion).
- Establish an effective bycatch reduction method for whiting using artificial light.

Key Findings

Irish Sea Light Trials (2019-2020)

- Comparing the catch of whiting and other fish bycatch on a vessel with two nets towed simultaneously (twin-rig trawler) - trials commencing this year
- Cameras (GoPro Hero series) attached to both nets to record and analyse the behaviour of whiting and other fish.



Preliminary Results from NI Gear Trials Project (AFBI):

- Blue lights most effective at reducing whiting bycatch.
- Greater effects on juvenile whiting (less than 27cm) than larger individuals.

Key Message

- Whiting are a prolific bycatch species in the Irish Sea.
- Artificial light could be an effective tool for eliminating whiting bycatch.
- Important to understand how light impacts both behaviour and capture of whiting to establish greater selective fishing and bycatch reduction with artificial light.

Development and trial of a novel bovine respiratory syncytial virus Pre-fusion F recombinant vaccine

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Supervisors: Prof. Ultan Power, QUB and Prof. Louise Cosby, AFBI.

Background

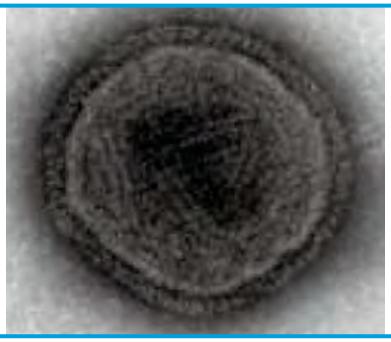
- bRSV - major cause of Bovine Respiratory Disease Complex (BRDC) - £60 million losses UK/annum.
- Existing vaccines ineffective - Inactivated/live attenuated.

Aims

To generate a safer, more efficient vaccine against bRSV using Sendai virus (SeV) expressing vaccine antigens.

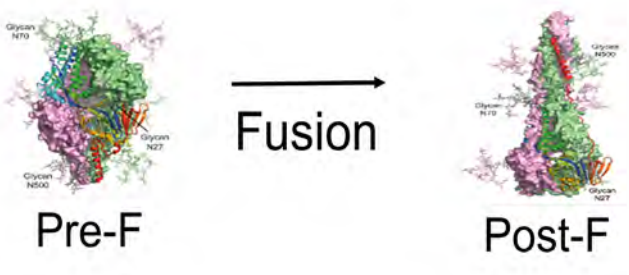
Sendai vaccine Vector (SeV)

- Cell tropism - infects respiratory tract.
- Humans and calves - non-pathogenic.
- Reverse genetics facilitates incorporation of heterologous genes.

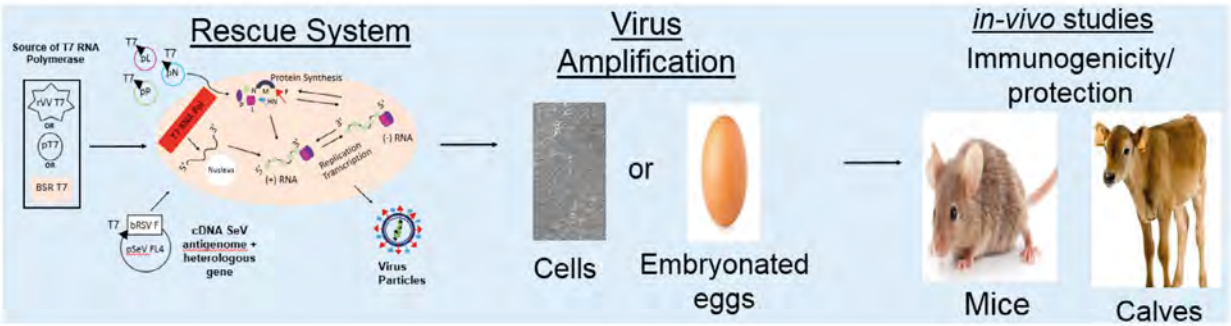


Vaccine antigen (bRSV F)

- bRSV F antigen - Fusion activity (host cell and virus envelope).
- A principle antigenic determinant.
- Stabilized pre-F used.

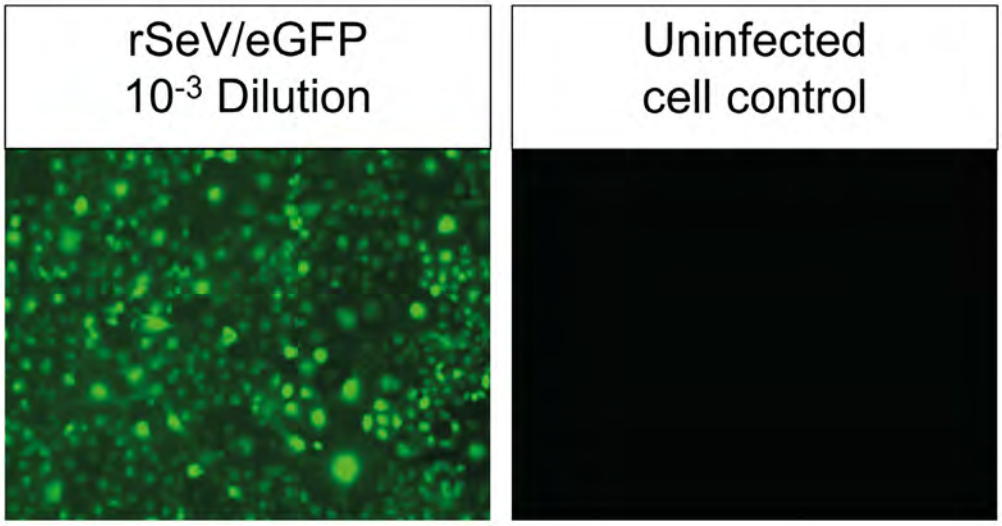


Methods



Initial Key Findings/Message

- Replication-competent clones express heterologous genes (GFP, bRSV pre-F and bRSV Fwt).
- Successfully rescued rSeV/eGFP and SeV WT; rescue conditions optimised - ongoing.
- Rescued rSeV/eGFP expresses GFP (green fluorescent protein).



UV microscopy of LLC-MK2 cells infected with rescued rSeV/eGFP.

Controls included uninfected (UI) cells. The cells were imaged by UV microscopy at 3 dpi.

Identification of parasite-derived antibacterial agents to tackle emerging antimicrobial resistance and reduce antibiotic use in livestock

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Supervisors: Dr. Angela Mousley, QUB; Prof. Sharon Huws, QUB and Dr. Louise Atkinson, QUB.

Gastrointestinal parasite of pigs: *Ascaris suum*

Background

Antimicrobial Resistance (AMR) is a serious threat to the control of disease in humans and animals. Novel antimicrobials are urgently needed to facilitate the sustained control of microbial infections.

Antimicrobial Peptides (AMPs) are naturally produced immune molecules with broad spectrum activity against bacteria, fungi and viruses. Helminths (nematodes and flatworms) often live in microbe-rich environments and may offer an untapped source of novel antimicrobials.

Aims

To identify and characterise AMPs in Helminths

Aim 1: To identify and map the expression of helminth AMPs through *in-silico* analysis of genomic and transcriptomic datasets.

Aim 2: To examine the antimicrobial properties, mode of action, and therapeutic potential of prioritised helminth AMPs against pathogenic bacteria.

Aim 3: To investigate the importance of helminth-derived AMPs to worm survival.

Initial Key Findings

- Bioinformatic analysis of genomic data from 106 nematode species revealed >2000 AMP-encoding genes representing five AMP families. The putative AMPs are diverse, suggesting that they may exhibit variable antimicrobial activities.
- One of the AMP families, the Cecropins are entirely restricted to gastrointestinal Ascarid species suggesting they could exhibit activities against intestinal pathogens.
- The Nemapores are the most abundant and widely distributed AMPs in nematodes suggesting they play a key role in nematode biology.

Key Message

- Nematodes display rich and diverse AMP profiles and are a source of novel antimicrobials.
- Some nematode-derived AMPs are highly restricted by clade, and/or species suggesting they may have highly specific antimicrobial activities which could be exploited.

Understanding the influences of agricultural practices on Antimicrobial Resistance (AMR)

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Supervisors: Prof. Sharon Huws, QUB; Prof. John McGrath, QUB
Dr. Steven Morrison, AFBI.

Background

- Antimicrobial resistance (AMR) is the ability of microbes (e.g. bacteria and fungi) to grow in the presence of chemicals that would normally kill them.
- This PhD researches the AMR risk of struvite fertilizer & AMR within NI dairy farms.
- Struvite is a renewable phosphate (P) fertilizer recovered from animal waste water streams, however how it impacts AMR in soil is unknown.
- Dairy farming is a key sector in NI, some farming practices may promote AMR emergence resulting in the sector becoming very vulnerable to the affects of the AMR crisis.

Aims

- Identify AMR genes in global soils.
- Assess if struvite application changes AMR genes in NI soils.
- Measure AMR levels in NI dairy farms.
- Identify farming practices that cause high AMR levels.

Initial Key Findings

- 306,239 AMR genes were identified in 99 global soils.
- 65% of genes encoded β-lactam antibiotic resistance.
- 13% encoded resistance against Macrolide-lincosamide-streptogramin B antibiotics.
- 40.9% of NI dairy farms had at least one scouring calf.

Research Plans

- 66 Dairy farms have been surveyed and sampled.
- Samples will undergo qPCR to identify AMR genes and build AMR profiles for each farm; allowing the **creation of advice on reducing farm AMR levels**.
- NI soil from struvite pot trials will also undergo qPCR to identify AMR genes.
- Organisms from both sets of experiments will be cultured and have their genomes sequenced.

66 dairy farms sampled across NI, in collaboration with AFBI and the Optihouse Project.

Key Message

AMR is a serious threat to animal and human health, causing a huge financial burden. Surveillance efforts must increase to create methods to slow down AMR emergence and assess currently unknown AMR levels within NI agriculture.

Elucidating the role of badger movements and behaviour using remote sensing technologies on the potential routes of Bovine Tuberculosis (bTB) infection

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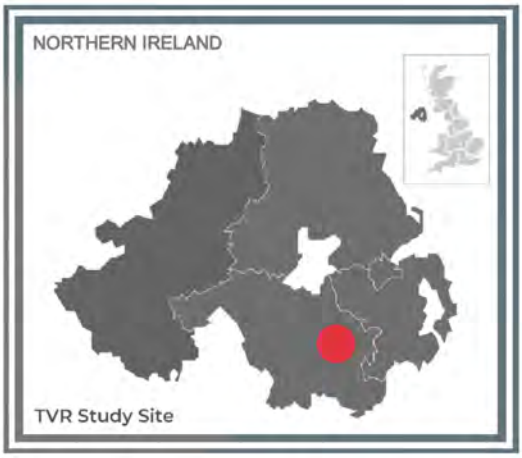
Background

Bovine Tuberculosis (bTB) is a chronic, infectious zoonotic disease, causing substantial impacts on animal and human health, and economic well-being. Incidence of both bTB and cattle breakdown has been increasing across the UK and Ireland, highlighting the need for novel disease control. As the European Badger *(Meles meles)* is implicated in at least some of the transmission of the bacilli in the environment, it's vital to understand how badgers may contribute to disease spread. Thus this PhD aims to increase our understanding of badger movement and behaviour to appreciate how they may affect disease spread.



Aims

- GPS data from the Trap Vaccinate or Remove (TVR) programme will be used to visualise badger movement and land use at both an individual and social group level across the four years of the study.
- Establish what impact a selective cull approach has on badger movement and hence on the likelihood of bTB transmission.
- Investigate if removing infected badgers during the study period successfully reduced bTB infection within the badger population and therefore the chance of badger-to-cattle transmission.

Key Findings

<u>Badger Ecology</u>

- Analyse the movements and habitat use of badgers in year 1 (control) and compare their habitat use in subsequent years (during and after the cull) with the expectation that their behaviours and habitat utilisation will change. Analysing badger behaviour at the social group level will more accurately represent behavioural differences within a population.

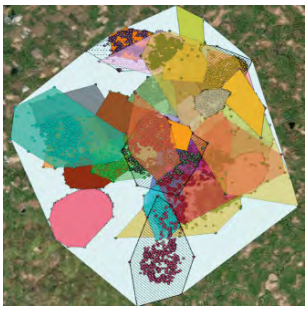
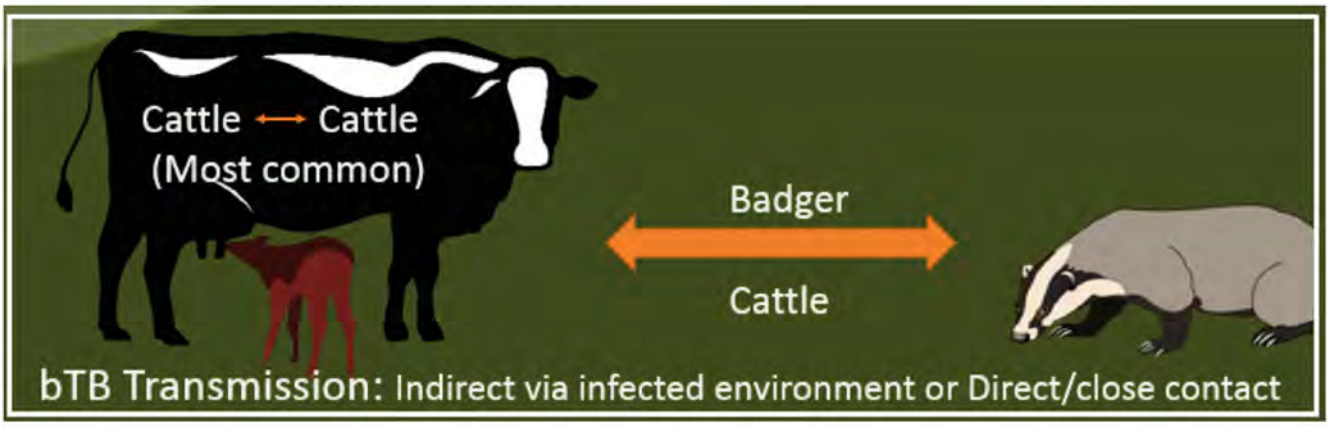


Fig. 1: Year 1 Data - Population Distribution

- bTB distribution will be measured by establishing the percentage and distribution of bTB positive badgers during year one. The number and distribution of bTB positive badgers in subsequent years will be used to assess what impact their removal has over time.

Initial results

An initial assessment indicated that there are no clear changes in spatial distribution of badgers during the study period. Future analyses will examine these aspects in more detail.



Key Message

The Problem

- bTB is an infectious disease of cattle and badgers.
- Complex epidemiology involving multiple hosts.
- Inadequate test - low sensitivity means >1 in 4 bTB positive cattle will not be detected in annual testing; severely hindering bTB control.
- Large economic impact costing NI ~ £44M annually, representing £555M since 1996.

PhD

AIM: To increase our understanding of badger movement and behaviour; to estimate the risk of badger-to-cattle transmission in NI; to aid the development of novel control strategies and inform biosecurity measures.

Quantifying and evaluating factors influencing the socialisation period of puppies reared in commercial breeding establishments (CBEs)

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Supervisors: Dr. Gareth Arnott, QUB & Dr. Deborah Wells, QUB.

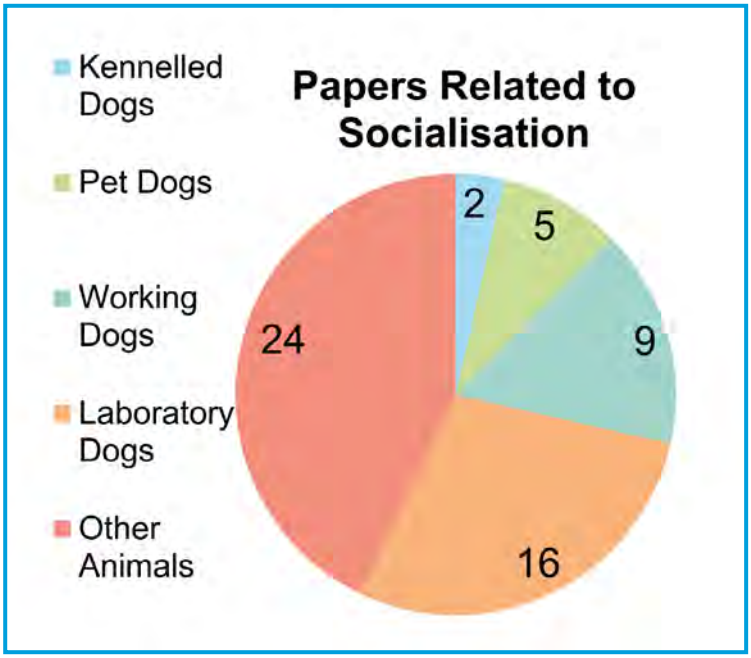
Background

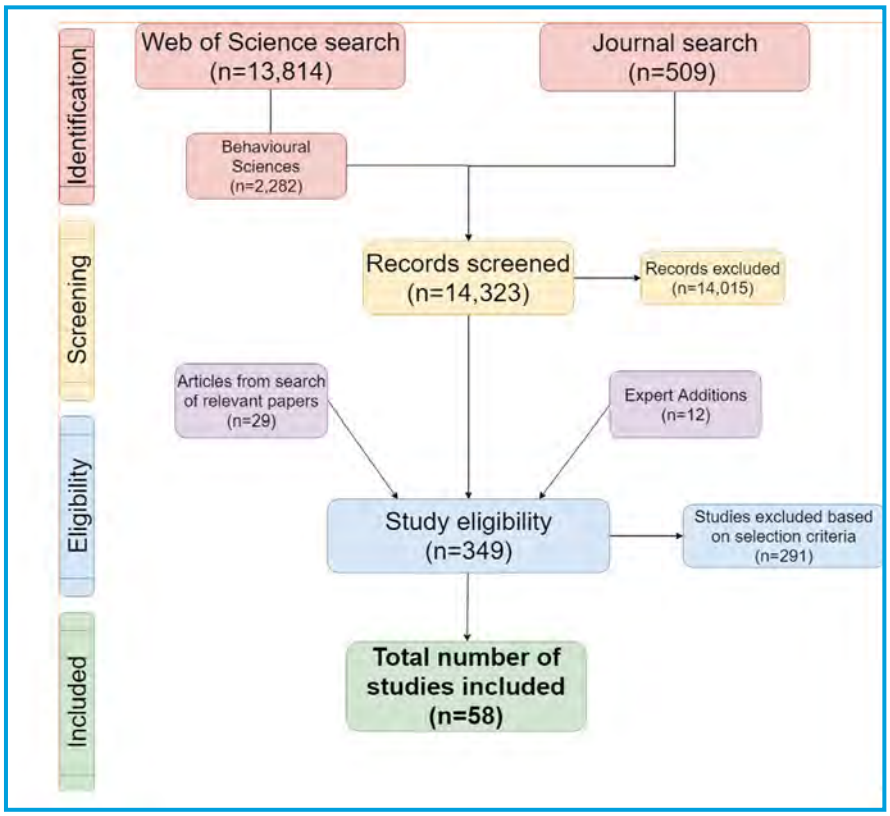
- Robust socialisation of puppies is required to produce well adjusted adult dogs.
- The socialisation period is widely accepted as between 3 and 12 weeks of age.
- Maximum and minimum levels of socialisation have never been investigated.
- Modern socialisation programs based on studies from the 1960's on laboratory dogs.
- Puppies in large scale commercial breeding establishments (CBEs), may not receive appropriate levels of socialisation.

Aims

- To complete a systematic literature review of puppy socialisation.
- Identify knowledge gaps and areas for future study.
- Apply this knowledge to influence management practices of large-scale CBEs.

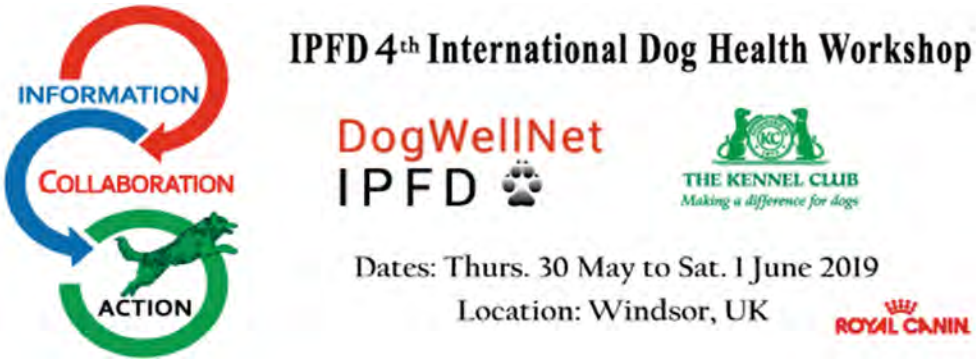
Key Findings





Key Message

- Will inform experimental protocols carried out on CBEs.
- Will achieve one of the actions from the 4th International Dog Health Workshop.
- Will be published in special edition of the journal 'Animals' in conjunction with Purdue University, Indiana.



Assessing the ecological impacts of escaped Rainbow trout *(Oncorhynchus mykiss)*

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Supervisors: Prof. Jaimie Dick, QUB; Dr. Sarah Helyar, QUB and Dr. Julia Sigwart, QUB.

Background

Escapes of trout from fish farms are a frequent occurrence. Rainbow trout are also frequently stocked into streams and lakes for recreational angling. With so many continued introductions, it is important to assess the impact of non-native rainbow trout on the native communities of rivers and lakes.

In 2017~300,000 rainbow trout escaped from a fish farm into the River Strule. The magnitude of this escape prompted investigation into its ecological impacts.

In order to quantify the potential ecological impacts of released and escaped farmed rainbow trout we are simulating an escape in a small stream through the mass introduction of ~1000 farmed rainbow trout.

Aims

Working with AFBI, I am monitoring the impact of the introduction on the following aspects of the stream ecosystem:

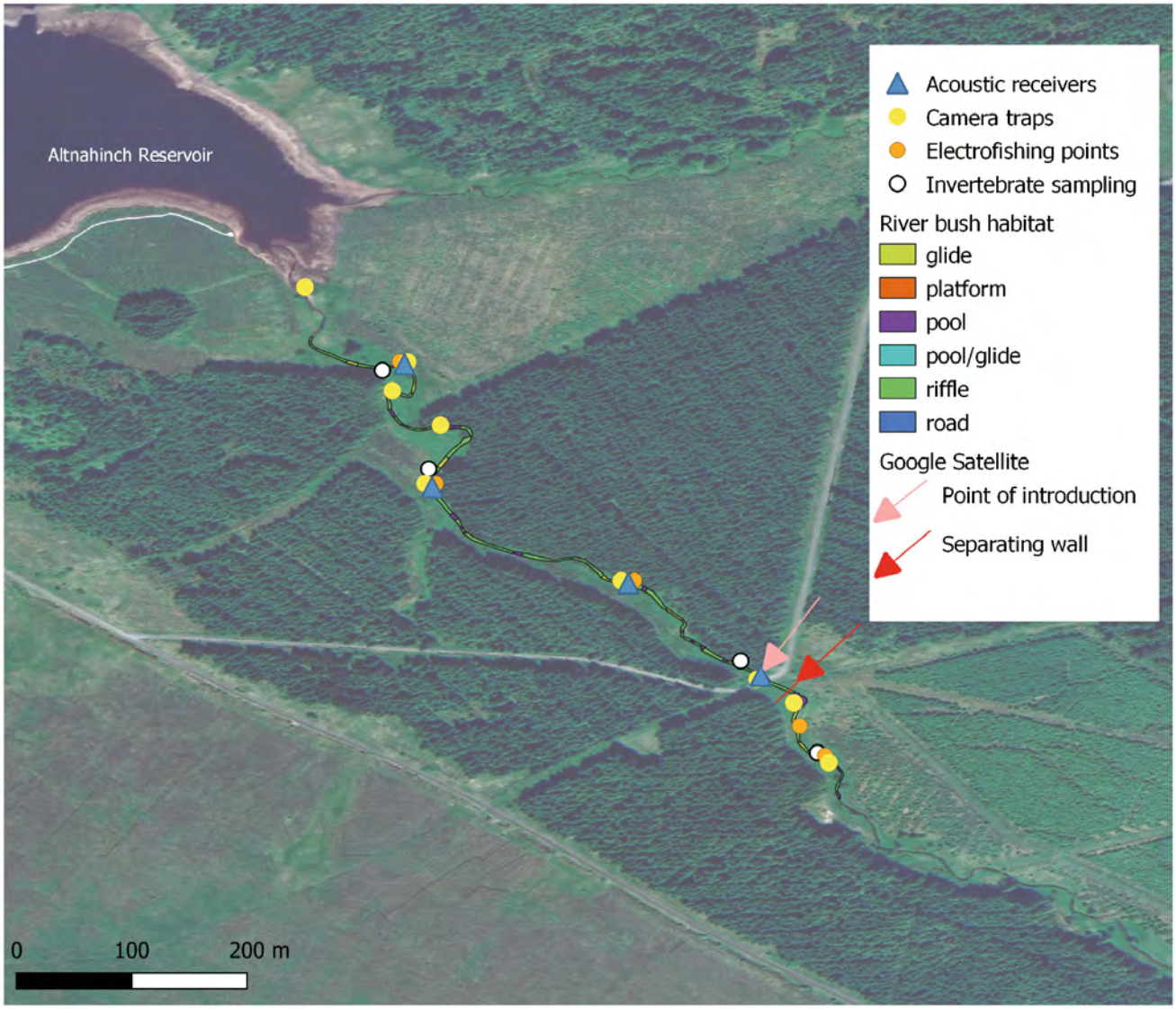
1. Invertebrate species richness and biomass in the stream.
2. Wild brown trout population size, condition and diet.
3. Riparian predator presence.
4. Movement behaviour of the two trout species in-stream.

Research

1000 rainbow trout will be introduced into the stream in July 2019. Sampling before and after the release will allow changes in the community to be detected over time. Two sites upstream of the release, above a separating wall, will provide a controlled environment for comparison with the experimental stream.

The following will be recorded regularly: in-stream invertebrates, the fish population (recording size and diet contents), and photographs of animals visiting the river.

12 wild brown trout and 20 rainbow trout will also be tagged with acoustic tags and their movement over time in the river recorded using acoustic receivers.



Key Message

By measuring multiple aspects of the same ecosystem it will be possible to quantify the impacts of a mass escape of rainbow trout in several dimensions.

A study of the chicken astrovirus pathobiology in the emerging disease 'White Chicks'

Kerry McIlwaine

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Supervisors: Professor Irene Grant, QUB; Dr. Ken Lemon, AFBI & QUB and Dr. Victoria Smyth, AFBI.

Background

White Chicks hatchery disease has recently emerged worldwide. Chicken Astrovirus (CAstV) was discovered as the virus responsible for the disease by AFBI scientists and is thought to be vertically transmitted from the adult hen into the developing embryo, resulting in high numbers of runted (small) embryos, many of which are too weak to hatch or die at the mid or late embryo stage (Fig. 1). The reduction in hatchability of these eggs is ~30%, but can be up to 68% in extreme cases. Chicks which do hatch are very weak and have white plumage instead of the typical yellow down and tend to survive less than 24 hours. These symptoms are seen in the embryos for approximately 2 weeks until the adult birds seroconvert, which is thought to prevent vertical transmission of the CAstV.

Fig. 1: Arrows point to small, weak chicks with white plumage among normal chicks. Box also contains unhatched eggs.

Aims

- Clone the CAstV genome and enhanced green fluorescent protein (EGFP, Fig. 2) gene into a vector & make infectious virus (Fig. 3).
- Infect birds and visually track infection through the birds, identifying which organs are infected in the adult birds and embryos.
- Identify the virus transmission route to the embryo and which tissues are infected.
- Study the maternal antibody type, titres and duration in the adult birds and chicks.

Fig. 2: Aequorea Victoria is a bioluminescent jellyfish that naturally expresses the EGFP.

Initial Key Findings

- LMH cells (continuous chicken cell line) is an effective cell line to use for virus rescue (Fig 4).
- CAstV is successfully cloned into the pUC-19 cloning vector.
- Experiments to rescue recombinant virus in LMH cells are currently underway.

Research Plans:

- Perform virus rescue of CAstV-EGFP in LMH cells and validate virus *in vitro* (Fig 4).
- *In vivo* study to visually track the virus through chickens, showing the organs infected and the transmission route to the embryo.
- Study the antibody type, titre and duration in the adult birds, embryos & chicks.

Key Message

- High financial impact of Canadian companies estimated the loses at US $68,500 per 10,000 hens.
- Infection occurs only once throughout the breeder flock's life.
- Currently there is no vaccine or treatment available so good biosecurity is the main means of prevention.

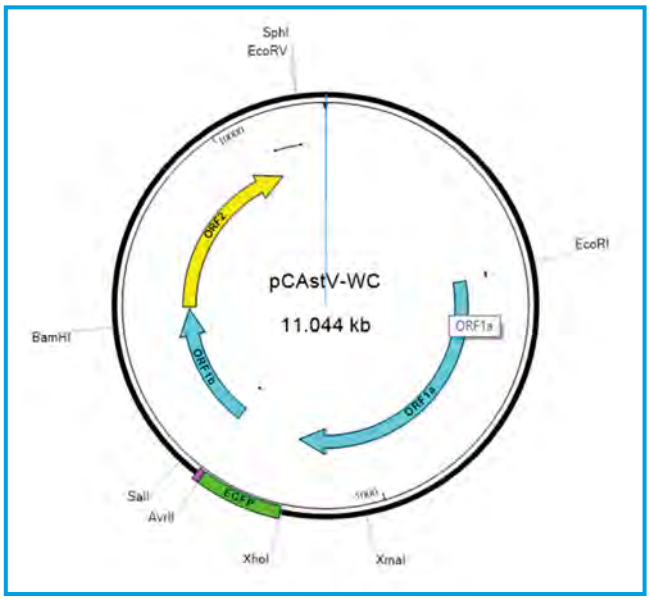

Fig. 3: Map of the CAstV genome containing the EGFP incorporated into the pUC-19 cloning vector.

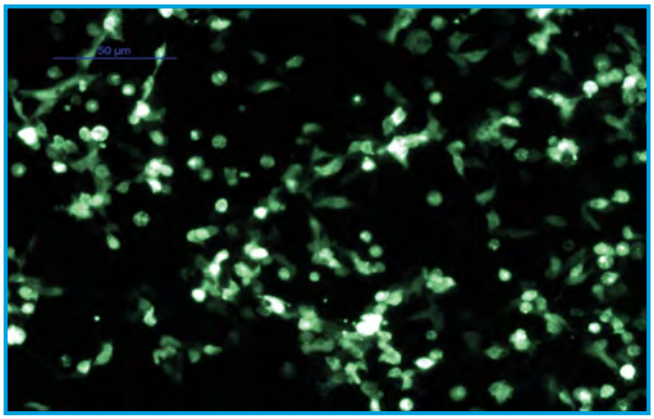

Fig. 4: LMH cells expressing EGFP to determine suitability of cell line for validation studies.

Novel approaches to avoiding spoilage of stored grain and silage: Minimizing fungal and bacterial spoilage; mycotoxin-production and pathogenic bacteria

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Supervisors: Dr. John E. Hallsworth, QUB and Dr. Konstantin I Panov, QUB.

Background

Grain is currently stored at 70% relative humidity, *Aspergillus penicillioides* (Fig. 1) has been shown to be able to grow in these conditions. This project will investigate if this fungi and others can take in water from the air and use this for growth causing spoilage and possibly leading to mycotoxin contamination. Lactic acid bacteria are essential for silage production but do not grow well below 10°C or above 40°C. It has previously been shown that substances known as chaotropes can improve fungal growth at low temperatures (Chin et al., 2010). I am investigating if these chemicals may help lactic acid grow at low temperatures improving silage fermentation in cold conditions and if they inhibit lactic acid bacteria growth at high temperatures which may make them undesirable in tropical countries.

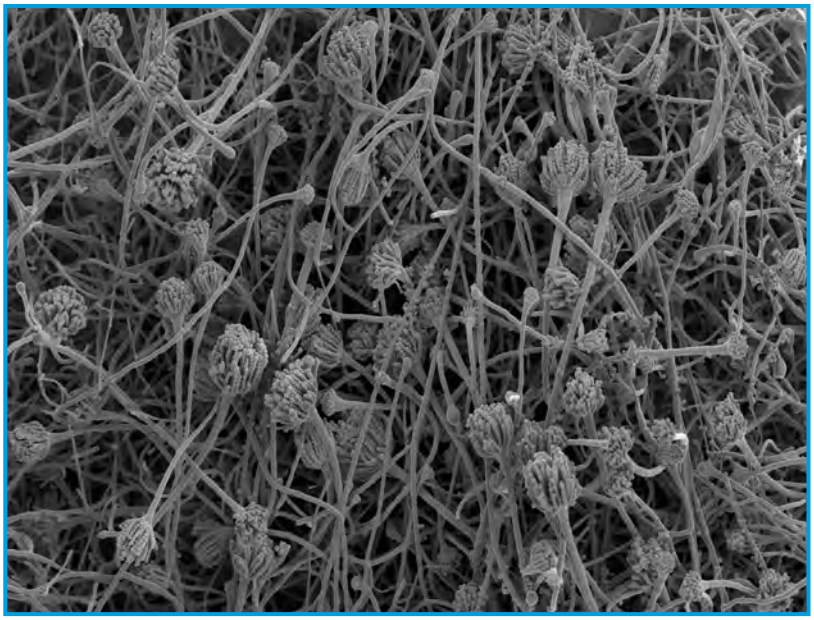

Fig. 1: Aspergillus penicilloides Hallsworth, 2019.

Aims

- To determine if Aspergillus penicillioides can grow using water vapour alone.
- To investigate the effect of chaotropic chemicals on lactic acid bacteria's growth range.

Initial Key Findings

Common silage additives sodium benzoate and potassium sorbate have been shown to be chaotropic.

Isolation of microbes from Northern Irish silage has uncovered a lactic acid bacteria able to grow at 8°C (Fig. 2) and over 100 isolates able to grow at 60°C.

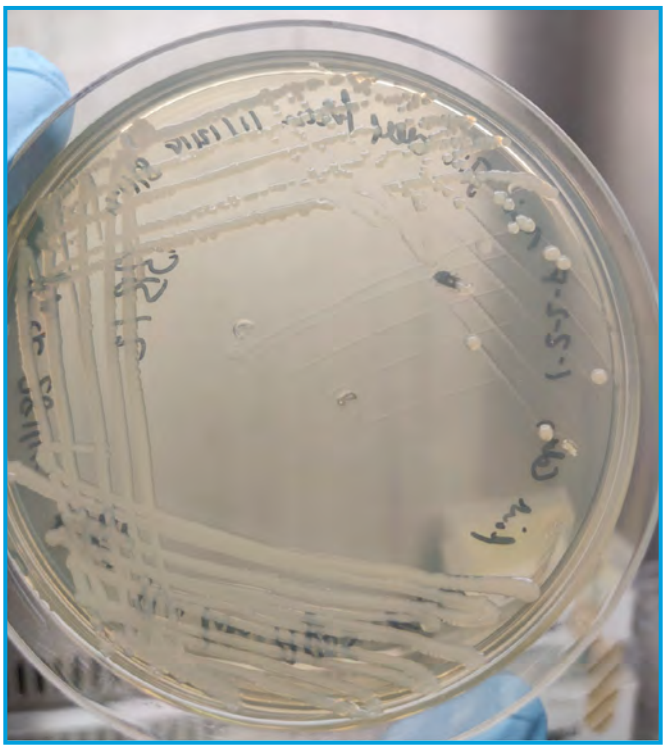

Fig. 2: Lactic acid bacteria isolated from NI silage at 8°C.

Key Message

If fungi are shown to be able to utilise water vapour in the air, storage conditions may need to be adapted to prevent spoilage.

Additives such as sodium benzoate and potassium sorbate may be beneficial during low temperature silage production but detrimental at higher temperatures.

References:

Chin, J.P., Megaw, J., Magill, C.L., Nowotarski, K., Williams, J.P., Bhaganna, P., et al. (2010) Solutes determine the temperature windows for microbial survival and growth. *Proc Natl Acad Sci USA* 107: 7835–7840.

Hallsworth, J.E. (2018) Wooden owl that redefines Earth's biosphere may yet catapult a fungus into space. *Environmental microbiology.*

Student research topics commencing 1 October 2019

1. Stock assessment and management plan for European Eels in the River Foyle catchment

Fearghail Armstrong

School of Biological Sciences, Queen's University Belfast (QUB).

Supervisors: Prof. Jaimie Dick, QUB John McCartney, Loughs Agency.

Commercial fishing of European Eel, *Anguilla anguilla* is worth £3 million and 220 jobs to the Northern Ireland economy per year. Eel monitoring sites throughout Europe have shown a rapid decline in recruitment since the 1980s, reaching as low as 5% compared with 30 years ago. This research aims to assess the stock levels and recruitment of European eels in the Foyle catchment. It also aims to develop a management plan to conserve and enhance eel populations within the catchment.

2. Using parasite egg-derived data to guide on-farm treatment and counter drug resistance

Rebecca Armstrong

School of Biological Sciences, Institute for Global Food Security and Queen's University Belfast (QUB).

Supervisors: Prof. Aaron Maule, QUB and Dr. Nikki Marks, QUB.

Liver fluke occurs on 75% of NI farms, undermining sheep and cattle production systems. Estimated costs are ~£20/head of cattle due to reduced growth and milk yield. With increasing flukicide resistance and no new alternatives, optimising use of available flukicides is essential for sustainable control. The development of new diagnostic platforms to detect/monitor drug resistance/susceptibility using parasite eggs will promote precision treatment regimens to be applied on-farm, reducing the burden of the most significant parasite infecting NI livestock.

3. Identification, characterisation and fate of bacterial pathogens in a range of organic manures applied to arable soils in Northern Ireland

Zoe Black

Ulster University (UU) and Agri-food and Biosciences Institute (AFBI).

Supervisors: Prof. James Dooley, UU; Prof. Nicolae Corcionivoschi, AFBI and Dr. Lisa Black, AFBI.

Organic manures are a significant bi-product of the livestock industry in Northern Ireland. These are valuable resources that deliver nutrients and improve soil health. However, manures can harbour pathogens which could negatively impact on humans, animals and the soil microbiome. Little work has been done on the fate of pathogens, including antibiotic resistant organisms, in organic manures applied to agricultural land. Understanding bacterial pathogen dynamics will make it possible to improve safe slurry use minimising the potential environmental contamination.

4. Managing bio-security risks from drug-resistant parasites and other diseases in deer

Tony Brown

Biological Sciences, Queen's University Belfast (QUB) and
Agri-food and Bioscience Institute (AFBI).

Supervisors: Prof. Eric Morgan, QUB; Dr. Siobhan Porter, AFBI and Dr. Paul Caplat, QUB.

Deer populations are growing across the UK and Ireland, but little is known about their role in the livestock - wildlife disease network. Gaining an understanding of contact patterns, parasite transfer and the dynamics of anthelminthic drug resistance between livestock and wildlife, will be important for future bio-security measures in Northern Ireland. This could lead to improved livestock productivity, whilst adding to a comprehensive knowledge of deer and their role in other economically important diseases such as Bovine Tuberculosis.

5. Microbial remediation of microplastics within peat, soils, and coastal and riverine sediments

Scott A. Coughlin

School of Biological Sciences, Queen's University Belfast (QUB).

Supervisors: Dr. John E. Hallsworth, QUB and Dr. Christopher J. Law, QUB.

Microplastics are widespread in the environment and their presence is detrimental to biodiversity, environmental health and food security. They also pose a threat to the health and productivity of livestock. Various microbes exist that are able degrade plastic. This project will develop novel strategies to optimise plastic degradation using biophysical and ecophysiological interventions.

6. Evaluation of local farm animal veterinary practitioners and dairy farmer's knowledge of and attitudes towards AMR and the challenges they may face in carrying out their role to control the spread of AMR in Northern Ireland

Sarah Farrell

Institute for Global Food Security (IGFS), Queen's University Belfast (QUB).

Supervisors: Prof. Moira Dean, QUB; Prof. Chris Elliott, QUB and Simon Doherty, British Veterinary Association & QUB.

Agricultural use of antimicrobials is a commonly identified contributor to the development of Antimicrobial Resistance (AMR), a global health concern. Veterinary practitioners and livestock farmers have a responsibility to aim for prudent antimicrobial use when treating food producing animals. Farmers' perceptions of AMR will be explored to identify barriers and facilitators to achieving best practice. Evidence based interventions will be created in the form of a behaviour change toolkit to enable reduced antimicrobial use within the Northern Irish Agri-Food Chain.

7. Identification of unique qualities of extensively-reared Northern Ireland red meat

Emma Foster

The School of Agriculture and Food Science, University College Dublin (UCD) and Agri-Food and Biosciences Institute (AFBI).

Supervisors: Dr. Linda Farmer, AFBI; Dr. Colin McRoberts, AFBI and Prof. Frank Monahan, UCD.

Increasing pressures on production and environmental challenges have resulted in Northern Ireland beef and lamb moving away from traditional outdoor, grass-fed practice to more intensive methods. These changes may cause reductions in natural antioxidants, vitamins and fatty acids, which could impact palatability, shelf life and nutritional quality. This project will provide evidence and recommendations to mitigate these effects. The aim of this project is to establish unique selling properties of NI red meat based on its traditional quality attributes.

8. The distribution, abundance and impacts of plastic pollution in Northern Ireland freshwater ecosystems

Rose Griffith

Queen's Marine Laboratory, Queen's University Belfast (QUB).

Supervisors: Dr. Julia Siqwart, QUB and Prof. Jaimie Dick, QUB.

Plastic pollution has seen huge research focus in recent years, however, freshwater environments are relatively under-studied. Plastic waste in water can infiltrate foodwebs which could damage freshwater ecosystems and threaten economically important fisheries. However, little is known about the severity of the issue or what targets are needed to mitigate further pollution. We will conduct surveys of key freshwater sites and exposure experiments on local fauna, to help identify species most at risk from plastic pollution and inform future policies.

9. Assessing the resilience of conservation objectives to climate change predictions for the critically endangered *D. intermedia*

Sophie Loca

School of Biological Sciences, Queen's University Belfast (QUB).

Supervisors: Dr. Patrick Collins (QUB); Dr. Paul Caplat (QUB); Paul Mensink (QUB/UWO) and Chris McGonigle (UU).

The IUCN red listed (Cr) *Dipturus batis* (synonm of *D. intermedia*) is a recognised NI priority taxa, with associated conservation objectives. Our current understanding of flapper skate *(Diphurus batis)* ecology, and the resilience of NI Marine Protected Areas (MPAs) to future climate change scenarios is lacking.

This multidisciplinary project will integrate data from EU INTERRIG - funded projects Seamonitor and MarPAAM into statistical models and bespoke simulations. Specifically I will look at potential MPA sites within NI, to aid planning and design of MPAs for NI resident skate.

10. Understanding the effects of leaving pigs with intact tails on measures of animal health, welfare and productivity

Melanie McAuley

Institute for Global Food Security, Queen's University Belfast (QUB) and Agri-food and Biosciences Institute (AFBI).

Supervisors: Dr. Stephanie Buijs, AFBI and Prof. Niamh O'Connell, QUB.

Intensive agricultural systems are facing increasing pressure from consumers to improve animal welfare and reduce antimicrobial use. Fully slatted pig housing can lead to increased tail biting behaviour, which has quickly become one of the most concerning issues to face the modern pig industry. This study is intended to provide scientifically robust, commercially-relevant, information on the effects of different (farmer-led) interventions to control tail biting on measures of health, welfare and productivity.

11. Biochar and soil health: a combined laboratory and field experimental, ecosystem-based approach, to test impacts on the sustainability of grassland production

Henry McGuiggan

Institute for Global Food Security, Queen's University Belfast (QUB)
and Agri-food Biosciences Institute (AFBI).

Supervisors: Dr. Neil Reid, QUB; Dr. Tancredi Caruso, QUB & Dr. Rodrigo Olave, AFBI.

The aim and objective of this research is to investigate the effectiveness of nutrient biochar (made from poultry litter digestate) application to grasslands and whether it improves soil health and crop yield via altering soil ecosystems through changes in bacteria, fungi and invertebrates. The knowledge gap filled will be the identification of biochar effects beyond those expected from the application of the feedstock from which the biochar is made, compared to traditional Northern Irish applications of slurry and commercial fertiliser.

12. Can parasitic worm infections be exploited to alleviate on-farm antimicrobial resistance?

Darrin McKenzie

School of Biological Sciences, Queen's University Belfast (QUB).

Supervisors: Dr. Louise Atkinson, QUB; Dr. Angela Mousley, QUB and Dr. Bobby Graham, QUB.

Antimicrobial resistance (AMR) represents an alarming and rapidly escalating threat to the Agri-Food sector. The discovery of novel antimicrobials is essential for the sustained management of bacterial diseases of agricultural animals. Nematode parasites of livestock survive in microbe-rich environments and may represent an untapped source of novel antimicrobials. The identification of novel antimicrobial agents from key nematode pathogens, via innovative peptidomics approaches, could alleviate AMR pressures, enhance animal health and productivity, and reduce antibiotic drug residues in food products.

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