Postgraduate Seminar 2017

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

27th September 2017
Greenmount Conference Centre
CAFRE - Antrim

Postgraduate Seminar 2017

09.15	Registration: tea/coffee.
09.30	**Chairman's introduction** Dr. Alistair Carson, Head of DAERA Science, Evidence & Innovation Policy Division.
09.45	**Guest speaker** Professor Nigel Scollan, Director, The Institute for Global Food Security (IGFS), School of Biological Sciences, Queen's University Belfast.
10.15	**Year 3 Student Presentations: 10 min + 2 min Q&A** • **Stephanie Brooks:** Competitiveness and resilience of the Northern Ireland total beef supply chain. • **James Brown:** Genetic variation in native Irish trees under threat from emergent fungal pathogens. • **Jennifer Fegan:** An investigation into the competitiveness of a local beef scheme operating as part of the Northern Ireland food supply chain in an international market.
10.50	**Tea & Coffee and Poster Viewing of Second Year Research Projects**
11.30	**Year 3 Student Presentations: 10 min + 2 min Q&A** • **Donal Griffin:** Trophic impacts of gelatinous zooplankton on commercial fisheries species. • **Kieran Higgins:** Maximising the market and non-market benefits of small, privately owned woodlands through eco-labelling: identification of willingness to pay. • **David Johnston:** The role of higher protein forages and locally grown protein crops within Northern Ireland dairy production systems.

Postgraduate Seminar

- **Christina Mulvenna:** Exploiting remote sensing technologies to improve farm animal management and production.
- **Victoria Murphy:** An evaluation of grouping and housing systems for Northern Ireland beef cattle.
- **Annabel Sharma:** An exploratory analysis of the effectiveness of a collective action based approach in tackling diffuse water pollution from agriculture in Northern Ireland.
- **Josie South:** Assessment and prediction of the potential threats of temperature change and invasive species to the sustainability of Northern Irish sea fisheries.

13.00 **Chairman's Closing remarks** - award of prizes for best 3rd year talk and 2nd year poster.

13.10 **Buffet Lunch**

13.45 **New First Year Year Students**
(commencing October 2017)
- Introduction to DAERA (Conference Centre).

13.45 **Current Second Year Students**
(commencing final year in October 2017).
Progress Meeting with Science Advisory Branch
(Conference Centre).

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

Postgraduate Seminar

Competitiveness and resilience of the Northern Ireland total beef supply chain.

Stephanie Brooks

School of Biological Sciences, Queen's University Belfast.

Supervisors: Prof. Moira Dean, QUB, Prof. Chris Elliott, QUB, Prof. Adam Leaver, University of Manchester and Dr. Helen McAneney, QUB.

This PhD project investigated the barriers to optimal performance (competitiveness and resiliency) in the Northern Ireland (NI) beef industry, using multiple stakeholder perspectives. The *Going for Growth* strategy identified the need to review the supply chain in totality. Interviews with farmers, processors, retailers, government, industry bodies, lobby bodies and research institutions (the 'stakeholders') were carried out and data thematically analysed to reveal 11 collated themes: 1) Farming Barriers; 2) Processing Barriers; 3) Retailing Barriers; 4) Governance Barriers; 5) External Barriers; 6) Marketing and Branding; 7) Opportunities for marketing improvement; 8) Protected Geographical Indicator (PGI) Approach; 9) Relationships, Power and Trust; 10) Collaboration, Integration, Communication and Transparency (CICT); and 11) The Future. A multi-stakeholder workshop was hosted to feedback results and facilitate discussion regarding how to trigger change in the industry.

Focusing on the marketing related themes, results revealed stakeholders agreed on how marketing related barriers and opportunities were viewed. Stakeholders described marketing efforts as fragmented, uncoordinated and ad hoc, with no one body dedicated to marketing and promoting NI beef. It was also acknowledged that the industry has created confusing messages by playing the Irish, British or Northern Irish card depending on the market. Furthermore, the industry has been subjected to reputational problems, as a consequence of being associated with Irish (horsemeat) and British (BSE) beef. There is a need for a long term marketing strategy to tell our story, but due to concerns raised about other countries' messages, this story must be consistent and quantifiable. A dedicated marketing body was regarded as essential by all stakeholders but they highlighted it must be agri-food industry led, rather than government led and be sufficiently resourced, both financially and people resourced. Participants discussed potential unique selling points of NI beef, of which PGI was one. However, there are concerns about the applicability of PGI at this current time.

Postgraduate Seminar

Genetic variation in native Irish trees under threat from emergent fungal pathogens.

James Brown

School of Biological Sciences, Queen's University Belfast.

Supervisors: Prof. Ian Montgomery, QUB and Dr. Jim Provan, Aberystwyth University.

The recent emergence of several fungal pathogens of trees, including those which cause ash dieback and larch disease, has the potential to cause considerable ecological damage to woodlands and hedgerows in Ireland. Due to the nature of these diseases, trees will be lost either directly through mortality or due to the clearing of trees to prevent disease. In either event, these trees will need to be replanted.

Currently, the Forestry Commission has drawn up a map of seed zones for Britain with the theory that trees should only be restocked from seeds which are locally adapted. However a study in ash found that it consisted of a single gene pool and so seed zones were not needed.

The overarching aim of this study is to examine four common tree species - hazel, aspen, blackthorn and hawthorn - with varying pollination and seed dispersal mechanisms, to examine large-scale patterns in diversity to inform future policy on conservation via restocking post-disease.

My results show that extensive pollen and seed-mediated gene flow occurs in populations of hawthorn and hazel, giving rise to high levels of genetic diversity but low levels of genetic differentiation between populations. I found very low levels of variation in aspen with the majority of populations being monoclonal. My results also indicate the presence of very large aspen clones in Northern Ireland. For blackthorn initial results suggest that it is also fairly clonal with hedgerows generally appearing to contain a progression of blackthorn clones.

Year Three

Postgraduate Seminar

An investigation into the competitiveness of a local beef scheme operating as part of the Northern Ireland (NI) food supply chain in an international market.

Jennifer Fegan

Ulster University Business School.

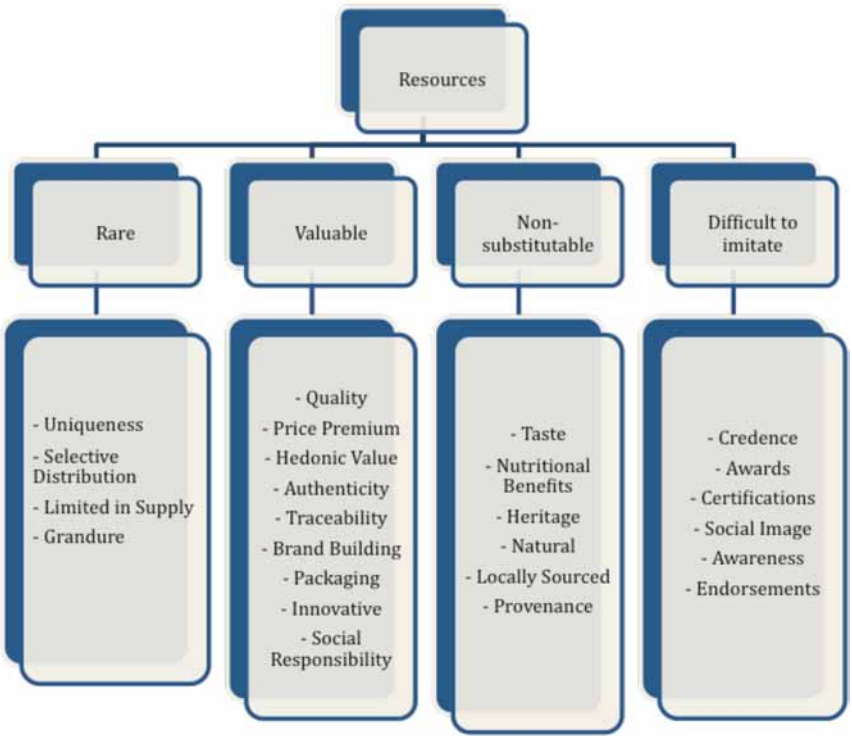
Supervisors: Prof. Gillian Armstrong, UU, Prof. Paul Humphreys, UU and Dr. Lynsey Hollywood, UU.

The aim of this research is to identify the unique attributes and dynamic capabilities of successful agri-food international supply chains and to determine how a Northern Irish premium beef supply chain can achieve a competitive advantage in an international market.

In 2013, the NI Agri-Food Strategy Board's *Going for Growth* plan highlighted the need to grow sales outside Northern Ireland, especially to new emerging global markets. As Brexit approaches, there is an urgent need within the agri-food industry to create strong agri-food supply chains that are capable of supplying premium high quality food produce to export markets, whilst at the same time securing home-based jobs and employment.

This research examines how a local beef producer can develop a premium product through the exploitation of their unique resources in order to drive a competitive advantage and fulfil consumers' needs in an international market.

NI premium beef products that have achieved success in international markets are seen to satisfy the VRIN (valuable, rare, inimitable and non-substitutable) criteria. They have been further analysed in the diagram.



The unique attributes of a NI premium beef product.

Postgraduate Seminar

Trophic impacts of gelatinous zooplankton on commercial fisheries species.

Donal C. Griffin

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Jonathan Houghton, QUB, Dr. Steven Beggs, AFBI, Prof. Mark Emmerson, QUB and Dr. Chris Harrod, University of Antofagasta, Chile.

With evidence suggesting regional increases of jellyfish biomass in discrete areas around the globe, there are concerns how this could impact negatively on commercial fisheries through competition with and predation of fish. However, there is a risk of focusing too heavily on the 'negative' impacts of jellyfish, before we fully understand their longstanding and intrinsic role within marine systems. Less well known are the 'positive' roles that jellyfish can play. Recent studies have highlighted how gelatinous species contribute to ecosystem services. Such services include the provision of microhabitat for developing fishes, and the provision of prey for large oceanic migrants.

Using a multi-disciplinary approach this research aims to address both the negative and positive impacts jellyfish can have on fish communities. Prompted by observed spatial overlaps between jellyfish and juvenile whiting in the Irish Sea, I used phylogenetic comparative analysis to investigate the evolutionary and selective forces resulting in fish using jellyfish as a developmental habitat. Secondly, using stable and compound specific isotope analysis I examined: trophic linkages between jellyfish and different life stages of fish; how those interactions change temporally; and how that in turn could impact fish recruitment. Lastly, I explored whether jellyfish as a community adhere to classic size-spectral theory with a decrease in abundance and biomass with increasing trophic level.

If successful, this approach will provide relevant information on the impact of jellyfish on commercial fisheries, paving the way for their consideration in studies as food web components, rather than as mere threats or stressors upon marine communities.

Year Three

Postgraduate Seminar

Maximising the market and non-market benefits of small, privately owned woodlands through eco-labelling: identification of willingness-to-pay.

Kieran Higgins

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Alberto Longo, QUB, Prof. George Hutchinson, QUB and Dr. Marco Boeri, QUB.

Wooded areas provide us with a variety of market and non-market benefits, including timber, fuel, paper and other wood products, as well as biodiversity, carbon sequestration, and air and water quality improvement. Rising deforestation, contributed to by pressures on landowners to clear forested areas to use as pasture and arable land, may cause the irrevocable loss of these benefits. To combat this, we need to encourage landowners to create or retain wooded areas on their land, as well as manage them sustainably.

A proposed solution is the use of an eco-labelling scheme. Eco-labelling is a process by which distinctive branding is applied to a product to assure a customer that the product is 'environmentally-friendly'. Customers may be willing to pay more for eco-labelled forest products. Eco-labels allow producers of forest products to differentiate themselves in the market or enter new markets entirely.

Through use of an experimental auction technique, I have determined that people are willing to pay an average of 90p more for every £1 spent on an eco-labelled wood product. This positive willingness-to-pay is largely related to the consumers' increased knowledge of the environment, their conservation-orientated environmental beliefs and their higher level of education. Information presented also plays a role in determing willingness-to-pay, with consumers favouring less information about the product's credentials, and preferring to be told generally that the product is 'eco-friendly' and 'sustainable'.

When tested for their opinions on label design, participants were against a label that was offered by a forestry industry body, believing them to lack trustworthiness and expertise, preferring one offered by an NGO or a government department. As for the visual appearance of a label, their preference was for a simple logo over all other types shown, but did not have a preference for contact information.

Postgraduate Seminar

The role of higher protein forages and locally grown protein crops within Northern Ireland dairy production systems.

David Johnston

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Conrad Ferris, AFBI and Dr. Katerina Theodoridou, QUB.

The milk yield potential of the Northern Ireland dairy herd has increased over the past few decades. These higher yielding cows require higher quality diets, with an increased focus on high quality protein. Much of the protein requirements of dairy cows are met through imported protein feeds, including soya and rapeseed meal, and this has led to a number of issues, including: the high cost of protein ingredients; price fluctuations; sourcing non-genetically modified products; and supply volatility. Consequently, there is increased interest in replacing 'imported protein' with 'locally grown protein', with field beans (*Vicia faba*) being a protein crop of particular interest in Northern Ireland. Three studies have been undertaken.

The first study, which involved 60 dairy cows, examined the impact of replacing up to 50% of the 'conventional' protein sources in concentrates with field beans (up to 4.73kg field beans/cow/day). Field bean inclusion had no negative effects on milk yield and composition, total dry matter intake, body condition score and liveweight. Furthermore, methane production was unaffected by a field bean inclusion level of up to 4.73kg/cow/day, while the cost of the concentrates was reduced by approximately £20/t (£269/t and £249/t) with field bean inclusion.

The second study, which involved 70 dairy cows, examined the impact of increasing field bean inclusion up a maximum of 698g/kg concentrate (representing 8.4kg beans/cow/day). Field bean inclusion had no negative effects on milk yield, total dry matter intake, body condition score and liveweight, yet milk fat and protein content were reduced. The overall effect was that cows offered diets containing a high level of field beans had a reduced yield of milk solids. The reason for this is being examined.

A third recently completed study has examined the impact of field bean processing techniques on cow performance (rolled vs milled vs propionic acid treated).

Year Three

Postgraduate Seminar

Exploiting remote sensing technologies to improve farm animal management and production.

Christina Mulvenna

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Michael Scantlebury, QUB, Dr. Nikki Marks, QUB, Prof. Aaron Maule, QUB and Dr. Lewis Halsey, Roehampton University.

The 'Whole Farm Needs Assessment' in 2015 identified a target of farmers is to 'increase resource and production efficiency to enhance viability of their business'. They understood that improving energy use, animal health and welfare were vital to achieve this. Such improvements can be made by increased understanding of livestock behaviour and their associated energetic costs.

The use of remote sensing data loggers has increased tremendously in recent years, and, in terms of livestock production can provide a large amount of information on the behaviour and energy expenditure of the various activities of the animal in question. This can be achieved without the presence (and interference) of an observer.

The aims of this project are to:

1) determine the energy costs of different behaviours of domestic sheep;

2) assess the accuracy of animal-borne loggers to record behaviour of sheep at pasture; and

3) use (1) and (2), above, to assess how behaviour and energy expenditure vary with abiotic factors (e.g. ambient temperature and season).

To achieve the above, sheep were trained to walk at various speeds and inclines within a metabolism chamber. Air flowed through the chamber and oxygen consumption (energy expenditure) was measured. As the sheep were wearing loggers that measured locomotion (acceleration), it was possible to determine the relationship between energy expenditure and movement. The same loggers were attached to sheep at pasture and simultaneous video recordings were taken to validate the use of tri-axial accelerometry in determining discrete behaviours (e.g. resting, walking and grazing). The energy costs of these various behaviours were then calculated. Finally, two important periods of production were examined; the reproductive season and lamb development. Time-energy budgets of sheep and lambs during these periods will be determined, providing invaluable information to producers on energy partitioning in their livestock.

Postgraduate Seminar

An evaluation of grouping and housing systems for Northern Ireland beef cattle.

Victoria Murphy

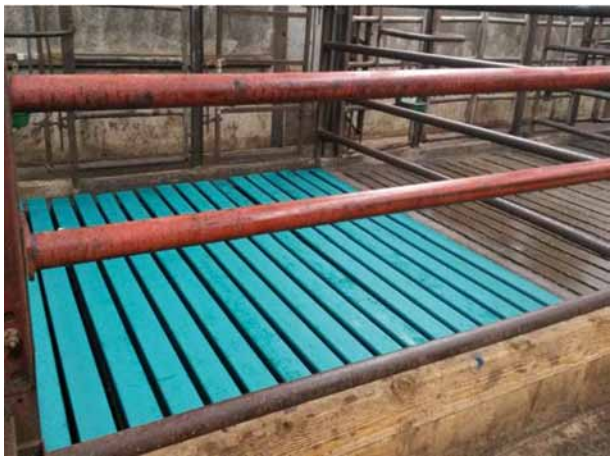
School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Denise Lowe, AFBI, Dr. Francis Lively, AFBI and Dr. Niamh O'Connell, QUB.

Concrete slats are a common floor type used to accommodate beef cattle in Northern Ireland. Scientific literature has demonstrated welfare benefits associated with covering concrete slats with rubber or using a solid floor covered with straw for finishing beef cattle instead of concrete slats. However, there is conflicting evidence that these floor types lead to improved performance. Straw availability is low in Northern Ireland and its use may not be economically viable for beef finishing systems. One alternative may be to accommodate beef cattle on concrete slats covered with rubber, although, concerns have been raised regarding the use of rubber flooring and the incidence of overgrown claws. The aim of this project was to evaluate the effect of using different floor types to accommodate beef cattle on performance, behaviour and hoof health.

Eighty dairy origin young bulls, with a mean initial live weight of 224kg and an average age of 8 months, were involved in the study, which lasted 204 days. The first 101 days were defined as the growing period, with the remainder of the study defined as the finishing period. The floor types studied were: concrete slats throughout the entire study; rubber strips throughout the entire study; concrete slats during the growing period and straw bedding during the finishing period; and concrete slats during the growing period and rubber strips during the finishing period.

The results of this project indicate that floor type has no significant effect on the performance of beef cattle. Bulls accommodated on straw bedding had the highest number of steps/day ($P<0.01$) and the shortest duration of lying bouts ($P<0.001$), followed by rubber strips, and then concrete slats. These results suggest that rubber flooring is a potential compromise between concrete slats and straw bedding. Front toe growth was greatest in bulls accommodated on rubber strips compared to those accommodated on concrete slats ($P<0.001$). However, there was no effect of floor type on locomotion score, suggesting that increased toe growth was not associated with pain or discomfort whilst walking.



Year Three

Postgraduate Seminar

An exploratory analysis of the effectiveness of a collective action based approach in tackling diffuse water pollution from agriculture in Northern Ireland.

Annabel Sharma

School of Law, Queen's University Belfast.

Supervisors: Dr. Brian Jack, QUB and Dr. Diane Burgess, AFBI.

The European Commission, has noted that 'diffuse pollution significantly affects 90% of river basin districts, 50% of surface water bodies and 33% of groundwater bodies across the EU. The agricultural sector is the primary source of diffuse pollution.'[1] In turn, the Commission has identified that this must be addressed to secure the Water Framework objectives (European Commission, 2015).

Diffuse water pollution from agriculture evades centralised regulatory mechanisms as a result of three primary constraints: difficulty in identifying and targeting polluters; poor enforcement; and strong political opposition (OECD, 2017). The OECD note that collective action approaches can be a means to overcome these traditional barriers (OECD, 2017).

This research looks at an amended form of the collective action approach first proposed by Elinor Ostrom, where resource users themselves protect common pool resources. This would empower farmers to address diffuse water pollution. It would also result in more efficient adaptive (location specific) solutions that are practical for farmers to implement, whilst strengthening social capital within farming communities and achieving higher rates of compliance. The research combined an analysis of the current regulatory system and an extensive literature review with empirical research. The empirical research was conducted in two parts; the first focused on interviewing 40 farmers and 10 stakeholders to gather practical knowledge of the issue from differing perspectives, which was then linked with the expert knowledge identified by the literature review. The second part of the empirical research conducted farmer focus groups to test the appropriateness of an Ostrom-based collective action approach in Northern Ireland. This presentation will briefly outline its initial findings.

[1] European Commission, 'The Water Framework Directive and the Floods Directive: Actions towards the 'good status' of EU water and to reduce flood risks' COM (120) 2015 final, 6.

Postgraduate Seminar

Assessment and prediction of the potential threats of temperature change and invasive species to the sustainability of Northern Irish sea fisheries.

Josie South

School of Biological Sciences, Queen's University Belfast.

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

Predation is a strong driver of population dynamics. It is essential to understand how predator-prey interactions may be affected by future oceanic warming.

Lesser-spotted dogfish *(Scyliorhinus canicula)* are extremely abundant in the Irish Sea. Dogfish are generalist predators that prey upon many commercial and non-commercial species. I looked to understand how increasing temperature will affect the proportional consumption of prey *(Echinogammarus marinus)*, and whether differential acclimation of predator and prey elicits a change in feeding behaviour in dogfish.

Attack rate was decreased when temperature was increased. Prey handling time was lowered and maximum feeding rate was increased with increased temperature. Non-acclimated predators had similar maximum feeding rates towards non-acclimated and acclimated prey, whereas acclimated predators had significantly higher maximum feeding rates towards acclimated prey as compared to non-acclimated prey. Results suggests that the predator attack rate is decreased by increasing temperature, but when both predator and prey are acclimated the shorter handling times considerably increase predator impact. The maximum feeding rate was lowest when the prey were acclimated to increased temperature but the predator was not.

At current temperatures, there is high proportional consumption at low prey densities but at predicted future temperatures there is low proportional consumption at low prey densities, however the maximum feeding rate is increased at raised temperatures. This could confer protection to prey at low densities in the future. Predator movement between different thermal regimes may maintain a destabilising predatory response, albeit with a lower maximum feeding rate. This has implications for the way the increasing population of dogfish in the Irish Sea may exploit valuable fisheries stocks in the future.

Year Three

Postgraduate Seminar

Investigating the sustainability of the local honey bee population.

Stephen Bell

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Nikki Marks, QUB, Prof. Aaron Maule, QUB and Prof. Rob Paxton, Martin-Luther Universtat, Halle-Wittenburg.

Honey bees are vitally important to the agri-food sector within Northern Ireland (NI) and also globally due to their ability to pollinate crops and wildflowers. 75% of crops which are integral to the sustenance of human life are reliant on pollinators such as honey bees. The apple crop is a good example, with the NI apple industry, valued at £11 million in 2015 and highlighted as an important contributor to the NI economy and also responsible for job creation.

Globally, colony loss is a major issue for both hobbyist and commercial beekeepers alike. A plethora of factors has been proposed as contributory or potential causes of colony loss, such as parasites, viruses, bacteria, fungi, climate change and habitat loss. Often colonies can be affected by more than one factor at any one time.

This project is examining factors threatening the sustainability of honey bee populations and beekeeping practices within NI. Husbandry techniques employed by beekeepers across the province have been examined through the use of a questionnaire. In addition, honey bees have been collected from sites across all six counties to determine the prevalence of pathogens through the use of molecular screening techniques. The results obtained from this project can be used to drive policy and initiatives within NI.

Postgraduate Seminar

Effects of land use practices on C sequestration and implications for tackling GHG emissions for the agri-food sector in Northern Ireland.

Jonathan Blair

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Rodrigo Olave, AFBI, Dr. Beatrice Smyth, QUB, Dr. Erin Sherry, AFBI and Dr. Neil Reid, QUB.

In agricultural settings ploughing is seen as a necessary management practice to aerate the soil and add nutrients in order to maintain high harvest yields. Ploughing has been described as a system that depletes soil organic carbon stocks and increases erosion rates due to the fracturing and inversion of the topsoil. Much work on carbon sink/source activity of ploughed grassland systems comes from the U.S. where controversy exits as to the loss of soil carbon by ploughing. In Ireland, ploughing a grassland system resulted in the net release of CO_2 due only to the loss of photosynthetic material. Soil respiration was significantly lower on a ploughed site than a non-ploughed site.

The present study was conducted to ascertain the effects of different levels of ploughing on the net carbon exchange of a grassland site in Northern Ireland.

Four treatments were established in a randomised block design: T1 = ploughing, power harrowing, rotavation and seeding; T2 = subsoiling, power harrowing, rotavation and seeding; T3 = overseeding existing grass sward; and T4 = control. Photosynthetic flux and ecosystem respiration were determined using a portable chamber with an attached EGM 4 infra red gas analyser. Measurements of soil properties, bulk density and carbon content, were determined for each of the treatments.

Year Two

Postgraduate Seminar

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

Emma Campbell

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Neil Reid, QUB, Dr. Fraser Menzies, DAERA, Dr. Andrew Byrne, AFBI and Dr. Mike Scantlebury, QUB.

Bovine tuberculosis (bTB), caused by *Mycobacterium bovis*, is an endemic disease in Northern Ireland, with a herd prevalence of 7.1%. There is a national eradication program in place.

The European badger, *Meles meles*, is a wildlife reservoir of *M. bovis*. The Department of Agriculture, Environment and Rural Affairs (DAERA) sample road kill badgers with 17% testing positive. Many badgers share the same strains of *M. bovis* as those present in local cattle herds.

Both species can be infected via the respiratory route. Close nose-to-nose contact between cattle and badgers is thought to be rare. So far, the direct (aerosol) transmission between badgers and cattle has not been proven.

Bacilli have been shown to be excreted in animal urine and faeces, meaning a possibility of indirect disease transmission at fomites (latrines, troughs, setts etc). The exact mechanism of disease transmission between cattle and badgers is poorly understood. The aim of this study was to investigate indirect contact between the species at fomites.

34 farms had wildlife motion detector cameras deployed on up to 6 locations per farm. The footage was watched and analysed to investigate co-use of fomites by badgers and cattle. The results show events on farm that could influence bTB spread.

Postgraduate Seminar

Effects of long-term nutrient fertilisation and land use change on the carbon sequestration potential of agricultural grasslands.

David Flynn

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Dario Fornara, AFBI and Dr. Tancredi Caruso, QUB.

Grasslands account for about 78% of the total farmed area in Northern Ireland and have high economic and societal value. Agricultural grasslands typically receive large amounts of organic and inorganic nutrient fertilisers, which can greatly affect the cycling and storage of key elements such as carbon (C) and nitrogen (N) in grassland soils.

The goal of this project is to advance our scientific understanding of the effects that long-term applications of inorganic (i.e. NPK) and organic (i.e. animal slurries) nutrient fertilisers might have on soil C (and N) accumulation and cycling.

The project focuses in particular on mechanisms and processes, which can ultimately influence the loss or gain of C and N in improved grasslands. I have focused on root mass decomposition, soil microbial composition, root-microbe interactions, and soil CO_2 respiration.

Preliminary findings show strong positive effects of organic fertilisation (i.e. cattle slurry) on root mass decomposition, soil C accumulation and significant negative slurry effects on fungal microbial communities including a reduction in arbuscular mycorrhizal fungi. By focusing on key below ground mechanisms and processes, my project findings will help improve our understanding of how C is stored and cycled in agricultural grassland soils thus contributing to their long-term sustainability.

Year Two

Postgraduate Seminar

AquacuLture SEcuRiTy: An evaluation of the social and economic threats to aquaculture security (ALERT).

Michaela Fox

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Katrina Campbell, QUB, Prof. Moira Dean, QUB, Dr. Heather Moore, AFBI and Dr. Matt Service, AFBI.

The aquaculture industry in Northern Ireland is gaining importance as the marine and freshwater fisheries begin to plateau and reach their maximum potential. Worryingly, this sector is highly dependent on its natural environment and is constrained by current and emerging threats.

In order to address these threats both qualitative and quantitative approaches were adopted to liaise with the industry to understand the successes, challenges and risks in Northern Ireland aquaculture. Subsequently, sound risk ranking, using HACCP, VACCP and TACCP principles and a Carnegie Mellon Approach will be conducted to assign mitigation strategies as close as possible to the node of entry and to determine which risks require action, when and by whom. Moreover, consumer studies will identify the drivers, influences and concerns of seafood consumption and offer insights into promotional activities for market place dominance.

The literature and interviews with aqua-culturists have revealed eight key stages in the aquaculture supply chain: source; hatchery operations; nursery operations; ongrowing techniques/wild; harvesting; processing; market; and consumers. Each actor carries out diverse and variable operations and functions to achieve a complex range of products distributed nationally and internationally. The key threats within the supply chain can be categorised into environmental, economic, technical, welfare, political and consumer factors.

Postgraduate Seminar

Characterisation, maintenance and refinement of the unique qualities of Armagh ciders.

Philip Hamill

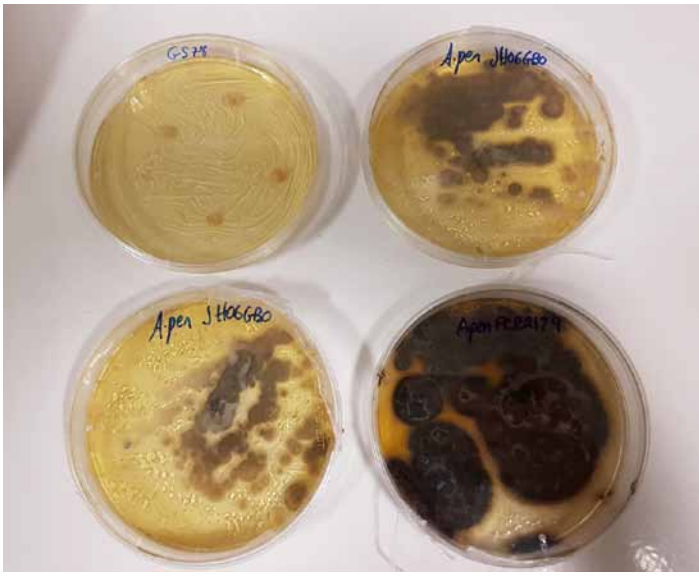
School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. John E. Hallsworth, QUB and Dr. Mark Mooney, QUB.

The aim of this project is to characterise fermentation microbiology via investigations of stressors within the fermentation process (alcohols, sugars, etc). The project is also investigating interactions between the stressors and attempting to elucidate cellular function.

Glycerol is a common polyol present during the fermentation process and can act as a biophysical determinant of microbial activity during fermentation. Work was carried out on model fungi in the presence of high glycerol concentrations, including *Aspergillus penicillioides* and *Xeromyces bisporus* that dominate league tables for ability to grow in high-solute environments and/or at low water-availability. They are commonly associated with environments where glycerol reaches molar concentrations, including fermentation systems, saline and sugar-rich habitats, foods, feeds and other manufactured products and within experimental systems.

Glycerol, the primary polyol produced during cider fermentations, enhanced cellular function at low water activity and reduced the water-activity minimum for differentiation and cell division. Other studies, based on comparisons between these fungi, the cider yeast *Saccharomyces cerevisiae*, and a bacterium indicate that the microbial lag phase, which is often regarded as an indicator of cellular stress, is in reality often inconsistent with the level of stress. These results from this work indicate that supplementation of fermentation media with glycerol (possibly in combination with other stressors) can enable the manipulation of microbial metabolism and/or cell division targeted towards specific industrial applications such as the consistency of product. The work carried out here also produced a novel assay in which to investigate the effect glycerol has on the survivability of microbes in highly stressful conditions and provided novel insights which are pertinent to the wider microbiology field. For instance, the data provided evidence that life can survive and germinate below the previous water activity window of life.



Year Two

Postgraduate Seminar

Identifying factors which affect feed efficiency and rumen development of dairy calves throughout rearing, in relation to biological and physical growth and development with possible consequences on first calving age and production efficiency.

Joshua McDowell

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Steven Morrison, AFBI, Dr. Katerina Theodoridou, QUB and Dr. Tassos Koidis, QUB.

Previous studies exploring the effects of accelerated milk feeding regimen on dairy heifer replacements have reported benefits on average daily gain (ADG) and performance of pre-weaned animals. However, accelerated milk feeding regimen can impact on concentrate intake, potentially delaying rumen development and reducing ADG during the weaning process. Forage inclusion in pre-weaned diets has been avoided by many calf rearing systems due to conflicting scientific reports, however more recent studies have indicated forage inclusion can encourage concentrate intake. The interaction between forage type, animal age when forage is provided and milk feeding levels requires investigation to ensure the correct strategies are promoted to optimise heifer development and future performance. Few calf rearing studies have followed animals from birth through to calving age therefore information is limited on the long term effects of pre-wean nutrition on ADG, nitrogen and energy utilization and methane production.

The main study from which a number of investigations have been built upon was a calf rearing production study which compared concentrate intake, forage intake and water intake of calves reared on an accelerated versus conventional milk replacer (MR) program and exposed to one of four forage treatments in a 2X4 factorial design. Dairy heifers from the calf production study were then used for two in depth energy metabolism studies: 1) at pre-weaning stage; and 2) at approximately eight months of age. A third energy metabolism study will investigate if pre-weaned MR level has permanently changed the maintenance energy requirements of heifers at approximately 16 months of age and will also provide valuable information to help update the nutritional recommendations of growing dairy heifers.

This project will provide relevant updated information for industry and farmers on the nutritional requirements of growing dairy heifer replacements from birth to calving age and highlight the potential impacts of early life management on future productivity and efficiency.

Calves on production study.

Calorimeter Chambers.

Postgraduate Seminar

Investigation into the effects of fatty acids in the diet of swine on immune response and the gut microbiome.

Robyn McKenna

School of Biological Sciences, Queen's University Belfast.

Supervisors: Prof. Louise Cosby, AFBI, Dr. Victoria Smyth, AFBI and Dr. Mark Robinson, QUB.

Previously, in-feed antibiotics were used to enhance performance gains and counteract the adverse effects of weaning. However, an EU-wide ban prohibiting the use of antibiotics as growth promoters came into effect in 2006 prompting the search for safe and innovative alternatives. Studies have indicated that dietary fatty acids are efficient in terms of minimising the adverse outcomes of weaning and enhancing pig performance, having a positive influence on both feed conversion rates and body weight gains. It is thought that these production gains come from an immunomodulatory role of the fatty acids, however, the mechanisms through which these changes are created are not well understood and this research is aimed at filling that knowledge gap. This project will ultimately evaluate the effects of fatty acids on swine immunology, virology and microbiology in order to create a safe, wholesome feed product with advantages to animal health and welfare as well as benefits that will reverberate through the supply chain and help improve the performance and sustainability of the agri-food sector here in Northern Ireland.

Initial research into the in *vivo* aspects of this project, looked at the effects a fatty acid supplemented diet had on sow colostrum quality, assessing IgA, IgG and IgM levels as indicators of nutritional value. The results from this study suggest that the colostrum produced by sows fed a fatty acid supplement was of a higher level of nutritional value in comparison with the control group. It is thought that the pathway for improving the milk quality involves promoting a healthier gut environment through controlling the balance of microflora in the intestines. This in turn allows the animal to maximise feed efficiency, thus improving immune status and body condition. Further work will investigate the mechanisms behind these changes, using metagenomic methods to look at potential alterations in the gut microbiome.

Year Two

Postgraduate Seminar

Linking Northern Ireland milk quality to farming landscape: elemental nutrient and microbial signatures.

Claire McKernan

School of Biological Sciences, Queen's University Belfast.

Supervisors: Prof. Andrew Meharg, QUB, Dr. Caroline Meharg, QUB and Dr. Irene Grant, QUB.

Milk is a primary source of trace elements iodine and selenium. Iodine forms an integral part of the thyroid gland hormones and is therefore essential in the function of the thyroid gland in regulating the body's functions. Selenium is fundamental to human health as it forms a portion of twenty-five selenoproteins within the body, involved in various biochemical functions. Dietary intakes of selenium and iodine are insufficient and the UK is among the top ten countries worldwide having issues with iodine deficiency.

The aim of this project is to determine if milk quality varies on a farm-to-farm basis, to determine if milk quality is directly related to the soils that pasture fed cows are grazed on, analysing geochemical and microbial components.

Milk is a nutritious food product, coupled with the neutral pH and high moisture content which provide a perfect environment for beneficial and pathogenic microorganisms to proliferate. Microbial analysis will be completed using PCR to determine and compare the microbial diversity in milk samples.

Samples of milk, soil, silage and grass have been collected from farms across Northern Ireland. The selenium and iodine levels have been quantified using inductively coupled plasma-mass spectroscopy (ICP-MS). This analysis found that iodine has shown relationships in the terrestrial environment. That is, strong statistically significant relationships between soil and grass iodine ($P<0.0001$), and grass and silage iodine concentrations ($P=0.0009$). However, there appears to be a disconnect regarding milk iodine concentration in relation to the environment as milk iodine did not correlate with soil, silage or grass iodine concentrations ($P>0.05$).

Postgraduate Seminar

Noise pollution as an emerging threat to commercial fisheries: a case study using the Norway Lobster *(Nephrops norvegicus)*.

Lorraine McLean

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Hansjoerg Kunc, QUB, Dr. Jonathan Houghton, QUB, Dr. Adam Mellor, AFBI and Dr. Paul Mensink, QUB.

Anthropogenic noise pollution has increased in both terrestrial and aquatic ecosystems. In marine vertebrates, this stressor can cause behavioural and physiological changes or even severe physical trauma and mortality. By contrast, studies of noise pollution and invertebrates are in their infancy.

As a starting point, I am conducting tank based and *in situ* experiments to test whether the commercially important Norway lobster (*Nephrops norvegicus*) displays any noticeable change in behaviour when exposed to anthropogenic noise. Specifically, I focused on behaviours that relate directly to fitness such as burrow emergence and feeding. The key finding to date is that individuals remained motionless for significantly longer during increased noise conditions, though burrow emergence and time spent transiting did not vary significantly. This prolonged "freezing" may have implications for predator avoidance and burrow emergence will be of particular relevance to the fishing industry as animals can only be caught when fully emerged from the burrow. Ultimately, this research is targeted at policy makers and fisheries management to support the Nephrops fishery, one of Northern Ireland's largest single, local sea fisheries.

Year Two

Postgraduate Seminar

Commercial and ecological impacts relating to the banning of discards.

Paul Mayo

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Jonathan Houghton, QUB, Dr. Steven Beggs, AFBI and Dr. Paul Mensink, QUB.

Fisheries discards supplement, in part, the diet of marine scavengers such as seabirds and demersal elasmobranchs (sharks and rays). Following the removal of discards as a food source (in line with new EU landing obligations), marine scavengers in the Irish Sea may focus their foraging effort more on commercially important crustaceans such as the Norway lobster *(Nephrops norvegicus)*.

To identify focal species for the study I considered the demographic trends for a range of Irish Sea demersal predators/scavengers known to feed on crustacea. The lesser spotted dogfish *(Scyliorhinus canicula)* was selected, given a marked increase in numbers (>300%) since 1991. I explored the spatial relationship between *S. canicula* and *N. norvegicus* between 1994 and 2015 using western Irish Sea survey data collected by AFBI.

The relationship between predator and prey abundance differed at each site, some showing a positive relationship and others a negative relationship. For the second part of the study, I deployed baited remote underwater video systems (BRUVs) at sites throughout the Irish Sea to directly observe the fate of discards at the seabed. Preliminary results indicate that although dogfish were recorded feeding on discards, plaice *(Pleuronectes platessa)* appeared to be the most abundant scavenger of fisheries discards.

Postgraduate Seminar

Development and assessment of potential diagnostic and biocontrol measures against soft rot in vegetables.

Maja Zaczek-Moczydłowska

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Colin Fleming, AFBI, Dr. Gillian Young, AFBI and Dr. Katrina Campbell, QUB.

Soft rot, caused by a range of pectinolytic Enterobacteriaceae, mainly *Pectobacterium* and *Dickeya* spp., is one of the most destructive diseases, in terms of economic losses, due to deficiencies in effective control methods. Soft rot causes severe post-harvest losses on a wide range of vegetables, fruits and ornamental plants.

There is currently no treatment for soft rot, and control is largely based on the use of sanitary growing practices. The increasing number of epidemics in recent years caused by soft rot pathogens in Europe, and the level of worldwide losses, indicated a need for the formulation of commercially available and effective biocontrol measures to counteract soft rot. A number of trials have been conducted using biocontrol agents such as bacteriophages - viruses that can kill bacteria - and different strains of bacteria such as *Pseudomonas, Bacillus* and *Lactobacillus*. However, to date, no proven safe or field ready to use bioproduct that could be used to combat or prevent soft rot in the field has been created.

2016/2017 is the second year of a three-year PhD project which aims to show that soft rot can be controlled, at least partially, though the use of 'green' biocontrol technologies. Genotypic characterization based on conventional PCR and qPCR followed by DNA sequencing has been performed on members of the Enterobacteriacea to differentiate populations of soft rot pathogens in N. Ireland. Bacteriophages isolated from processing water have been identified using transmission electron microscopy and, after Next-Generation Sequencing, will be used to formulate a novel biocontrol against soft rot in potato, carrot and onion. This biocontrol will be developed and assessed through *in vitro* and *in vivo* experiments and compared with other potential bacterial biocontrols that are known to be capable of secreting antibacterial compounds (for example, *Pseudomonas, Bacillus* and *Lactobacillus*).

Year Two

Postgraduate Seminar

Development of a dynamic mathematical model to assess spread and control of bovine tuberculosis (bTB) integrating both domestic and wildlife hosts.

Emma Brown

Mathematical Sciences Research Centre, Queen's University Belfast.

Supervisors: Prof. Adele H. Marshall, QUB, Dr. Andrew Byrne, AFBI and Dr. Hannah Mitchell, QUB.

Bovine tuberculosis is a zoonotic disease, caused by *Mycobacterium bovis*, with the main host being cattle. The disease is endemic in Northern Ireland, with a herd incidence of 7.45% in 2016. For Northern Ireland to be considered Officially Tuberculosis Free (OTF) by the European Union, herd incidence needs to be below 0.1% in a given year. Thus, it is the focus of an ongoing long-term eradication programme run by DAERA.

Mathematical models can be used to investigate the factors associated with disease maintenance and spread over time and across space, illuminating how such factors may change over time. Models can estimate useful epidemiological parameters to understand such disease dynamics. Most importantly, mathematical models can predict future disease levels, estimate the uncertainty around such projections, and simulate disease levels under changing scenarios, such as movement restrictions, that otherwise would be impractical or too costly for field trials.

Initial analysis during this project has focused on the role of cattle movements in the long distance spread of bovine tuberculosis in Northern Ireland. The network of cattle trade was constructed and visualised using Social Network Analysis (SNA) and underwent statistical analysis to assess the structure of network. Many epidemiologic models assume a constant flow of movements across network nodes, however this analysis identified that there is a small group of highly connected herds significantly contributing to network connectivity. This finding could illuminate the differential impact how movement restrictions across nodes may have impacts on an eradication scheme.

Postgraduate Seminar

Early detection of plant disease using remote sensing.

Ciarán Carlin

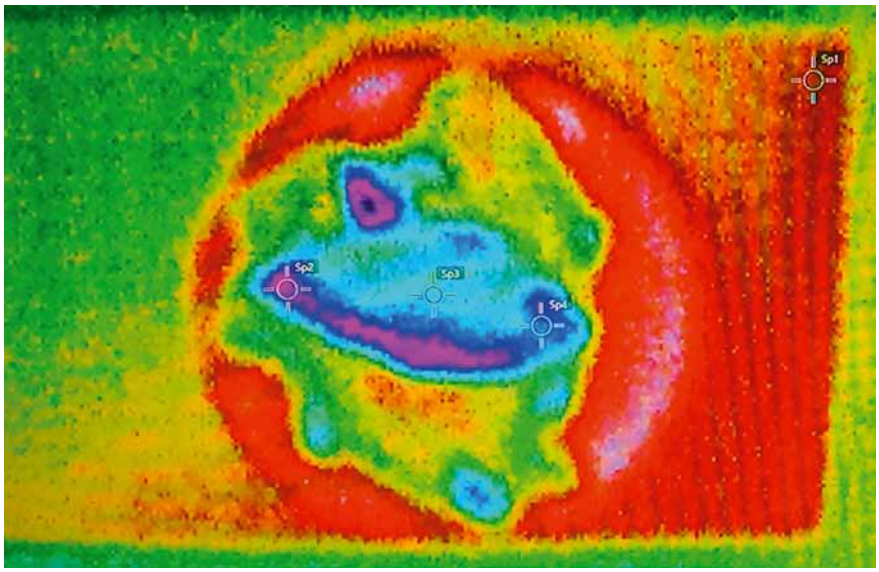
School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Richard O'Hanlon, AFBI, Dr. Katrina Campbell, QUB and Dr. Colin Fleming, AFBI.

When a plant becomes infected with a pathogen it undergoes various chemical changes in response to infection. Preliminary research has shown that when infected with a pathogen, these chemical changes result in alterations to the levels of infrared light reflected from the foliage. I hypothesise that these changes occur before visible symptoms of disease occur, therefore indicating infrared imagery as a potential early detection method for plant diseases. This project aims to reduce the impact of diseases on plant populations by developing infrared imagery as an early detection system, with a view to linking the technology with unmanned aerial vehicles (i.e. drones) and geospatial analysis which would allow more efficient management and eradication of new outbreaks. The potential to scan imported plants for latent asymptomatic infection will also be investigated.

This project aims to study and categorise the changes in reflected infrared light given off by distressed plants that are infected with the plant pathogen *Phytophthora ramorum*, before applying the technique to other pathosystems.

The longer term impact of the research would be the creation of an early detection method for a wider range of invasive pathogens. This project will develop an early detection method for plant diseases leading to more effective management of plant health in a cost effective manner.



Year One

Postgraduate Seminar

Intergenerational Farmers in Northern Ireland: Understanding entrance and exit to farming in order to inform future rural development policies.

Lorraine Holloway-McCarney

School of Social Sciences, Education & Social Work, Queens University, Belfast.

Supervisors: Prof. Sally Shortall, QUB, Prof. Madeleine Leonard, QUB and Dr. Laura Dunne, QUB.

There have been vast changes in farming operations over the last 50 years and, with this, it can also be assumed that every generation of farmers' perceptions will also vary as to what is considered 'good farming practice' through either cultural knowledge or modernization. It has been identified through previous research in the United Kingdom that interviewing farmers through different generations can have major advantages to inform future policies and support mechanisms. Intergenerational observation and considerations could provide a valuable tool for the future of effective farming and succession practices in Northern Ireland. This could not only aid in a preservation of traditions through cultural knowledge and changes but also ascertain new challenges or innovative prospects identified through different generations.

The purpose of this research is to adopt an approach, through semi-structured interviews, that could aid in understanding and be reflecting across two farming generations from those who are entering farming through agricultural college to those that are more established. The premise here is to highlight from a thorough understanding of: succession; inheritance; perceptions; challenges; supporting mechanisms; and innovations, past or present, of both cohorts to farming. This could ultimately inform future rural development policies and programmes to ensure rural Northern Ireland remains competitive with the ever increasing global pressure on small farms.

Postgraduate Seminar

Perception predominates preparedness: how perceived climate change effects affect agriculture practices.

Emma-Louise Kells

School of Biological Sciences, Queens University Belfast.

Supervisors: Prof. George Hutchinson, QUB, Dr. Simone Cerroni, QUB and Dr. Roy Nelson, CAFRE/QUB.

Globally, food security is a significant topic with factors such as population growth, climate change and shifting demands of developing countries placing increasing pressure on food resources. Impacts on the food chain from the top feed down, affecting the initial role of production. With increased demand, increased production is necessary but even more vital is the need for this increased production to be sustainable. Locally, the *Going for Growth* 2020 Vision is of 'Growing a sustainable, profitable and integrated Agri-Food supply chain, focusing on the needs of the market' (Agri-food Strategy Board, 2013). To ensure production is sustainable, external factors such as climate variability and its associated effects must be taken into consideration when planning for the future. This prompts the query, when planning, what exactly do farmers consider and what affects the way they consider or interpret available information?

This study will look at the decision making process and aims to ascertain how perception affects decisions and actions concerning climate change preparedness, or adaptation behaviours, within Northern Irish Agriculture. The findings could aid policy formulation, education and training for further future adaptation and help to safeguard sustainability throughout the agri-food supply chain whilst also meeting environmental targets and other necessary industry measures.

Year One

Postgraduate Seminar

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

Clare Maguire

School of Chemistry and Chemical Engineering, Queens University Belfast.

Supervisors: Dr. Pamela Walsh, QUB, Dr. Gary Sheldrake, QUB and Dr. Jaimie Dick, QUB.

This project is a study of the nutritional value of microalgae grown using an alternative biofertiliser, in this case anaerobic digestate. The algae being grown are known to contain substantial amounts of omega-3 fatty acids, sterols and carotenoids. These compounds have great value, nutritionally and commercially.

The first objective of this project is to analyse the anaerobic digestate. The contents must be identified in order to ensure it contains appropriate nutrients and doesn't have any contaminants. The samples will also be screened for hormones and pesticides commonly found in agricultural waste.

Once the effluent has been properly quantified it will then be directly compared with a purchased f/2 media for use as a fertiliser for the microalgae.

The nutritional value of the algae from each growing method will be compared and mainly focus on fatty acids and pigments, like fucoxanthin. The fatty acids are extracted from the algae using supercritical CO_2 method. These results will then be used to see if the biofertiliser is producing comparable nutritional value in the algae to f/2 media.

The bioremediation of this agricultural waste in a process that can eventually produce products such as animal feed supplements would greatly increase the worth of these biofertilisers, which are underused.

Postgraduate Seminar

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

Ryan McGuire

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Alberto Longo, QUB and Dr. Erin Sherry, AFBI.

DAERA's Tackling Rural Poverty & Social Isolation (TRPSI) Framework (2011-2017) aimed to mitigate rural deprivations. The most significant scheme within this framework has been Maximising Access in Rural Areas (MARA), which used a 'personal touch' approach to encourage people to avail of a range of services. These services included benefits and grants through benefit entitlement checks, improvements in home energy efficiency and home safety, transport and occupational therapy assessments etc., but MARA's impact needs to be measured. This is the overall objective of this research and will do so through natural experiment and statistical econometrics (analysis).

It is my hypothesis that by assessing the impact of current 'rural poverty targeted' policies, policy makers can be better equipped to implement more accurate and effective schemes and support in the future. My research will evaluate the impact of MARA and identify its strengths and weakness and examine the relationship between social isolation and rural poverty. A further objective is to identify which issues MARA addressed and which groups, sectors or areas have benefited the most. This research has the potential to provide an official review of the effect of MARA and can influence future policies with the potential to ameliorate rural deprivations.

Year One

Postgraduate Seminar

Microbial ecology of bee pathogens: averting the threat to the Irish bee.

Conor P. McKinley

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. John E. Hallsworth, QUB and Dr. Tancredi Caruso, QUB.
Collaborator: Dr. Archie Murchie, AFBI.

There are two main bacterial bee pathogens: *Paenibacillus larvae* (American foulbrood); and *Melissococcus plutonis* (European foulbrood). These bacteria are responsible for endangering bee populations world-wide. The current study aims to elucidate the natural ecology of these pathogens in order to better understand how to control them.

Thus far, studies have focused on investigations of microbial ecology in diverse environments and have established proof-of-principle that microbes inhabit places and are dispersed via routes alien to their primary habitat. Further work will be carried out which will include: environmental sampling targeting soils, plant surfaces, nectar and bioaerosols; identification of nutrient and biophysical requirements of bee pathogens; characterization of their competitive ability; identifying the conditions which promote hyper-production of pathogen biomass in natural habitats; and determination of risk factors which lead to disease epidemics in bee populations and protocols to mitigate and prevent epidemics.

Postgraduate Seminar

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

School of Geography & Environmental Sciences, Ulster University.

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

In the 2015 assessment under the EU Water Framework Directive, only 29.2% and 1.5% of river waterbodies in Northern Ireland reached good or high status respectively, with biological water quality identified as a cause of failure in many cases. Anthropogenically driven sediment inputs, particularly fine sediment (defined as organic and mineral particles < 2mm) has been identified as an important stressor in these aquatic environments. Impacts include light reduction through increased turbidity, abrasion and direct damage to fish and invertebrates and habitat loss through sediment deposition on the riverbed. Sources of sediment inputs include wastewater treatment works, forestry and agricultural activities linked to the disturbance of soil (arable rotation, overgrazing and livestock access to rivers).

Agricultural inputs of sediment are anticipated to rise with the intensification of land use required to achieve the targets for increased agricultural production. This problem is further exacerbated by the uncertainty surrounding climate change, as high-intensity rainfall events are projected to increase altering the magnitude and timing of sediment delivery in rivers. At present, there are no agreed methods for monitoring fine sediment in Northern Irish rivers under the Water Framework Directive. Thus, it is difficult to access the effects of fine sediments on stream ecology. Therefore, this project will identify siltation hotspots and mitigation options through a quantitative investigation of fine solids in selected Northern Ireland rivers with regards to catchment sources, transfers and impacts upon stream ecology.

Year One

Postgraduate Seminar

Development of systems to improve the health and performance of dairy beef young stock.

Naomi Rutherford

School of Biological Sciences, Queens' University Belfast.

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

Dairy-origin beef production represents over 50% of prime beef produced in Northern Ireland. Calf mortality and morbidity is a major challenge and cost for producers while antibiotic usage in agriculture is a major concern for consumers.

This project will evaluate the impact of early detection and treatment of morbidity through the use of rumen boluses to continuously monitor reticulo-rumen temperature. Hyperthermia occurs when reticulo-rumen temperature rises above 40.2°C for a prolonged period of time. Hyperthermia incidents have been shown to occur 3-5 days prior to the onset of clinical signs of pneumonia. Thus, the strategic monitoring of these hyperthermia incidents, presents the opportunity to improve calf health and the efficiency of beef production.

Further to this, elevations in temperature have also been linked to subacute ruminal acidosis, agonistic social behaviour and stress. Additional components of this project will include the effect of three different levels of concentrates, behavioural observations and an assessment of stress induced hyperthermia. Thus, reticulo-rumen temperature may also have the potential to act as a novel, non-invasive welfare indicator.

Postgraduate Seminar

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

Joanna Shooter

School of Biological Sciences, Queen's University Belfast.

Supervisors: Dr. Brian Green, QUB, Dr. Michelle McKinley, QUB, Prof. Jayne Woodside, QUB and Dr. Stephen Hunter, Royal Victoria Hospital.

Type 2 diabetes mellitus (T2DM) is a common chronic metabolic disease that leads to abnormally high levels of blood sugar. The global incidence of T2DM is expected to rise at an alarming rate to 592 million people by 2035. Undiagnosed and poorly controlled diabetes can have some serious health implications such as stroke, heart disease and retinopathy. This massively impacts the economy and by 2030 costs relating to healthcare are expected to rise to 490 billion USD.

Whey is a by-product of various yoghurt and cheese making processes. *In vitro* evidence suggests that whey protein isolate could have a positive effect on energy intake and glucose tolerance and via these mechanisms may affect body weight and risk of T2DM.

Epidemiological evidence indicates that consumption of dairy products is associated with decreased prevalence of metabolic related disorders and recent studies have focused on the whey component of milk.

Recent studies have shown that whey can be used to manipulate gut function and, as a result, slow gastric emptying and stimulate the secretion of incretin hormones.

The overall aim of this project is to investigate the effect of whey protein on metabolic health when delivered in isolation or within the dairy matrix.

Whey proteins are highly beneficial for enteroendocrine cells and they are most beneficial to these important gut cells when they are not digested by the stomach. The focus of this PhD project is to maximise the effects of whey proteins by protecting or encapsulating them, and to assess their effectiveness by dietary intervention.

Year One

Postgraduate Seminar

Legacy P in Lough Neagh sediments, understanding the characteristics and estimating timescales of recovery.

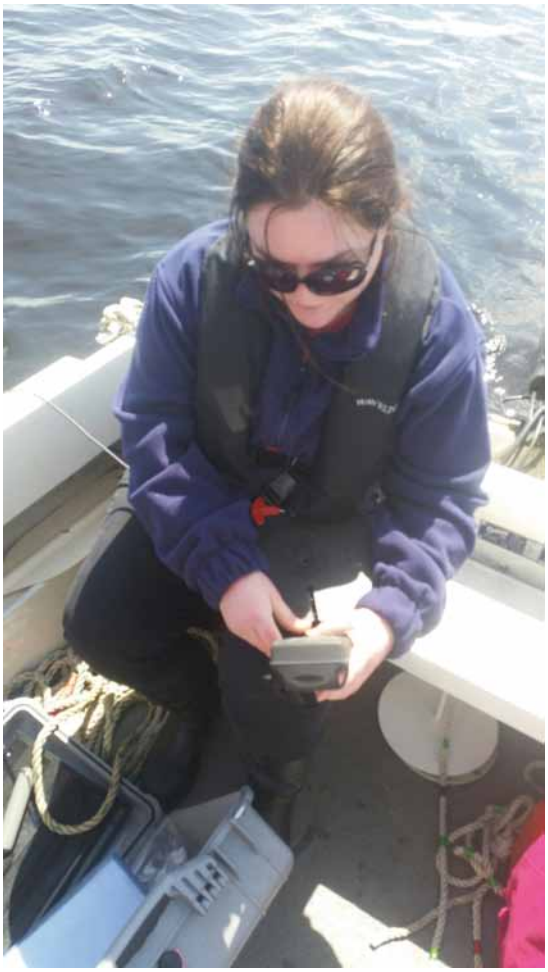
Emma Smyth

School of Geography and Environmental Sciences, Ulster University Coleraine.

Supervisors: Dr. Richard Douglas, UU, Prof. Brian Rippey, UU and Dr. Yvonne McElarney, AFBI.

The cycling of phosphorus (P) within the sediment of freshwater lakes contributes to internally driven eutrophication, a well-documented problem currently causing management issues in many lakes worldwide. Lough Neagh has a lengthy history of P influx from human and agricultural sources; from the late 1960s onward this has been compounded by seasonal release of approximately 200 - 400 tonnes of P from the sediment which may impede improvement in water quality following management efforts.

The aim of this project is to produce an estimate in years for the depletion of excess P stored in the sediment of Lough Neagh. This project will seek to develop robust internal loading models specific to Lough Neagh that can be used to estimate a timescale for the reduction of internally released phosphorus, providing useful information for management plans.



This project will also capture baseline information regarding internal loading, characterise the nutrients held in the sediments of Lough Neagh as well as investigating mechanisms of P release from lake sediment, including the effect of bio-irrigating invertebrates, particularly chironomid (midge) larvae, on the rate of release. The baseline and models developed will allow for a comprehensive water quality management strategy and, potentially, the introduction of new P management guidelines.

Postgraduate Seminar

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

School of Law, Queen's University Belfast.

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

The expansion of global markets and greater volume of trade have increased the risks of plant pathogens and pests entering Northern Ireland. These plant pests and pathogens pose a risk to both Northern Ireland's environment and economy. The agri-food sector employs over 70,000 people and agriculture also contributes over 5% of the Gross Value Added (GVA) for Northern Ireland. There is a further added economic element to the protection of plants, including forests, as the rural environment attracts tourists and this creates opportunities for many small businesses.

This research will examine the changing landscape of plant health protection in Northern Ireland in response to the new EU regulation and Brexit. It aims to establish how DAERA can enhance plant health protection in Northern Ireland and offer recommendations from other jurisdictions based on their experiences.

Year One

Postgraduate Seminar

New student research topics - due to commence 1 October 2017

• 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 Northern Ireland post-Brexit.

Amy Arnott
Supervisors: Dr. Neil Reid, QUB, Prof. Mark Emmerson, QUB and Dr. Aurélie Aubry, AFBI.

Hill farms within Less Favoured Areas (LFAs) incur an average loss of £16,000 per annum, which is compensated for by funding from Agri-Environment Schemes (AESs). Farms in these areas rely on ecosystem service provisioning, in which endangered species may play a significant role. This project will address the following hypothesis: the potential removal of funding from AESs post-Brexit may reduce the natural stability of agricultural ecosystems, affecting biodiversity and hindering Northern Ireland as a competitor within the agricultural market.

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

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

Low profitability in beef production is a real threat to the sustainability of the Northern Ireland (NI) beef industry. Grazed grass is the cheapest form of feed. However, in many cases it's poorly utilised on many farms and with an increasing trend for concentrates supplementation, finding a profitable and practical means of improving performance of beef production from grassland is critical. This project aims to identify strategies for increasing the utilisation of grass within beef production systems in NI.

• Maximising the benefits of cover crops through optimising the management of rotations, organic manures and N fertiliser.

Paul Cottney
Supervisors: Dr. Ethel White, AFBI, Dr. Lisa Black, AFBI and Dr. Paul Williams, QUB.

Cover crops are grown over the winter to improve soil structure and health, whilst locking up residual nutrients. To date, no research on this topic has been conducted in Northern Ireland (NI) and climatic variations mean we are unique compared to other areas of the UK. This project aims to investigate: 1) How can cover crops be managed to increase cereal yields in the following growing season? 2) What are the best types suited to NI and does the use of manure increase the benefits of cover crops?

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

Gavin Grant
Supervisors: Dr. Patrick Collins, QUB, Prof. Mark Emmerson, QUB and Dr. Mathieu Lundy, AFBI.

The ecological status of Strangford Lough, which has been designated a Special Area of Conservation, is a matter of concern. This project will aim to improve understanding of decapod (crab) population dynamics, with particular emphasis on the role of crab fishing and predations by elasmobranchs (the shark family). It is hoped that the project will contribute to improved ecological status and the sustainable development of the crab fishing industry.

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

Samuel Hawe
Supervisors: Dr. Elizabeth Magowan, AFBI and Prof. Nigel Scollan, QUB.

The sustainability of the local pig industry relies on high output and efficiency. This project will aim to maximise growth performance of compromised piglets post-weaning through nutritional intervention, with the development of an optimal feeding regime. This regime will be trialled on the different genotypes used within the industry. Gender effects on performance and meat quality will also be quantified. The genomic technique of transcriptomics will provide an understanding of the underlying mechanisms driving differences in performance and meat quality.

- ## Measuring the impacts of Social Farming on participants and farming families in Northern Ireland.

Suzanne Johnston
Supervisors: Prof. George Hutchinson, QUB, Dr. Judith Stephens, QUB and Professor Michael Donnelly, QUB.

Social farming is a therapy by which vulnerable people are supported to improve their health and well-being by participating in agricultural activities on working farms. To achieve financial security for the Social Farming service, it is necessary to prove its clinical effectiveness using methods approved by the Medical Research Council. This project aims to prove the efficacy of the service and its ability to enhance the quality of life of both participants and the farming families who offer the service.

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

Rebekah McMurray
Supervisors: Dr. Chen Situ, QUB and Dr. Elizabeth Ball, AFBI.

There is a reliance in poultry and pig production on prophylactic antibiotic use to reduce morbidity, mortality and to increase growth performance. This contributes to antimicrobial resistance in pathogens passed to humans by contact with animals and through the food chain. This means that over time the therapeutic use of antibiotics for animals and humans will become less effective. Therefore, this project aims to develop natural botanical animal feed supplements as sustainable alternatives to antibiotics to promote animal health and performance.

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

Tara Meeke
Supervisors: Dr. Aurélie Aubry, AFBI, Prof. Nigel Scollan and Dr. Katerina Theodoridou, QUB.

Northern Ireland's competitive advantage in ruminant livestock production hinges on maximising the contribution of grass, our cheapest feed resource; however, it is often poorly utilised. Grass, either grazed or conserved, can supply 90-95% of the energy requirements of sheep; therefore, any improvement in grass utilisation per hectare, can greatly increase productivity in pasture-based production systems. The project aims to identify and test sheep grazing strategies that can optimise the utilisation of grass on lowland sheep farms in Northern Ireland.

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

Holly Milne
Supervisor: Dr. Geoff Simmons, QUB.

The research will draw on Tesco Clubcard big data being made available to small agri-food businesses in Northern Ireland, concerning their customers, competitors, supply-chain and their broader environment. The provision of big data market information can assist agri-food firms to innovate and inform new product development (NPD). The goal of this project is to provide a more detailed understanding of market trends and consumer purchasing behaviours vital in shaping their NPD and competitiveness. The findings will uncover the process by which small agri-food businesses exposure to big data over time influences NPD processes to create competitive advantage.

• Biostimulant strategies to enhance grass growth.

William K. O'Neill
Supervisor: Dr. John E Hallsworth, QUB.
Collaborator: Prof. Trevor J Gilliland, AFBI.

Northern Ireland agriculture is estimated to be worth £1.8 billion in terms of total gross output. Out of the 25,000 farms in Northern Ireland, 22,250 are dairy, cattle or sheep farms, and their net profit margins are highly influenced by the availability, amount and quality of edible grass. The aim of this project is to develop a biostimulant protocol to enhance soil and grass health, thereby improving annual grass growth rates, especially at low temperatures and during periods of drought.

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

Jessica Pollock
Supervisors: Dr. Debbie McConnell, AFBI and Dr. Mark Mooney, QUB.

Grazed grass is Northern Ireland's cheapest source of livestock feed; it is essential we optimise our competitive advantage to grow grass. This project aims to measure individual dry matter intakes of dairy cows using precision technologies at pasture. By understanding dry matter intake we can develop strategies to improve grass utilisation on dairy farms and increase milk from forage. In addition, this project aims to facilitate precision feeding of dairy cattle and reduce nutrient surpluses on farm.

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

Sophie Redpath
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Bovine tuberculosis inflicts severe financial losses on the cattle industry each year and has a serious impact on farmers in the UK and Ireland. The Eurasian badger (*Meles meles*) has been identified as a principal wildlife reservoir of bovine TB (bTB), spreading the disease through faeces and urine. However, despite years of research, there is still a dearth of understanding of how the disease is transmitted between badgers and cattle. This hinders the ability to control the disease. This PhD study aims to improve understanding of the epidemiology of bTB, examining the behaviour of wild badgers and information obtained from roadkill specimens.

Postgraduate Seminar

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