

ARES School Research Conference 2018: Speaker Abstracts

Session 1 – Animal Behaviour, Performance and Welfare

Chair: Kym Griffin

Putting Animal Welfare Science into Practice

Heleen van de Weerd (Cerebrus Associates Ltd)

Improvements in the welfare of farmed animals can be achieved through policy formulation and legislation, litigation, consumer and NGO pressure and agri-sector business innovation. Another pathway is to incorporate animal welfare in the Corporate Social Responsibility policies of food companies, as their management of welfare is of critical importance to the animals in their supply chains. Scientific evidence is an essential foundation for all these routes to change. This presentation will present two ways of applying animal welfare science (thereby improving welfare) into practice, through engagement with businesses.

The first example presents the approach to welfare by World Animal Protection in China, by working with two pig producing business. While animal welfare is still in its infancy in China, these progressive businesses are collaborating and showing willingness to learn and try new practices on farm. There are some limitations to what can be achieved, typical for the local country and farm situation, but progress is made.

Another example of business engagement is using a novel driver of change. Public business benchmarking can help to incentivise actions, albeit not without business engagement to guide towards realistic goals. The Business Benchmark on Farm Animal Welfare (BBFAW) is a structured, annual evaluation of farm animal welfare-related practices, reporting and performance of food companies. Published information (e.g. corporate websites, annual and corporate responsibility reports, press releases and consumer brochures) is assessed, by using a structured evaluation framework. An overall score reflects how close a company is to best practice. Since 2012, the evaluation framework has been applied annually to a growing number of the world's largest food companies: from 70 companies in 2012 to 150 in 2018.

Over the years the programme has seen a positive trend towards a growing number of companies that have published some commitments to animal welfare, but mostly with limited information on how this is implemented.

Only a small number of companies have comprehensive farm animal welfare policies, accompanied by extensive management systems and monitoring of outcomes. However, the BBFAW influences companies as it provides clear (published) expectations and guidance, and enables companies to benchmark themselves against their industry peers. The increasing scores suggest that companies take note of their results in the annual ranking and this ultimately leads to tangible improvements in the welfare of the food animals in their supply chains. These two examples illustrate different ways to engage with businesses on their routes to higher animal welfare. Most importantly, there is no one approach that fits all.

Heleen van de Weerd (Cerebrus Associates Ltd)

Speaker Biography:

Heleen van der Weerd works as a consultant with corporate, NGO and government clients, applying animal welfare knowledge to achieve improvements to animal's lives. She has an international reputation for her research and knowledge on animal behaviour and welfare. For almost 25 years, she has been active in this field and has generated both fundamental and applied animal welfare research that has been of direct relevance to policy makers, both at a national and EU level. She has conducted animal welfare policy evaluation and has made recommendations directly to EU member states and stakeholders. Her motivation to improve the welfare of companion animals drove her to acquire a degree in companion animal behaviour counselling. Heleen has experience in securing funding for research and consulting and delivering a complicated portfolio of projects in the area of animal welfare.

Equine Hydrotherapy - Effects of reduced belt speeds at various water heights during exercising horses on the Aqua Treadmill

Rebecca Brassington (Bishop Burton College)

The use and availability of equine water treadmills has increased in recent years, despite a number of research trials aiding understanding kinematic adaptation during exercising in water, there is limited information to support and justify exercise regimes. Water height has been investigated to determine alterations to strides parameters and axial movement, particularly at different water heights. Little scientific research has been focussed on effects of belt speed despite anecdotal findings indicating reductions in speed during increased water heights is beneficial for the horse' movement.

The current research utilised accelerometers to understand the impact accelerations of the equine limb during exercise at normal and reduced belt speed, at various water heights. The sample population (n= 8) of sound college horses familiar with the water treadmill (>6 sessions) included a variety of ages (19 years \pm SD 2.10) and heights (158.75cm \pm 10.24). A cross-over design was applied to measure at three different speeds on three separate occasions, each session included warm-up (5 minute), two minutes at each height; Dry, Proximal Interphalangeal Joint (PIP) and base of carpus (CAR) and cool down (3 min). Experienced practitioners determined normal comfortable speed for each horse on a dry belt during pilot study, horses were exercised at their individual normal speed (100%) and reductions by 10% and 20% in the trial. Accelerometers were bandaged four limb segments on the offside, proximal and distal to carpal and tarsal joints, and one to the dorsal thoracic trunk to allow calculations of mean maximum resultant force (acceleration) and relevant attenuation from 10 step cycles.

The results demonstrate predictable adaptations occur in impact accelerations as horse' incur additional loading from increased water heights, thus can inform practitioner regimes based on these similarities across the population. Accelerations appear to increase in the whole body, the horse attempts to reduce that experience however has less ability to attenuate accelerations at increased water heights in the distal segment.

Speaker Biography:

Rebecca Brassington graduated from Lincoln University in 2005 with a BSc (Hons) Equine Science before qualifying as a McTimoney Corley animal therapist. Rebecca has a background of working as an equine therapy practitioner, as well as a shift manager in a Microbiological testing laboratory before joining the lecturing team at Bishop Burton College. During her teaching career Rebecca has developed and course managed the BSc (Hons) Equine Therapy & Rehabilitation programme and is currently programme leader for the Equine degrees, holding Senior Fellowship of the Higher Education Academy. She has published work in equine hydrotherapy measuring skin surface temperature using Intra-Red Thermography, and continues to research water treadmill exercise in collaboration with researchers at Nottingham Trent University, and will provide findings of the latest research.

Non-invasive temperature monitoring

Dr Anne Carter and Emily Hall

Body temperature is a key physiological parameter used to monitor animal health and welfare. Body temperature changes can indicate disease, stress, pain, parturition and exertion. Access to accurate methods of monitoring body temperature is essential for health professionals, veterinary professionals, research scientists, livestock managers and pet owners to name a few. However, the most accurate methods of monitoring body temperature are normally the most invasive, and therefore not appropriate for everyday use. If a method of temperature measurement requires physical restraint or manipulation of the animal, the method may itself influence and alter the animal's temperature.

The ideal temperature monitoring tool is non-invasive, quick, accurate and continuous. Ingestible telemetry devices are currently the only readily available thermometry tool to come close to meeting these criteria. However, they require the animal or person to swallow an electronic device, which is itself invasive, and can only measure temperature for a relatively short period of time whilst they are passing through the gastrointestinal tract. This talk will review Nottingham Trent University's research investigating methods of monitoring body temperature in a range of animal species.

Identifying behavioural stress indicators in actively and passively coping horses: an investigation into behavioural reactivity and physiological responses to challenges

Aurelie Jolivald (PhD student, Year 1)

Leisure and sports horses are regularly exposed to training and management practices that may elicit stress responses in some individuals. To safeguard animal welfare and human safety, equine professionals and owners need reliable tools to evaluate the strength and valence of horses' emotional responses to challenges; behavioural indicators are used most often. Traditionally, evasive behaviour and active resistance against procedures are thought to reflect negative responses, while their absence reflects a more neutral response. However, recent evidence suggests that this may not accurately reflect physiological responses to the same situation. Crucially, compliant behaviour was observed alongside physiological evidence of a stress response. The use of behavioural reactivity to infer negative responses might therefore lead to underestimation of the demands placed on compliant horses, and compromise their welfare. In order to ensure that behavioural indicators of negative states available to horse owners adequately reflect emotional responses, this PhD project aims to further investigate this potential disconnect between behavioural reactivity and physiological responses to challenging situations in some horses. If confirmed, the second aim of this project will be to identify more suitable behavioural indicators of stress in passively coping horses.

Session 2 – Natural Environment

Chair: Nicholas Midgley

Structure and geometry of Icelandic glaciers: implications for sediment transfer

Dr David Graham (Loughborough University)

Continuity of sediment transfer through glacial systems is essential to maintain subglacial bedrock erosion, yet transfer processes at temperate glaciers with overdeepened beds remain poorly understood. Complex multiple transfer processes are indicated by the presence of large moraine systems, supraglacial debris of mixed transport origin, thick basal ice sequences, and englacial thrusts and eskers. At Svínafellsjökull, thrusts comprising decimetre-thick debris-rich bands of stratified ice contribute substantially to the transfer of subglacial material in the terminal zone. Substantial sediment transfer also occurs within basal ice, with characteristics dependent on the hydrological connectedness of the adverse slope. A process model of transfer at glaciers with terminal overdeepenings is proposed, in which the geometry of the overdeepening influences spatial patterns of ice deformation, hydrology, and basal ice formation. It is concluded that the significance of thrusting in maintaining sediment transfer continuity has likely been overlooked by glacier sediment budgets and glacial landscape evolution studies.

Speaker Biography:

Dr David Graham is currently a Senior Lecturer in Physical Geography at Loughborough University. After completing his degree in Geography at the University of Nottingham, David moved to Aberystwyth to undertake doctoral research with Prof Michael Hambrey and Prof Neil Glasser on the role of glacier structure in landform genesis. This work was principally focused on the last period of glaciation in the UK, the Younger Dryas stadial, but also provided opportunities to study contemporary glacial processes in the Svalbard archipelago. During his PhD, David developed a particular interest in the use of innovative methods of data collection and analysis, which led to his appointment as a research associate at Loughborough University developing automated image-analysis methods for characterising the physical properties of river sediments. The commercial potential of this technology was recognised by his appointment to a Gatsby Innovation Fellowship, during which he developed a software package for sediment analysis which is widely used within academia, and by consultants and regulatory agencies. Following his appointment as a lecturer at Loughborough, David has continued his work on glacial sediment transfer, working mainly in Iceland as part of a team including Dr Nicholas Midgley (NTU) and Dr Darrell Swift (Sheffield). He is currently working on the development of low-cost sensor networks for environmental monitoring, and statistical treatments of sediment properties. He is the unmanned aircraft operations coordinator for Loughborough University.

Implications for natural flood management when upscaling to the wider catchment: findings from an interdisciplinary approach

Josh Wells (PhD student, Year 3)

Southwell in Nottinghamshire has experienced two significant flood events since 2007, one due to prolonged rainfall over saturated soils and the other as a result of high magnitude, low frequency rainfall ($102\text{mm}\cdot\text{hr}^{-1}$) during a summer event. The catchment is characterised by clay soils and steep gradients, with a predominant land use of arable cropping. Runoff from the upper catchment is an important factor influencing flood risk for the town.

An experimental natural flood management (NFM) scheme has been designed and installed in the rural catchment, on farmland within the Nottingham Trent University Brackenhurst campus. This is the first part of a mosaic of flood risk management measures being planned for the town. The interventions for the research project include earth bunds in the corners of fields, large woody debris dams and the restoration of a 200m section of stream, which includes additional online storage. Hydrological data are being collected, including discharge and rainfall, both pre and post NFM intervention. Alongside this, stage monitoring within the bunds has allowed for analysis to demonstrate how individual bunds store runoff during events, and how water storage within the bunds impacts on stream discharge. This talk presents the impact of earth bunds on discharge at both the sub catchment and catchment scale.

This project has taken an interdisciplinary approach, as the success of NFM intervention goes beyond impacts on hydrological processes. Demonstration sites are often regarded as a method to increase landowner uptake when upscaling NFM to the wider catchment. Interviews with landowners, before and after a site visit to the experimental site, were used to assess changes in knowledge, attitudes and behaviour, as well as the barriers to upscaling.

Following on from the experiment, funding has now been obtained to expand NFM into the wider catchment, taking a collaborative partnership working approach. The wider catchment project is still within the design phase, yet it is important that monitoring should begin as early as possible in order to maximise the hydrological research benefits.

Oxygen nanobubble - a promising technology to improve water safety, energy generation and food production

Dr Tao Lyu

The research centre of integrated Water, Energy and Food (iWEF) is focusing on developing the integrated technology to solve globally strategic problems of water safety, energy shortage and food security/safety. Oxygen Nanobubble Technology, as one of the key technologies in iWEF, is studied for eutrophic water restoration, wastewater purification, energy generation through microbial fuel cell and crops yield promotion. The studies provide a promising eco-friendly and cost-effective method to improve the water treatment coupled with energy generation and intensify the food production in agriculture.

Long-term changes in the macrobenthos of NW European estuarine ecosystems

Dr Sally Little (J. P. Lewis and K. Mazik)

Estuaries are changing, threatened and in a state of global decline due to multiple climatic and human driven pressures operating over a number of spatial and temporal scales. Estuaries are particularly vulnerable to these pressures as they are both connected to, and part of a dynamic aquatic continuum, linking the terrestrial environment and human-dominated catchments (through streams, rivers and run-off) with the continental shelf and open ocean. The composition and structure of benthic macrofaunal communities are commonly used to assess estuarine ecosystem health and status and to detect changes in environmental conditions and the impact of stressors. They are also important indicators of impacts at higher trophic levels because of their position in the foodweb (i.e. an important link for energy flow between primary production and upper trophic level species).

Here an attempt is made to collate the vast amount of macrobenthos community data available for NW European estuaries over the last 50-100 years to explore both large-scale and long-term macrobenthos response to both local endogenic pressures (emanating from within the system) and regional/global exogenic pressures (emanating from outside the system) and their interacting effects. The data will be used to assess if there are common patterns of long-term macrofaunal community response to drivers of change across NW Europe and whether longer-term global/regional change can be identified/isolated from shorter term 'noise' (i.e. local/human impacts) and attributable to a common underlying driver (e.g. climate/environmental change). This research is important in the face of global change as in order to manage estuarine ecosystems and predict future change, we need to understand how estuaries respond to multiple and confounding pressures, achievable only with a solid understanding of the long-term and natural variability both within and between estuaries.

Developing a Sustainability Assessment Toolkit for Abaca Plantation Agriculture

Dinish Nadaraja (PhD student, Year 1)

Abaca is an agriculturally and commercially important plant, grown primarily for the extraction of a hard fibre (Manila hemp) . This fibre has widespread usage particularly in the manufacturing of speciality papers such as filter paper and currency notes. Companies relying on agro-industrial products such as Manila hemp must ensure that their operations are carried out in a sustainable manner as compliance with sustainability standards is a pre-requisite for product certification, which is increasingly becoming vital for market competitiveness. As such, the aim of this PhD project is to develop a sustainability assessment protocol for Abaca plantation agriculture. This research will apply a systems approach, drawing on sustainability science and employ bottom up, participatory and multi stakeholder processes in the development of the protocol. Such a methodology is expected to generate a sustainability assessment protocol which is practical, user-friendly and has greater legitimacy among the stakeholders concerned.

Session 3 - Sustainable Agriculture and Food Security

Chair: Dawn Scholey

Increasing crop yields and abiotic stress tolerance through biostimulants and micronutrients

Doug Chaplin and Wilson Boardman, MicroMix Plant Health, UK

Global warming and reduced rainfall mean that by 2023, UK farmers will face a water shortfall of 115bn litres pa, 47% of their current use (Committee on Climate Change; 2013). This in turn will lead to high prices, lower yields and a reliance on imports. Building upon InnovateUK project (No. 710633), we developed a combined biostimulant-micronutrient solution that reduces heat stress and the amount of water needed to grow by suppressing the heat stress related genes to heat-induced abiotic stress in pepper and other crops and stimulating further growth and increasing crop yields.

A biostimulant is any substance or microorganism applied to plants with the aim to enhance nutrition efficiency, abiotic stress tolerance and/or crop quality traits, regardless of its nutrients content. By extension, plant biostimulants also designate commercial products containing mixtures of such microelements and/or microorganisms. Working with the School of Animal, Rural and Environmental Sciences at Nottingham Trent University (NTU), we obtained a joint project on the "Increasing drought resistance in crops by 25% - controlling epigenetic expression to abiotic stress through biostimulants and micronutrients". We will map the epigenetic pathways of heat-related abiotic stress in crops and develop the first biostimulant-micronutrient formula to increase drought resistance by 25%. Our main objective is to increase understanding of epigenetics, we intend to extend this abiotic stress response mapping to five indicator crops and develop a novel bio-solution that genetically suppresses a plant's negative responses to reduced soil moisture (drought conditions) and provides the necessary micronutrients to stimulate continued healthy and productive growth under conditions when the plant would normally fail.

Speaker Biography:

Wilson has over 20 years of experience at company director level. He is responsible for business development, co-ordinating R&D and bringing new products to market. He has strong links with many University staff, bringing fundamental research to his market-driven business.

Of particular relevance is his experience in previous roles in registering products as pesticides or growth promoters as necessary. He is currently a member of the HSE steering committee to facilitate continued export of products excluded from use in the EU.

Household Resilience against Food Insecurity in Conflict-Affected Libya

Rashd Swesi (PhD student, Year 3)

Conflict is one of the widely known causes of global food insecurity. It is therefore important to know how to overcome this problem. Increasingly, governments and development institutions around the world are using “resilience-building” as a strategy to improve food security in developing countries. Nevertheless, little is known what the concept of “resilience against food insecurity” implies and what factors affect such resilience in the context of conflict-affected countries like Libya. Therefore, the overall aim of this study is to fill up this knowledge gap. A mixed method (qualitative and quantitative) has been used in this research. The qualitative phase involved in-depth interviews with 44 households and 11 food officials in Libya and thematic analyses of the data. The results of the qualitative phase have inputted into the successive quantitative phase, for which survey data (numerical) have been collected from 320 households in Libya. These are still under analysis. In this presentation, I intend to report some emerging findings from this analysis, specifically, the nature and extent of resilience exhibited by the Libyan households. I also intend to discuss my plans for the successive analyses.

The role of silica in improving skeletal integrity in poultry

Sophie Prentice (PhD student, Year 3)

(with Emily Burton, Carole Perry, Dawn Scholey and Michael Bedford of ABVista)

Due to intensive and selective breeding, poultry are predisposed to a variety of skeletal weaknesses, particularly those affecting the legs. These have proven to be extremely costly to the industry, both in terms of welfare and economically. Previous work has shown that Silica (Si) plays an important role in bone formation, growth and mineralisation (potentially via a role in collagen formation), and deficiencies can exacerbate skeletal issues and leg weakness, although problems with bioavailability mean its exact mechanisms of absorption and utilisation remain unclear.

Chemists at NTU have developed a new Si supplement that has higher bioavailability than other commercially available supplements, and has shown improved absorption. Work done aimed to use this increased bioavailability to examine the effects of this supplement on bone integrity, and to help elucidate the sites and mechanisms by which Si is absorbed and utilised, its mode of action and any other interactions that it may be involved in within the bird, and any secondary benefits, other than improved skeletal integrity, to the bird.

Feeding trials were run to assess various concentrations and delivery methods of the Si supplement and, at the end of each trial, various samples were collected for analysis. All trials showed a significant increase in blood Si levels ($p < 0.001$) in birds fed the NTU supplement indicating it was successfully absorbed, and increases in bone strength and morphological parameters. There were no deleterious effects on performance parameters in birds fed the NTU Si supplement, with some trials showing an improvement in BWG and FCR. Whilst no differences were seen in tendon parameters, some significant differences were seen in both histological parameters and in blood biomarkers for bone turnover. This suggests that the NTU Si is having an impact on skeletal integrity via a number of different mechanisms, although further study is needed to fully elucidate these.

Prebiotics, gut microbiota and the environment.....the trinity of gut health in broilers?

Saba Amir (PhD student, Year 1)

The central idea of my PhD is that more animal-derived protein needs to be produced to meet the food demands of the growing human population while reducing or eliminating its impact on society and the environment i.e it needs to be produced in a sustainable manner. One aspect of sustainability is eliminating the use of antibiotics in animal feed due to the emergence of multidrug resistant bacteria that have endangered the use of antibiotics to treat infectious diseases in both humans and animals. Since the removal of antibiotics from poultry diets, due to regulation (Europe) or reasons of consumer preference (US and Canada), there has been tremendous pressure on the poultry industry to look for viable alternatives. Several natural alternatives to antibiotics have been investigated including pre and pro biotics, enzymes, acidifiers, herbs and essential oils.

Xylo- oligosaccharide (XOS) as prebiotic candidates are still in an early stage of development. There are limited but contradictory results available in literature on the effects of XOS on performance of broilers. But many studies agree regarding the positive influence of XOS on gut health in chickens by means of either stimulating the beneficial microbiota or ameliorating the effects of pathogens or inhibiting their colonization. This project will investigate the effect of a XOS alone and in combination with enzyme on immune markers, gut hormones and gut integrity and understand how XOS influence development of gastrointestinal microbiome and production of short chain fatty acids. Furthermore, the effect of XOS on the aforementioned will be investigated under research and commercial conditions. The findings from this study will broaden our understanding of how XOS influence the gut microbiota which in turn contribute to overall health and productivity of broiler chickens and support development of new XOS based prebiotics as an alternative to infeed antibiotics.

Characterisation of a novel oligosaccharide as a potential pre-biotic

Alex Desbruslais (PhD student, Year 1)

Chicken is now the globally most frequently eaten meat and remains one of the few viable options for feeding the ever growing human population. This has placed pressure on the poultry industry to produce more meat, in a shorter period of time and for less money. The poultry industry has responded to this pressure and commercial broilers chickens are now reaching slaughter weight in 35-42 days instead of the 80+ days required in the 1950's. However, the increase in bird growth and corresponding increased feed conversion ratios puts added pressure on the gastrointestinal tract (GIT) and immune system of the bird and as a direct result there has been an increase in the research into the understanding of how best to establish and maintain optimal gut health. Poor gut health has been linked to poor growth, performance and an increase in enteric disease (Yegani, 2008). Optimal gut health in broilers centres around the establishment and maintenance of the microflora within the gut. There have been a number of methods investigated to improve the gut health of broilers, including feeding pre and pro-biotics.

This project will look at supplementing broilers with three novel Xylooligosaccharides (XOS) as potential pre-biotic supplements, derived from the waste products of industry. The project will investigate their efficacy in modulating the microbiome and stimulating the immune system of commercial broiler chickens. The main aims of the project are to characterise the efficacy of the novel Xylooligosaccharides in improving the gut health of broilers, to characterise the mode of action of XOS supplements and to assess the effect of the XOS products on the immune function of the bird.

Development of novel approaches to assess and improve skeletal development in laying hens

Alex Kemp (PhD student, Year 1)

Skeletal development is a major factor when considering poultry nutrition as many skeletal issues can arise that vary with the function of the bird. In broiler chickens, skeletal problems occur in leg joints growth due to the support required for the disproportionately high body mass. Whereas in laying hens, osteoporosis and keel bone damage are the most common skeletal problems. Poultry is the fastest growing animal production sector globally; the past decade has seen an annual growth rate of over 3%. Up to 85% of free-range layers are affected by skeletal deformities. It is estimated that 2 – 10% of hens are lost in UK production annually. In the UK this results in substantial economic loss and poorer environmental sustainability of egg production, together with major welfare issues for the birds. Increased interest in animal welfare and sustainable food production has increased the focus on identifying solutions to these issues. This study aims to address the issues surrounding skeletal development in laying flocks. Bone morphology data from this study will facilitate the creation of a database aiming to identify 'normal' bone development in layers. In a recent NTU study using broilers, a database was reported to be a useful tool for identifying issues within a flock. The layer database will be extended to cover the transitional period between the rearing stage and laying stage. By extending the database it is hoped that any signs of poor skeletal developments or problems can be identified and solved so that the welfare of future flocks will be improved.

Session 4 - Ecology and Conservation

Chair: Richard Yarnell

Untangling the complexity of Intra-guild Predation; a study of the European badger (*Meles meles*) and the European hedgehog (*Erinaceus europaeus*)

Katie Lee (PhD student, Year 1)

Intra-guild predation is a widespread interaction, exhibited by badgers and hedgehogs. Despite this, both species have been observed coexisting, confounding our understanding of their relationship further. Preliminary results from a substantive study, indicate clear separation between the distributions of these species and a negative correlation between badger and hedgehog density. Data collected as part of the wider study, aims to identify the mechanism driving this negative pressure albeit; food availability, habitat or predation itself.

Using camera trapping to study population densities of the European hedgehog across urban and rural British landscapes

Jessica Schaus-Calderon (PhD student, Year 1)

Reliable population size and abundance are crucial for effective wildlife management. However, the biggest challenge for ecologists is to find standardised methods that can be implemented across different landscapes for the long-term monitoring of species. This study aims to test the suitability of the Random Encounter Model (REM) to estimate hedgehog (*Erinaceus europaeus*) densities, by comparing the results with densities derived from capture mark re-capture estimates across urban (n = 5) and rural (n = 4) areas. Survey effort included 44655 camera trap hours, and repeated spotlight transects resulting in 1360km of walked transects, yielding in 1010 independent videos of hedgehogs and 131 hedgehog captures respectively. Density estimates from both methods produced comparable results, however, start-up costs (equipment) and human resources were significantly higher when carrying out the camera trapping surveys, especially in urban areas. The implications of these findings are discussed in relation to logistical constraints associated with estimating hedgehog population size and monitoring.

Using spatially-explicit capture-recapture models to estimate large carnivore density in Kasungu National Park, Malawi

Robert Davis (PhD student, part-time)

This study aimed to provide the first robust density estimates for miombo woodlands, at a site with increased anthropogenic disturbance, using spatially-explicit capture-recapture techniques. The study was conducted in Kasungu National Park (KNP), Malawi. KNP is dominated by miombo woodland and subject to high levels of human encroachment and poaching that have severely depleted wildlife numbers. Leopard (*Panthera pardus*) density in KNP was estimated at 2.52 (\pm SE 0.56) adults per 100km² and spotted hyaena (*Crocuta crocuta*) density at 2.5 (\pm SE 0.57) per 100km² from 2614 camera trap nights between June-October 2017. Lion (*Panthera leo*) and wild dog (*Lycaon pictus*) were both recorded on the survey but only single dispersing males. Further research is needed to understand the basic ecological requirements and population dynamics of large carnivores in this habitat and, in a wider context, their ability to adapt to large scale anthropogenic change.

The Macroecology of Biodiversity Evolution and Extinctions: Where, when and why?

Dr Daniel Pinchiera-Donosa (School of Science and Technology, NTU)

The evolution of biodiversity is the result of species proliferations and extinctions. Lineages proliferate when available niche space offers the 'ecological opportunity' for new species to emerge. Adaptive radiation theory predicts that mass extinctions vacate large volumes of niche space, thus creating opportunities for new lineages to proliferate through the occupation of those niches. In the modern world, extinctions have peaked to exceptional levels since life originated on Earth. Can evolutionary theory predict that we are, therefore, about to witness the emergence of new forms of life? A critical problem is that the evolutionary formation of species takes long periods of time, while human-induced extinctions take only few decades. Therefore, we are likely to witness a disparate loss of life relative to formations of new life. The Global Amphibian Biodiversity Project (GABiP), a global-scale scientific initiative led by Daniel Pincheira-Donoso, investigates the patterns, processes and the future of biodiversity, through the unique case of amphibians, considered the "modern dinosaurs" given their unparalleled rates of extinction. This talk is a synthesis of the work being done by GABiP.

The Evolution of Superpowers

Dr Louise Gentle

A crack team of 20 academics and illustrators were tasked with completing a fifteen-chapter book in just 36 hours at the Manchester Science Festival last October. 'The Secret Science of Superheroes' explores the science that must exist behind superheroes and superpowers, assuming that our world's scientific laws apply to the comic book universes. 'The Evolution of Superpowers' covers the circumstances that might cause the evolution of superpowers, such as natural selection and genetics of small populations. It also explores whether evolution has already created any 'superpowers' in the animal kingdom – from senses such as vision and magnetic senses, to shapeshifting and chemical weapons – and relating them to superheroes and villains.

The autecology of a flagship species: the influence of food, temperature & sex on the spatiotemporal distribution of the Noble Chafer beetle (*Gnorimus nobilis*)

Dr Adam Bates

Traditional orchards typically have a high diversity of tree species and varieties, a diverse age structure of trees, and little tillage and agrochemical input. As such, they provide habitat for a wide diversity of species of woodlands and grasslands that have declined due to changing management practices and agricultural intensification. In recognition of this importance, coupled with their widespread decline, traditional orchards were made Section 41 habitats of principle importance. The Noble Chafer beetle (*Gnorimus nobilis*) is a Section 41 species that is almost exclusively associated with traditional orchards in the UK, however, relatively little is known about its ecology. This presentation reports the findings of two years of research into the spatiotemporal distribution and thermoregulation of the Noble Chafer in a traditional orchard and nearby woodland in Worcestershire. The findings are used to make suggestions for the further study and conservation of this charismatic and elusive species.

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The significance of blanket bog in the context of climate change

Guaduneth Chico León

Peatlands cover less than 3% of the global land surface, yet these areas represent the largest store of terrestrial carbon and are assumed to serve as carbon sinks. Rare peatland types such as blanket bog are also recognised for internationally important flora and fauna, but these areas are widely reported to be in degraded condition. Anthropogenic activities are increasingly being linked with reduced peatland biodiversity and with the instigation of peat erosion. Degraded blanket bogs may now be acting as carbon sources, but there is often not enough information with which to assess the importance and status of individual bogs. This study provides an approach to quantify the amount of peat stored within a blanket bog and to estimate the rate of peatland loss. The extent and depth of peat at Zalama blanket bog in the Basque Country (N Spain) was mapped using manual survey methods and the rate of surface change of exposed peat was determined using terrestrial laser scanning (TLS). Peat cores were analysed to determine the organic carbon contained. A total extent of 6.5 ha of blanket bog was identified with peat depth ranging up to 2.82 m. The peatland is calculated to contain 74,341 m³ of peat, indicating that 6,383.6 tonnes of carbon are contained here. The annual rate of surface change was negative (-1.5 cm yr⁻¹) indicating that erosion is the dominant surface process occurring on exposed peat here. This rate of change is equivalent to a loss of 1.26 kg C m⁻² yr⁻¹. Although recognised peatlands cover less than 0.07% of the land in Spain, a number of new and currently unmapped areas of blanket bog have recently been identified here. Assessment of Zalama indicates that these areas may form a key component of national and regional carbon budgets. Restoration of degraded blanket bog may improve peatland biodiversity and help mitigate climate change.

Niche partitioning and carnivore coexistence in human-dominated landscapes

Anthony Sévêque

Sympatric carnivores compete for common resources, and interspecific competition is an important driver of interactions and coexistence between carnivore species. Subordinate species can reduce such competition pressure by adjusting their ecological niche to dominant competitors. This process can be achieved through spatiotemporal modifications of habitat use and patterns of food resource use. However, most carnivore species now live in human-dominated landscapes, and the combined effects of landscape alteration and extreme exploitation of wildlife can interfere with the strategy of niche partitioning in carnivore guilds. Because human encroachment into natural ecosystems is increasing at an alarming rate, it is essential to evaluate the effects of anthropogenic disturbances on coexistence between sympatric carnivores. Here we reviewed the published literature on spatial, temporal and trophic niche partitioning within carnivore guilds, and assessed the multiple effects of anthropogenic perturbations. We further investigated the consequences of such changes on intraguild competition, and how they could reshape carnivore guilds in heavily modified landscapes. Although the effects of human disturbances on niche partitioning in carnivores are strongly context dependent, they can be grouped into two categories. First, the top down effects of exploitation, both of herbivore and carnivore species, can increase competition between larger carnivores through depletion of the prey base and scarcity of refuge areas. Secondly, the bottom up effects of heavy landscape alterations can promote generalist mesocarnivores, at the expense of specialist species, through a reduction of resources diversity and landscape heterogeneity. Because human perturbations can significantly alter the structure of the carnivore guild, and have cascading effect on entire ecosystems, we encourage a sustainable land management and exploitation of wildlife, aimed at promoting intact carnivore communities.

A preliminary investigation of red squirrel (*Sciurus vulgaris*) home ranges in an urban environment

Kat Fingland

Urbanisation is globally increasing, altering the habitats and resources available for wildlife. Eurasian red squirrels (*S. vulgaris*) can adapt well to these environments. This native British species was historically widespread across the country, but their numbers have deteriorated following the introduction of the North American grey squirrel (*S. carolinensis*). There are several urban red squirrel populations across the UK, including one thriving in the town of Formby, Merseyside. This research aims to investigate their patterns of space and habitat use in Formby and its surrounding woodland, in order to aid long-term conservation plans for urban refugia. Red squirrels were live-captured in May/June 2018 and a sub-sample of 12 adults (8 males, 4 females) were radio-collared. The collared squirrels were tracked and their locations recorded once per day, at least once every two to three days until mid-August, to obtain at least 30 location fixes per squirrel. The preliminary visualisation suggests that territories are small, although those in the town itself and the southern woodland seem to have larger home ranges than in the northern woodland. Only one squirrel established a new territory, while ten were philopatric and one died during the tracking period. These initial findings may be due to differences in woodland management, provision of supplementary food, and the availability of native tree species as food sources. However, the small home ranges indicate that food availability across the whole site is high compared with populations elsewhere. These data also highlight that the available habitats throughout the town are used as established territories for breeding individuals, which suggests that these patches need to be maintained to ensure the availability of natural food and nesting resources. However, further analyses will be conducted, including comparisons with published literature regarding rural populations, in order to investigate these preliminary observations in more depth.

Structural controls on supraglacial lakes using Ground Penetrating Radar (GPR)

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Supraglacial lakes play an important role in the response of debris-covered glaciers to climate change, both in terms of water storage and ablation rates. Regions with high proportions of glacial lakes and associated ice cliffs strongly enhance ablation rates. Although low gradients and low ice velocities have been shown to partially control supraglacial lake formation, additional controls are less well constrained. We propose that glacier evolution and pre-existing ice structures play a significant role in the location of supraglacial lake formation and potential drainage. Ground Penetrating Radar (GPR) reflection surveys were undertaken on the Miage Glacier, the largest debris-covered glacier in the European Alps, located on the southwest flank of Mont Blanc. A total of four supraglacial lakes and an ice-marginal lake were bathymetrically surveyed during summer field seasons in 2017 and 2018, prior to and after GPR data collection. This study aims to provide an insight into subsurface structural controls on the location, formation and evolution of supraglacial lakes. GPR data were collected using a Mala ProEx 100 MHz rough terrain antenna (RTA) in March 2018. A total of six GPR transects across the glacier covered a total distance of ~5.2 km. Data were processed in ReflexW using standard processing steps (including time zero and topographic correction). Two way travel time of returned signals resulted in depth penetrations of up to ~40 m. Internal structures are consistent with high debris concentrations entrained within the ice. Internal water was identified within a number of transects interpreted to be crevasse or meltwater features. GPR on the Miage Glacier has provided an insight into the internal structure of the glacier. Further analysis of such structures in relation to the presence of supraglacial lakes is required.

Investigating the effects of Tween 80 on some phyto- and myco-remediation agents applied on crude oil contaminated silty-loam soils from the Niger Delta region of Nigeria, Africa

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Phyto- and myco-remediation are eco-friendly techniques whose prospects have been explored for management of contaminated soils for a number of years. Current trends in this field centre on innovations to enhance these processes for clean-up of contaminated environments. This study focuses on the effect of the surface active agent-Tween 80 on the remediation potentials of (1) sunflower (*Helianthus annuus*), (2) ferns (*Dryopteris affinis* AGM), (3) fermented palm wine from *Raffia africana* and (4) white rot fungi (*Pleurotus ostreatus*) for the remediation of crude oil contaminated soils. Three different types of soils namely silty-loam, sandy and clayey soils contaminated with crude oil were collected from the Niger Delta region of Nigeria (Africa) and brought back to the NTU glasshouse complex at Brackenhurst to be treated for remediation of Total Petroleum Hydrocarbons (TPH) using the above four agents. Four different experimental set ups were designed to investigate the effectiveness of Tween 80 in combination with the agents on a silty-loam soil obtained from the Niger delta region of Nigeria. These set ups include: (a) contaminated soils with the remediation agents without Tween 80, (b) contaminated soils with the remediation agents with Tween 80, (c) contaminated soils with Tween 80 alone, and (d) control set of contaminated soil without any treatment. Results obtained revealed Initial high concentrations in TPH up to 25071.42mg/Kg of soil. Each of the agents exhibited promising abilities to reduced TPH in the soils. The remediation aptitudes of these agents, expressed in terms of % reduction of soil TPH levels after a period of one month treatment, were in the following order: white rot mushrooms (73.58%), Sunflower (57.37), ferns (56.37) and fermented Palm wine (51.48%). Application of Tween 80 to the agents for this initial period significantly increased ($p < 0.05$ at 95% CI) the remediation potentials of the agents in the order Sunflower (BDL), mushrooms (84.07%), fermented palm wine (78.86%) and ferns (71.33%). These preliminary results therefore reveal that the application of Tween 80 to some phyto- and myco-remediation agents could offer an eco-friendly and cost effective option for management of crude oil contaminated soils.