All Ireland Mammal Symposium

10th Anniversary Meeting

Conference Booklet

22nd – 24th November 2019

DCU All Hallows

An Roinn Cultúir,
Oidhreachta agus Gaeltachta
Department of Culture,
Heritage and the Gaeltacht

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🐾 denotes students eligible for "Best Talk" or "Best Poster" prize

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🐾 denotes students eligible for "Best Talk"

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🐾 denotes students eligible for "Best Talk"

MAPS

DCU All Hallows Campus: Eircode D09 N920

Pedestrian access via N1/Drumcondra Rd & Church Avenue

Vehicular access via Grace Park Road

Conference Venue (John Hand Room)

KEYNOTE SPEAKERS

Dr Denise O'Meara

Waterford Institute of Technology

Denise O'Meara's research in Waterford Institute of Technology's Molecular Ecology Research Group involves the use of remotely obtained DNA from hair or faecal samples to study wildlife populations.

Non-Invasive genetics of Irish mammals: Past accomplishments, future directions

Non-invasive genetics of mammals means acquiring a source of DNA without the need of trapping or otherwise disturbing the animal. The ability to do so facilitates addressing questions related to mammal distribution, population, conservation and management, and even provide insights into mammal diet. To address such questions requires the development of species-tailored molecular tools, including methods for species, sex and individual identification, as well as markers for the assessment of genetic type or strain. Paramount to the molecular methods, are the strategies required for the collection of good quality samples suitable for genetic analysis. Survey techniques may require the collection of faecal samples from bats, otters or pine marten. Hair offers better quality DNA, and sometimes the only available source of DNA suitable for DNA analysis from species such as squirrels. More recently, emerging technologies such as DNA metabarcoding is being used to assess the breath of the diet of species such as bats, and environmental DNA or eDNA is being used to detect mammals, both native and invasive, from water bodies. This talk will provide an overview of what we have learned in over a decade of non-invasive genetics, and where the frontiers of research will take us over the next.

Prof Eric Morgan

Queen's University Belfast

Eric Morgan is Professor in Veterinary Parasitology at Queen's University Belfast in Northern Ireland. His research interests focus on disease (especially parasite) transmission, including at the wildlife-livestock interface, and the effects of climate and management.

What killed 242,000 saiga antelopes in Kazakhstan and

why might it matter for mammal conservation?

This seminar will address how climate and other environmental change might affect disease dynamics in such systems and discuss approaches to predicting future change. In 2015, an unprecedented pass mortality event killed 242,000 saigas in Kazakhstan over three weeks, reducing the population to 30,000. The seminar will tell the story of the investigation into this event and the implications for mammal disease and conservation under climate change. The difficulties in predicting such implications will be discussed using other examples, including the use of simulation models of parasite dynamics, which have been applied in other areas including parasite flows across mixed use landscapes in Botswana.

ORAL PRESENTATION ABSTRACTS

Non-invasive population genetic analysis reveals severe fragmentation of Ireland's population of the lesser horseshoe bat (*Rhinolophus hipposideros)*

A.P. Harrington[1]*, D. O'Meara[1], K. McAney[2], R. Hanniffy[3], F. Marnell[4], N. Roche[5], C. O'Reilly[1].

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2. Vincent Wildlife Trust, Donaghpatrick, Headford, Co. Galway, H91 PXY4.
3. Vincent Wildlife Trust, Room 101, School of Natural Sciences, Martin Ryan Building, NUI Galway.
4. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, 90 North King Street, D7.
5. Bat Conservation Ireland, Ulex House, Drumheel, Lisduff, Virginia, Co. Cavan.

Keywords: Population genetics; non-invasive sampling; bats; habitat fragmentation

The lesser horseshoe bat, *Rhinolophus hipposideros*, is one of Ireland's rarest bat species, with an estimated population of only 12,800 individuals. Although its population has increased in recent decades, its future remains precarious due to roost site deterioration, habitat fragmentation, a narrow range restricted to Atlantic coastal counties (from Cork to Mayo) and its complete isolation from the rest of the European population. Previous studies have also shown that Ireland's horseshoe bats are subdivided into two isolated subpopulations, likely due to habitat fragmentation. In this context, maintaining gene flow within the Irish population is essential to prevent the future risk of inbreeding depression or local extinctions. In this study, we obtained faecal DNA samples from 749 individual lesser horseshoe bats from across their Irish range in order to carry out population genetic analysis using seven microsatellite markers. This is one of the first studies where such analysis has been carried out at a national scale on a bat species solely using non-invasive sampling. The results showed that the Irish lesser horseshoe bat population is more subdivided than previously thought, with evidence of four isolated subpopulations, in Cork-Kerry, Limerick, Clare-South Galway and North Galway-Mayo. These results indicate that the species is at risk of potential local extinctions. Future work on this species urgently needs to focus on identifying barriers to dispersal between the current subpopulations and the measures needed to reconnect them, such as habitat restoration and provision of new roost sites.

Revealing the diet of the Lesser Horseshoe bat (Rhinolophus hipposideros) in Ireland via DNA metabarcoding

Thomas Curran[1*], Sam Browett[2], Denise O'Meara[1], David O'Neill[1], Catherine O'Reilly[1], Andrew Harrington[1], Allan McDevitt[2]

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Keywords: DNA Metabarcoding; dietary analysis; Lesser Horseshoe bat; non-invasive

R. hipposideros has the most restricted range of any resident bat species in Ireland, with the next closest population occurring on the west coast of Britain resulting in the isolation of the Irish population from other European populations. *R. hipposideros* is protected by Irish and European law (Wildlife Act 1976; EU Habitats Directive). Understanding the diet of *R. hipposideros* is important for making informed conservation management decisions, and to understand the role it plays in the provision of ecosystem services. Traditional morphological approaches to dietary analysis of bat faeces can result in the over-representation of hard-bodied versus soft-bodied insects but DNA metabarcoding approaches employing next generation sequencing facilitates simultaneous and unambiguous identification of multiple taxa from a single DNA extract. In this study, we used DNA that was extracted from faecal samples collected at *R. hipposideros* roosts. These DNA samples were previously species and sex-typed using real-time PCR and individuals identified via genotyping. Using this DNA metabarcoding approach, the dominant prey groups revealed were Diptera and Lepidoptera, with Hymenoptera, Coleoptera, Neuroptera and Trichoptera also identified. Female bats had greater amounts of Lepidoptera in their diet in comparison to males, suggesting sex-specific hunting strategies. Pest species such as mosquitoes (*Culiseta* spp., *Culex pipiens*) and midges (*Culicoides punctatus*) implicated in disease transmission were detected, highlighting the role of *R. hipposideros* in the provision of ecosystem services relevant to human and animal health. The combination of these molecular techniques can be used to understand the individual and gender-specific prey preferences of *R. hipposideros*.

Bat Roost restoration and the "Green Bridge" on the M17/18 motorway: Benefits of appropriate mitigation for bats and other mammals

Tina Aughney[1]

1. Bat Eco Services, Virginia, Co. Cavan, Ireland

Keywords: Chiroptera; mammal; bat mitigation; road schemes; green bridge; roost renovation; trail cameras.

The vicinity of the new road scheme of the N18 is important for bats in general and the lesser horseshoe bat in particular. The N18 scheme was merged with two other schemes to form the M17/M18 Gort to Tuam PPP Scheme. This road was built and opened in September 2017.

As part of the bat mitigation measures, Garryland House, an existing derelict house located in Garryland Woodland, was renovated as a maternity roost for lesser horseshoe bats. The number of lesser horseshoe bats recorded in Garryland House has seen an annual increase since works were completed in April 2011. The renovation works have significantly improved the building as a maternity roost and numbers present now match historical records from the 1970s having declined to zero in the 1990s. In addition, the building now provides suitable roosting sites for this species all year around, which was previously not the case.

As part of the bat mitigation measures to facilitate the safe movement of this bat species across the motorway, a green bridge was constructed. The location of the green bridge was determined by radio tracking of lesser horseshoes within the Coole Park and Kiltartan Cave area. Preliminary trail camera surveillance has documented various terrestrial mammal species crossing the motorway. Therefore, the green bridge also facilitates the safe passage of other wildlife species.

Mitigation and monitoring works are funded by Galway Co. Co. and works are completed under licence from NPWS.

What are the consequences of a warming climate for common bat species in Ireland?

Niamh Roche[1*], Steve Langton[2], Tina Aughney[1], Deirdre Lynn[3] and Ferdia Marnell[3]

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3. National Parks and Wildlife Service, Dublin 7, Ireland

Keywords: Spatio-temporal variability; weather; Chiroptera; climate change model

Climate change presents a serious threat to global biodiversity. In the extreme north of Europe, for example, some boreal bat species have been predicted to become extinct by the end of the century. We have used bat activity data from yearly car-based surveys across Ireland to examine the effects of weather and climate using an approach that teases apart their spatial and temporal effects. This allows more accurate modelling of the impacts of weather than has heretofore been possible. We used the results of this modelling exercise to forecast the effects of predicted climate change on three widespread Irish species for the years 2046-2059. Leisler's bat is predicted to undergo a decline in the north-west, but with increases likely in the south-east. Common pipistrelle is predicted to undergo similar changes to Leisler's bat, with declines in the north. The soprano pipistrelle may increase in coastal locations. Predicted declines in the north of Ireland run somewhat contrary to expectations since increased ambient temperature there may have been anticipated to favour bat population growth. This work is a promising step towards disentangling the spatial and temporal impacts of weather. Pipistrelle species are likely to be north-western Europe's most abundant consumers of aerial nocturnal insects and future conservation plans must consider potential losses of these species from agricultural areas and how any resulting reduction in ecosystem services can be mitigated.

Camera trap distance sampling for hare and badger density and abundance estimation

N.E. McGowan[1]*, N. McDermott[2], R. Stone[3], L. Lysaght[4], S.K. Dingerkus[3], A. Caravaggi[5], I. Kerr[2] & N Reid[1]

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2. IDASO Ltd., Mullingar, Ireland
3. Giorria Environmental Services, Bohola, Ireland
4. National Biodiversity Data Centre, Waterford, Ireland
5. University of South Wales, Pontypridd, Wales

Keywords: Conservation status; detection function; *Lepus timidus*; *Meles meles*; population biology

The Irish hare (*Lepus timidus hibernicus*) is listed under the EC Habitats & Species Directive (92/43/EEC) requiring monitoring and surveillance of its conservation status whilst the badger (*Meles meles*) is of policy relevance as a wildlife reservoir of bovine tuberculosis. Camera trap technology allows for 24/7 survey effort whilst recent statistical developments permit Distance Sampling to be used with camera trap footage. We deployed 596 camera traps for one week each during winter 2018/19 (=106,026 survey hours equivalent to 12 years of continuous observation) in 44 x 1km^2 survey squares selected throughout Ireland (in every county) to be statistically representative of the country's habitat composition. A total of 253 Irish hares and 108 badgers were detected with methods developed to estimate the distance of each detection from the camera lens. The Irish hare exhibited a bimodal crepuscular activity cycle peaking during dawn and dusk whilst the badger exhibited a single nocturnal activity period. The mean (± 95% Confidence Interval) of Irish hare density was estimated at 3.19 (1.59 – 6.43) hares/km^2 (highest in the northwest at 3.50 hares/km^2 and southwest at 3.46 hares/km^2 compared to the east at 2.66 hares/km^2). Mean badger density was 2.70 (1.86 – 6.82) badgers/km^2 and was similar between geographic regions (range: 2.27 - 3.08 badgers/km^2). Population estimates for both species were similar to that of last major surveys for each despite previous surveys using different methodologies (spotlight surveys and sett survey extrapolations) suggesting no significant change in either animal's population over the last two decades.

Stop, Look and Listen. Badger road traffic accidents in the N11 study area 2010-2017

Enda Mullen [1] *, Teresa MacWhite [2], Peter Maher [2], Aoibheann Gaughran [3], David J. Kelly [3], Margaret Good [3], Nicola Marples [3]

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Keywords: Badger; *Meles meles;* road traffic accident; N11 study

The N11 Badger Project was established to examine the impact of a major road re-alignment on the local badger population. It examined their ecology and health status before, during and after construction. One aspect of this was to detail the locations of badger RTAs.

During this period, 28 badgers were killed on the N11, 23 on side roads and 2 on the new M11. The number of casualties varied by year but averaged 6 per annum. Most badgers were killed on roads within their home range although some coincided with dispersal or extra-territorial excursions. More male badgers died on the roads than females and most were between the ages of 3-5 years. There was a seasonal difference with more badgers killed in winter and spring than the other seasons as well as a gender difference depending on the season.

All badger road deaths are human traffic accidents, so we examined the characteristics of locations which had multiple RTAs to see if there were common elements. The mitigation measures which helped make the motorway safer provide important examples of design and planning which could be used on other roads to reduce the probability of accidents.

Going the extra mile: GPS tracking reveals the extent of movement during badger dispersal.

Aoibheann Gaughran[1*], David J. Kelly[1], Enda Mullen[2], Teresa McWhite[3], Peter Maher[3] and Nicola M. Marples[1]

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3. Department of Agriculture, Food and the Marine, Dublin, Ireland

Keywords: *Meles meles*; dispersal; GPS tracking; tuberculosis; disease transmission

European badgers (*Meles meles*) are implicated in the spread of bovine tuberculosis to cattle and act as a wildlife reservoir for the disease. In badgers, only a minority of individuals disperse from their natal social group. However, dispersal may be extremely important for the spread of TB, as dispersers could act as hubs for disease transmission.

We monitored a population of 139 wild badgers over seven years. GPS-tracking collars were applied to 80 different individuals. Of these, we identified 25 dispersers. Thirteen badgers were wearing collars as they moved, allowing us to describe the process of dispersal in much greater detail than ever before.

We show that dispersal is an extremely complex process, and measurements of straight-line distance between old and new social groups severely underestimate how far dispersers travel. Such assumptions of straight-line travel also underestimate the potential for direct and indirect interactions and opportunities for disease transmission. For example, one female disperser that eventually settled 1.5km from her natal territory travelled 308km and passed through approximately 22 different territories during the dispersal process. Knowledge of badgers' atypical ranging behaviour during dispersal is crucial to understanding the dynamics of TB transmission, and for designing appropriate interventions, such as vaccination.

Remote, non-invasive measurements of complex antlers in fallow deer using photogrammetry

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Keywords: photogrammetry; morphology; non-invasive; deer; data collection;

Photogrammetry is the acquisition of real-world measurements from photographs. We calibrated and validated photogrammetry systems for remotely measuring deer antlers and demonstrated the high-accuracy in measuring sizes from antlers attached to skulls to emulate a free-living animal. We developed an efficient correction protocol to deal with curved and tilted antler features, validated with independent antler sizes. Our antler measurement estimates were characterised by mean errors lower than 5% when compared to true antler sizes, with our correction protocol for antlers particularly effective and importantly, the ecological meaning of antler estimates was never altered, as the ranking of the deer based on true antler sizes was identical to the ranking estimated by photogrammetry. As photogrammetry is non-invasive, remote, and fast, it fits alongside modern wildlife conservation and management and is particularly suited to long-term studies where repeated measurements of individuals are necessary, but handling is not. We implemented the first steps in data-collection in wild deer to link closely with coinciding studies on animal welfare, management, and behaviour.

A smart and open-science approach to monitor and analyse deer populations in Ireland

Simone Ciuti[1*], Barry J. McMahon[2], Charles Harper[2], Maarten Nieuwenhuis[2]

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2. School of Agriculture and Food Science, University College Dublin, Belfield, Dublin, Ireland

Keywords: Deer; open-science; smartphone app; management; modelling.

Deer populations have reached extreme levels in many parts of the island, resulting in financial and environmental damage to forests, agriculture, welfare and road safety. Neither the precise distribution nor the population density of the four deer species is currently known. This lack of knowledge makes managers unready to face upcoming challenges with deer management, namely costly human-wildlife conflicts and climate change. We believe that three actions are needed to implement an all-island coordinated strategy. Firstly, we need to involve all Irish stakeholders and congregate spatial resolution datasets mostly unexploited so far, e.g. systematic deer observations by hunters, national deer culling data, forest damage data, and deer-car collisions. These data need to be available to stakeholders in an open-source platform that would help them to drive management and conservation decisions. Secondly, there is the urgent need to model deer distribution data using recent advances in species distribution and habitat modelling, produce the most up-to-date distribution maps of deer species in the island, and identify hotspots of human-deer conflicts to prevent forest damage, traffic collisions, interaction with livestock. Finally, it is important to introduce smart approaches to improve the way we monitor deer populations, possibly taking advantage of those stakeholders who continuously observe deer in the field. We discuss the opportunity to develop and test a smartphone application for hunters to report the number of deer observed while hunting, a cost-effective means to collect systematic deer observations to significantly improve deer monitoring in the island.

The Cone Wars: The changing fortunes of red and grey squirrels in Ireland

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3. Vincent Wildlife Trust, Galway, Ireland

Keywords: *Sciurus vulgaris*, *Sciurus carolinensis*, *Martes martes*, citizen science, distribution

There are two species of squirrel in Ireland, the native Eurasian red squirrel *Sciurus vulgaris* and the invasive eastern grey squirrel *Sciurus carolinensis*. The grey squirrel was introduced and became established on the island of Ireland in the early 20th century, and its spread from the one-off introduction point to cover much of the eastern half of Ireland has been documented through early anecdotal reports, and later dedicated surveys. The spread of the invasive species was mirrored by a loss of the native red squirrel, which is impacted by exploitative competition and the squirrel pox virus. The most recent surveys, however, indicated that the grey squirrel had started to disappear once again from certain areas, a loss that has been attributed to the regional recovery of the native carnivore, the pine marten *Martes martes*. In this talk we will review the successive distribution surveys carried out on the two squirrel species and the pine marten, and present the results from the latest survey conducted throughout 2019. The 2019 survey is a cross-border initiative involving research teams and NGOs in Northern Ireland and the Republic of Ireland. Records of the animals have been collected through a citizen science survey, conducted through social media, and utilising the web platforms of the National Biodiversity Data Centre (Rep. Ireland) and CEDaR (N. Ireland). Further records and validation of sightings have been obtained using non-invasive monitoring techniques such as hair-tubes and trail cameras.

Pine marten mediated reversal of squirrel replacement may be impeded by urban refugia

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Keywords: invasive species; native predator; squirrels; pine marten; occupancy modelling

Invasive species pose one the most serious threats to biodiversity globally. Investigations into the interactions of native and non-native species mostly focus on the impacts of single species, despite such interactions being embedded in a network of direct and indirect interactions between multiple species and their environments. Here, we demonstrate that native red and invasive grey squirrels, two species in Europe which are linked by resource and disease mediated competition, are also linked by a shared enemy, the European pine marten. We develop on previous qualitative research into the topic, using multi-species occupancy models applied to quantitative camera trap data collected by citizen scientists in a specifically designed survey from 332 sites throughout Northern Ireland. We demonstrate the presence of the pine marten to reverse native red squirrel replacement by invasive grey squirrels, with non-native grey squirrel occupancy strongly negatively effected by exposure to pine marten. In contrast, the native red squirrel has positive response to the presence of the native predator. We go beyond the species interactions and highlight that despite the potentially strong effect of the recovery of the native predator in controlling grey squirrels, they are likely to persist in urban refugia that are either inaccessible or avoided by the pine marten.

www.pinemarten.ie: Using the internet to meet the conservation challenges of a recovering native carnivore

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Keywords: pine marten; website; journalists; gun clubs

The pine marten population in Ireland has recovered from the brink of extinction in the 1970s. Despite being one of Ireland's few positive wildlife conservation stories, its return has been marred by misinformation and unsubstantiated claims about the animal's behaviour. These are presented as facts across print and online journalism and have impacted on the genuine issues faced by people. Two such concerns are its increasing use of attics as denning sites (due to the lack of suitable woodland habitat), and the necessity for local gun clubs to enhance existing pens to exclude pine martens.

In response to the need for reliable material on the species, we developed a website - www.pinemarten.ie - in partnership with the National Parks and Wildlife Service. This provides factual information targeted at four groups: Journalists; Householders; Gun Clubs and Poultry Keepers; and Foresters and Farmers. Journalists can use the website to access evidence-based data and licenced photographs for articles. Individuals from the other three groups often have direct contact with the species, so the website contains instructions for reducing potential conflict during these encounters. Information is provided on the marten's place in Irish history and folklore, as well as the potential for ecotourism and habitat improvement, and visitors can submit sightings and queries.

We hope this national resource will address the needs of the public and help to lessen negative attitudes towards the animal, so that the pine marten's return will be viewed as a conservation success story in an age of biodiversity crises.

Public awareness and attitudes to predators in Ireland

J. Algeo-Orr[1], J.Twining[1], T. Hamill[2], D.G. Tosh[3*].

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Keywords: Wildlife; conflict; attitudes; questionnaire

Human Wildlife Conflict (HWC) can arise when wildlife has a negative impact on human interests and, in turn, the human response typically has negative connotations for the species involved. Examples of HWC exist from across the world, and Ireland is not exempt with the red fox (*Vulpes vulpes*) widely considered problematic for sheep, game and poultry interests. Evidence of wider HWC between Ireland's predators is scant with anecdotal evidence suggesting problems with pine martens (*Martes martes*) and buzzards (*Buteo buteo*). We therefore set out to assess the public's knowledge, awareness and attitudes towards four Irish predatory species to identify whether HWC may be occurring.

Over 600 respondents participated in face-to-face (n= 365) and online (n= 259) surveys from across the island of Ireland. As expected, awareness, knowledge and attitudes towards the different species and their management varied. A greater proportion of respondents could identify the mammals than birds whilst perception of risk posed to pets, livestock and other protected species similarly differed between avian and mammalian predators. Overall, the results highlight the complexity of attitudes towards the species of concern, with views and knowledge ranging from highly positive to highly negatively and well informed to poorly informed. The results form the foundation for future studies to examine why negative perceptions are held by certain parts of the community and determining whether HWC is partly responsible for such views.

Alien AND Invasive: The establishment of Coypu in Ireland

Fidelma Butler[1*], Eugene Finnerty[1], John Armstrong[1], Allen Whitaker[1], Eamon Cooper[1], Eileen Dillane[1], Danny O'Keefe[2]

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Keywords: Coypu; field signs; establishment risk

During May 2017 sightings of coypu (*Myocastor coypus*) were reported from Cork city and areas of the county. These reports were widely publicised in the regional and national media and led to concerns about 'unusually large' invasive rodents. Here we report on the subsequent work that was undertaken to establish the magnitude and extent of coypu presence, to determine population parameters of the group and to investigate the origin of these coypu using microsatellite and mitochondrial DNA sequencing. Coypu are one of a number of alien mammal species that have been reported in recent years but their adaptability to available habitat highlights the risk of widespread establishment.

Is it a bird? Is it a plane? No, it's an Irish hare!

Samantha Ball [1,2*], Anthony Caravaggi [3], Fidelma Butler [1]

1. School of Biological, Earth and Environmental Sciences, University College Cork, Cork, Ireland
2. Dublin Airport Authority, Dublin Airport
3. University of South Wales, Cardiff, Wales

Keywords: Ecology; airfields; strikes; Irish hare

Mammal-strikes with aircraft are a global phenomenon constituting 3-10% of strike incidents. Despite mammal strikes being 5x more likely to inflict damage to an aircraft, there has been relatively little research into the management of mammals on airfields or on mammal strike mitigation. Here we report on the unique opportunity to study mammal strikes in Ireland, by focusing on the ecology of the endemic Irish hare (*Lepus timidus hibernicus*) inhabiting the airfield at Dublin Airport, in an effort to reduce strike events, which have been steadily increasing since the first confirmed event in 1997. We aim to achieve this through ecological and behavioural approaches to deliver targeted and effective management of the hare population. By using ecological survey methods including diurnal/ nocturnal DISTANCE sampling to estimate population size and camera trapping to determine circadian rhythm, we have estimated the preliminary population size of the Irish hare at Dublin Airport and identified seasonal fluctuation over the past year. Additionally, these methods have allowed us to identify activity hotspots and the proximity of hares to the active runway. These data will help to determine mammal strike risk at Dublin Airport and allow us to develop a risk index of when strikes are most likely to occur. Given the sensitive nature of the airport environment, paired with the protected status of the Irish hare, this work gives us a valuable insight into how to conduct ecological research in heavily restricted and anthropogenically influenced habitats.

10 years on: a new Red List of terrestrial mammals for Ireland. Has anything changed?

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Keywords: IUCN; Red list; mammals; threat status; Ireland

A new Irish Red List of Terrestrial Mammals has been published. This updates and replaces the previous 2009 Red list. All 25 terrestrial species native to Ireland or naturalised in Ireland before 1500 were included in the assessment. In addition the grey seal and harbour seal, which spend much of their time on land, were also included. The geographic scope of this assessment, as with other Irish Red Lists, covers the whole island of Ireland.

The Ireland Red List of Terrestrial Mammals:

- Provides a full and objective assessment of species using the IUCN conservation status categories.
- Allows for direct comparisons with the European and global mammal assessments.
- Identifies those species most in need of conservation interventions.
- Highlights the major threats to Ireland's terrestrial mammals so that mitigating measures can be implemented.
- Identifies areas of mammal ecology in Ireland requiring further research.

The most recent species distribution and population trend data available were used to inform categorization. Three species have seen their status improve since 2009. No species has dis-improved. The black rat (*Rattus rattus*) remains the only mammal species in Ireland threatened with regional extinction.

Know your enemy: A molecular approach identifies multiple key factors driving the invasion and extinction of shrews in Ireland

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Keywords: Metabarcoding; shrew; microbiome; diet; invasion

Ireland's smallest resident mammal, the pygmy shrew (*Sorex minutus*), is rapidly being out-competed and replaced by the invasive greater white-toothed shrew (*Crocidura russula*). This invasive shrew was discovered in 2007 and has been spreading rapidly across the island at a rate of ~5km per year. Considering these two species co-inhabit other regions of Europe, this raises the question of why they cannot coexist in Ireland. This study applies DNA metabarcoding to shrew gut contents to investigate two linked factors in this invasion-extinction event; i) resource use and ii) gut microbial community structure. This was applied to over 300 shrews of both species sampled across radial transects in Ireland, two seasons, and a natural 'control' site in France where both species occur together in high abundance. Identifying the invertebrate prey taxa using the COI genetic region indicates a changing dietary preference of the invasive shrew along the invasive route. While pygmy shrews show a broad range diet, Irish populations remain unable to sufficiently adapt their diet in response to this new competitor. By targeting different genetic regions, the bacterial (16S region) and fungal (ITS region) communities of the shrews were characterised using DNA metabarcoding. During this invasion there is evidence of structural changes in the microbial communities in both species, which may reflect changing condition of fitness during invasion and/or stresses induced by restricted resource availability. This multi-faceted approach on a well-studied invasive system has demonstrated the importance of identifying multiple factors occurring simultaneously in invasion-extinction events in mammals.

EMMA 2: A new and expanded Atlas of European Mammals

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Keywords: Mammal distribution; monitoring; Europe; Atlas; mapping

A new Atlas of European mammals will be published in 2024, 25 years after the original European Atlas published in 1999 by Mitchell Jones *et al*. Data collection is underway across Europe, from Connemara to the Ural Mountains. Distribution maps will be based on data collected by mammal experts and from citizen scientists. Species accounts will be penned by relevant experts from across Europe.

In the Republic of Ireland the data will be collated by the National Biodiversity Data Centre and submitted at 50 x 50km grid level to the Mammal Atlas project steering group. The new volume will update the original European Mammal Atlas published in 1999, but the geographical coverage this time has been extended to include Ukraine, Moldova, Belarus and Russia as far as the Ural Mountains. The taxonomic scope has also been expanded to include seals. In total, the Atlas will cover 265 species across 37 countries, covering an area of greater than 11,000,000 km^2. It will be one of the biggest biodiversity mapping exercises ever undertaken.

While we are well positioned to contribute data to the new Atlas given the work that was done for the recent Mammal Atlas of Ireland, some species remain under-recorded. This presentation will provide an overview of progress with the European Mammal Atlas so far and highlight areas where Irish mammalogists can contribute to the final product.

Spatio-temporal variability of harbour porpoise life history parameters in the North-east Atlantic

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Keywords: Cetacean; life history; growth; mortality; monitoring

Intrinsic and extrinsic factors can influence both population vital rates and population structure, which ultimately cause changes in dynamics within and between biological units. Here, we undertook a retrospective analysis of mortality data collected over a 24-year period for assessing life history traits of the North-east Atlantic harbour porpoise population. We use time-period specific models for key life history relationships that considered cause of death of individuals, sex and management unit (MU). Sexual variation in asymptotic length, asymptotic age, average length at 50% maturity (L50) and average age at 50% maturity (A50) were observed, with females attaining a larger asymptotic length, larger L50, and delaying attainment of both sexual and physical maturity, compared to males. While females are constrained in their minimum body size due to giving birth to proportionally larger offspring, males exhibited more plasticity in size at sexual maturity, enabling re-allocation of available energy resources towards reproduction. Data were then used to compare biological parameters among two designated MUs. In both MUs, females significantly increased their A50 and males significantly declined in their L50. An increase in the age at asymptotic length and a significant decline in the growth rate was observed in both sexes. While availability of suitable prey resources may be a limiting factor, a combination of other factors cannot be ruled out. Porpoises in the Celtic and Irish Seas were significantly larger in their maximum length, asymptotic length and L50 compared to North Sea porpoises, suggesting limited gene flow between MUs and justifying their designation.

Informing the conservation of harbour seals in Ireland through non-invasive genetics

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Keywords: Harbour seal; genetics; conservation; Ireland

Harbour seals (*Phoca vitulina*) are one of the two pinniped species breeding in Ireland, where their population structure and genetic diversity are currently unknown. Furthermore, mortality due to past Phocine Distemper Virus outbreaks may have reduced genetic diversity in local populations, which could make them less adaptable and more vulnerable to future pressures. In order to effectively manage protected seal populations and facilitate effective conservation actions it is important to delineate biologically significant Assessment Units (AUs), which can support the implementation of environmental legislation such as the Marine Strategy Framework Directive (MSFD). AUs have not been proposed for harbour seals in Ireland, which are currently considered as a single nationwide population.

The present study is using a combination of mitochondrial (control region d-loop) and nuclear genetic markers to characterise the population structure of harbour seals around Ireland, thereby providing advice towards the delineation of reproductively and biologically distinct AUs. A total of 180 individual biological samples were collected around the Irish coast, including samples collected non-invasively (e.g. scat, hair) from key haul-out locations and from stranded/rehabilitated individuals (Ireland and Northern Ireland).

To date, the analysis of mtDNA among distinct geographical areas, based on the distribution of key haul-out sites, identified a high haplotype diversity and indicated the presence of population sub-structuring within Ireland. These preliminary findings suggest that the current single-population approach may be inappropriate. Once examined via 10 selected nuclear genetic markers, these analyses should provide key information for improved conservation and management of harbour seals in Irish waters.

POSTER PRESENTATION ABSTRACTS

The role of ecological corridors and habitat fragmentation in the dispersal of small mammals through an urban environment.

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Keywords: *Sciurus vulgaris*; ecological corridors; dispersal; citizen science; habitat fragmentation

Following a severe decline in distribution, the population recovery of *Sciurus vulgaris* has been attributed to a number of factors: localized grey squirrel decline; public awareness; and successful conservation efforts. Our knowledge of this recovery has been informed by national squirrel surveys, the latest taking place in 2019. This cross-border initiative uses citizen science and non-invasive monitoring to record squirrel and pine marten distributions.

Galway city centre is an urban environment surrounded by a moderate number of small, fragmented woodlands, some of which have limited resources and are relatively isolated. Besides an extensive road system, the River Corrib acts as a further barrier to wild mammal movement. Merlin Forest Park, to the east of Galway city, is resident to an established population of red squirrels. Since the launch of the 2019 squirrel survey, red squirrel sightings have also been reported in other wooded areas such as Terryland Forest Park and Menlo, which lie to the centre and north of Galway city respectively, and Dangan, located to the west of the River Corrib.

This new study aims to investigate population dynamics of urban red squirrel populations in Galway, and model movement and dispersal through the fragmented habitat. This information will help to determine the feasibility of population expansion into other forested areas such as Barna Woods to the west of the city, and will aid in planning for the future management of the species in Galway.

Population analysis and distribution mapping of two translocated red squirrel (*Sciurus vulgaris)* populations.

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Keywords: *Sciurus vulgaris*; post release monitoring; translocation; distribution mapping; population analysis.

Following the introduction of the grey squirrel (*Sciurus carolinensis)* to Ireland, the red squirrel (*Sciurus vulgaris)* population declined dramatically. This was due to red squirrels being outcompeted by the larger grey squirrels, who also serve as a vector for the squirrel pox virus. In an effort to increase the distribution of red squirrels, two translocation projects were completed in the mid-2000s. The translocated populations are located in the west of Ireland where grey squirrels are not present due to barriers and unsuitable terrain. This project aims to investigate the dynamics of these translocated populations and map their current and future distributions.

Invasive and non-invasive techniques will be used to determine population size and status. Trail cameras, hair tubes and line transects will be utilised to determine presence or absence, habitat preference and indices of population density. These data will be compared to previous distribution data to determine the spread and growth of the population since the previous assessments. These data will also be modelled to determine the population's potential distribution, and used to determine the accuracy of previous models of spread and population viability.

Live trapping and mark-recapture studies will be used to estimate population density. Data such as weight, age, breeding status and sex will be obtained from captured individuals and provide information on population fitness. This project will provide medium to long-term assessment of translocation success, while also adding to our understanding of reintroductions in general.

Using genetic and genomic data to identify re-invasion pathways of the grey squirrel (*Sciurus carolinensis*) following eradication programmes in the UK

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Keywords: Genetics; genomics; squirrels; invasive

Invasive species can cause major ecological and economic impacts. In the British Isles, the invasive North American grey squirrel (*Sciurus carolinensis*) has been shown to contribute to the decline of the red squirrel (*S. vulgaris*) through resource competition and the spread of disease. The grey squirrel has been subjected to extensive control efforts in the UK which can temporarily reduce the population, but if control is not sustained, the population can recover. In the case of the Isle of Anglesey, an island connected to mainland Wales via man-made bridges, complete eradication of the grey squirrel occurred in 2013. However, in 2015, several individuals had returned, possibly from the surrounding areas through natural dispersal or intentional release. Previous studies in Anglesey have shown that prolonged control efforts in partially isolated environments can lead to a loss of genetic diversity, an effect that might accelerate population decline and the success of an eradication programme. The aim of this study is to identify re-invasion pathways into Anglesey from surrounding areas following control efforts. This will be achieved using genomic and genetic approaches including SNPs (using ddRAD), microsatellites and mtDNA on hundreds of animals sampled between 2011 and 2019. Comparisons will be made across genetic markers to determine the method that provides the best resolution for the identification of the source of re-invasion across fine spatial and temporal scales. The results will inform ongoing adaptive management efforts to allow the recovery of red squirrels in Anglesey, and the continued management of grey squirrels.

Bridging the gap between conservation genetics and red squirrel (*Sciurus vulgaris*) conservation management

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Keywords: Conservation, Genetics, Squirrels, Disease

The red squirrel (*Sciurus vulgaris*) suffered population declines in Britain and Ireland due to habitat removal and fragmentation, historical trade and movement of the species, and competition from the invasive North American grey squirrel (*Sciurus carolinensis*). In recent years, the red squirrel has demonstrated a natural recovery in Ireland, possibly coinciding with the recovery of a native carnivore, the pine marten (*Martes martes*), and a subsequent decline of the grey squirrel. It is likely that further population reinforcement projects of the red squirrel will occur throughout Britain and Ireland as stakeholders attempt to restore and conserve ecosystems. The aim of this project is to demonstrate how conservation genetics can be used to support and inform practical management decisions for the long-term survival and management of red squirrel populations. The study will demonstrate how genetic tools can be used to support reinforcement projects to avoid risks such as inbreeding, outbreeding and disease susceptibility while demonstrating sensitivity to the conservation of the genetic heritage of the species. The application of the techniques will be demonstrated through the genetic assessment of a translocation project in the West of Ireland, current conservation and reinforcement projects in Northern Ireland and historical red squirrel samples.

Using the Mostela to detect the Irish stoat (*Mustela erminea hibernica)* in Counties Mayo and Galway

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Keywords: Irish stoat; novel detection method; greater white-toothed shrew

The Mostela is a monitoring device developed by the Dutch Small Mustelid Foundation. It consists of a wooden box with a plastic tunnel running through it and a camera trap within to record footage of any animal that enters. It has been used successfully to detect stoats in the Netherlands and the UK. The Irish stoat is a subspecies endemic to Ireland and the Isle of Man and, despite being widespread in Ireland, there is no information on its overall population status due to the difficulty with detecting it. We conducted a twelve-week study from May to July 2019 at twelve locations in Mayo and Galway to test the efficacy of the Mostela to detect the Irish stoat. Rabbit lure was applied to cotton wool that was placed in a small container secured within the Mostela and a second camera trap was placed outside the unit to record any stoats that did not enter. All the study sites were on private land and were chosen based on existing stoat records, the presence of hedgerows or stone walls near broadleaf woodland and the potential for disturbance by livestock. A total of 9,615 video clips of wildlife were recorded during 91 survey days, 1,520 internal and 8,095 external. A stoat was first detected at 25 days into the study and detected internally and externally at two sites and externally only at two other sites. Twelve other mammal species were detected, including the pygmy (*Sorex minutus*) and greater white-toothed shrew (*Crocidura russula*).

The impact of roadworks on the ranging behaviour of European badgers

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Keywords: *Meles meles;* ranging behaivour; GPS tracking; tuberculosis, roadworks

The European badger (*Meles meles*) acts as a wildlife reservoir of *Mycobacterium bovis*, the causative agent of tuberculosis in cattle. To understand the dynamics of this disease and to control it successfully, a complete picture of ranging behaviour of the carrier species is required. There is concern that environmental disturbances, such as major roadworks, could increase movements between badger social groups, resulting in TB breakdowns in local cattle herds.

The ranging behaviour of a badger population was monitored before, during and after a major road realignment. GPS-tracking collars were applied to 80 different individuals. Using these data, we estimated badger home range size, nightly distance travelled and the distance of extra-territorial excursions.

We found the roadworks had a very limited effect on ranging behaviour of the study animals. A small increase in nightly distance travelled, during the roadworks, did not translate into an increase in home range size, nor an increase in the distance of extra-territorial excursions. As territoriality was not disrupted by the roadworks, we believe the small changes in behaviour are unlikely to have caused additional TB breakdowns in local cattle herds.

Super-ranging. A new ranging strategy in European badgers

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Keywords: *Meles meles;* ranging behaivour; GPS tracking; tuberculosis, disease transmission

We monitored the ranging of a wild European badger (*Meles meles)* population over 7 years using GPS tracking collars. Badger range sizes varied seasonally and reached their maximum in June, July and August. We analysed the summer ranging behaviour, using 83 home range estimates from 48 individuals over 6974 collar-nights. We found that while most adult badgers (males and females) remained within their own traditional social group boundaries, several male badgers (on average 22%) regularly ranged beyond these traditional boundaries. These adult males frequently ranged throughout two (or more) social group's traditional territories and had extremely large home ranges. We therefore refer to them as super-rangers. While ranging across traditional boundaries has been recorded over short periods of time for extraterritorial mating and foraging forays, or for pre-dispersal exploration, the animals in this study maintained their super-ranges from 2 to 36 months. This study represents the first time such long-term extra-territorial ranging has been described for European badgers. Holding a super-range may confer an advantage in access to breeding females, but could also affect local interaction networks. In Ireland & the UK, badgers act as a wildlife reservoir for bovine tuberculosis (TB). Super-ranging may facilitate the spread of disease by increasing both direct interactions between conspecifics, particularly across social groups, and indirect interactions with cattle in their shared environment. Understanding super-ranging behaviour may both improve our understanding of tuberculosis epidemiology and inform future control strategies.

How effective are forestry guidelines at protecting badgers and their setts during clearfelling?

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Keywords: Breeding badgers; disturbance; exclusion zones; timing of operations

Forestry guidelines aim to protect badgers by restricting the use of heavy machinery around setts. Felling took place in Co. Wicklow, Ireland, in February 2012 in adherence to the basic guidelines. The sett contained an adult female badger (Gina) which was wearing GPS collar as part of a bigger study. In January she displayed behaviour consistent with pregnant females. During felling she remained underground for 11 consecutive nights. When captured in April she was not lactating. Circumstantial evidence suggests that she may have lost cubs during this period of disturbance. We suggest amending forestry guidelines. We recommend that felling should not take place during January – March in forestry coupes containing breeding setts. From April to June there should be a 150m exclusion zone. For the remainder of the year the exclusion zone should be 50m. Our findings are based on one incident. It would be unethical to try to replicate it. We would like to open a conversation about the guidelines so welcome comments to enda.mullen@chg.gov.ie

The Ecology of the European Hedgehog (*Erinaceus europaeus*) in Ireland

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Keywords: Hedgehog; citizen science; population model; diet analysis; badger.

While the hedgehog is one of Ireland's most distinctive mammals, it is one of the least studied. Naturalised in Ireland since its introduction around the 12th Century, the hedgehog is neither an invasive species nor a pest. It is not considered a species of conservation importance though it is protected by the Wildlife Acts. There is a perception that the species is widespread and common in Ireland, but no census of the hedgehog population has yet been carried out.

In Britain and Europe, research indicates that the numbers of hedgehogs are in steep decline due to habitat loss caused by intensification of agriculture and urbanization. There is also evidence that hedgehog densities are now higher in suburban habitats than in rural areas. Ireland has suffered many of the same ecological problems as Britain, and it would seem likely that the hedgehog population has followed a similar trend here.

This research will address key questions about how hedgehogs are distributed on the island of Ireland across urban and rural habitats. It will also investigate the role of human activity and interactions with other animals in determining hedgehog abundance and distribution. Citizen science surveys and landscape and habitat level population studies will be used to model the hedgehog population. Terrestrial invertebrate surveys along with faecal analysis of badger and hedgehog scats will be used to investigate intra-guild competition and predation. Road kill records and data from admissions to wildlife rescues will provide additional information on hedgehog mortality.

BATLAS 2020: An All-Ireland Bat Distribution Survey

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Keywords: Chiroptera; pipistrelle; Daubenton's bat; citizen science

BATLAS 2020 is an Ireland-wide survey of the distribution of four target species: common pipistrelle, soprano pipistrelle, Daubenton's bat and Leisler's bat. Nathusius' pipistrelle is a fifth target species for Northern Ireland. The majority of survey work is carried out by 'citizen science' volunteers. BATLAS 2020 follows BATLAS 2010, which was carried out a decade ago and was the first standardised bat detector-based distribution survey in Ireland. The methods used for BATLAS 2020 were broadly similar to 2010 with the most significant changes being more intensive surveying, collection of additional environmental data and the inclusion of several offshore islands.

For BATLAS 2020, 37 training courses were delivered. Two hundred and thirty seven people registered their interest in participating and 121 volunteers actively surveyed and submitted data. BATLAS 2020 surveys were carried out in over 800 10km squares from 2016-2019 (representing +80% of the island). Over 3,500 survey sites were surveyed for BATLAS 2020 which was almost double the number of sites surveyed for BATLAS 2010.

Detection rates across target species followed a similar order to those for the BATLAS 2010 study with soprano pipistrelle being the most commonly detected, followed by common pipistrelle, then Leisler's and Daubenton's bats. However, some species were recorded at higher rates during BATLAS 2020 compared with BATLAS 2010 at both the 10km square and the individual site level. For example, common pipistrelles were recorded at just over 40% of sites during BATLAS 2010, but at over 53% of sites during BATLAS 2020. Other findings from the BATLAS 2020 survey will be also discussed.

Comparative Behavioural Analysis of Asiatic Lions (*Panthera leo persica*) at Fota Wildlife Park.

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Keywords: Behaviour; captive; lions; welfare; enclosure.

It has been shown that understanding the behaviour of captive animals is important for analysing their welfare in a non-invasive way. Enhancing the care of captive animals can help to improve species typical behaviour and increase breeding success. Considering the importance of breeding programmes to the status of populations in the wild, this area of research plays an important part in conservation projects worldwide. This study examines the behaviour of six Asiatic lions *(Panthera leo persica)* housed at Fota Wildlife Park, Co. Cork, Ireland. Behavioural data were collected using focal, scan and ad libitum sampling. The results showed that the pride spent the majority of their time engaged in inactive behaviours. The six individuals were compared using Mann Whitney U tests, Chi Square tests and Spread of Participation Indices to determine similarities and differences in behaviour. Results showed that, between the adult and juvenile males, cheek rubbing, climbing and playing were significantly different. Between adult and juvenile females there were no statistically significant differences in behaviour. When examining how visitor numbers affected behaviour there were ten associations seen. The test performed on data examining how time of day affects behaviour found six associations. Results also showed that each individual lion used the different areas of their enclosure in an uneven way. The reasons for the uneven usage warrant further investigation. The study showed a wide variety of behaviours and a low percentage of abnormal or stereotypic behaviours, indicating positive welfare amongst the six lions. Understanding their behaviour is key to ensuring their continued breeding success and contribution to the European Endangered Species Programme.

Protecting Dublin's fallow deer (*Dama dama*): identifying and mitigating the impacts of human-deer feeding interactions in a public park.

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Keywords: Behavioural ecology; management; human wildlife conflict; nature and humans; feeding interactions; animal welfare.

Approximately 600 fallow deer (*Dama dama*) currently inhabit Phoenix Park, Dublin. This population has experienced a recent spike in human-wildlife conflict in the form of self-motivated, visitor feeding interactions. This is a major public safety and deer welfare concern, with little consensus on how to manage it. Our study aims to identify the effects of tourist feeding on deer ecology and behaviour, reduce these interactions effectively, and develop a model management plan that is applicable to other areas also experiencing this issue. We are performing a study with a before-during-after design to (1) evaluate the severity of the issue, (2) implement appropriate management techniques and (3) quantify their success. We collected empirical data on deer-human interactions, showing for the first time that only a fraction of the entire population actually engages repeatedly in such interactions (~24% of males, ~18% of females). This highlights the potential for artificial selection processes mediated by food provision and increased stress due to inter-individual competition for food. The implications of this provision of recorded unregulated foods for deer species' ecology is discussed. The model management plan currently under implementation is outlined and short-term, preliminary impacts are explored.

The relationship between small mammal ecology, tick pathogen prevalence, and Lyme disease risk.

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Keywords: Lyme disease; ticks; small mammals; disease ecology

Lyme disease is the most common tick-borne disease in Europe, and its incidence is increasing. The pathogen which causes Lyme disease in humans, *Borrelia burgdorferi*, also has the ability to infect a range of mammalian hosts. As a zoonotic vector-borne illness, Lyme disease risk is influenced by environmental factors affecting ticks, including climate, habitat fragmentation, and mammal diversity. The 'dilution effect' postulates that a high level of host biodiversity can reduce the human incidence of Lyme disease. Furthermore, it has been reported that the influence of predator abundance on host community structure is also a factor which affects Lyme disease risk. This project critically reviews the evidence supporting mammal diversity as a possible mechanism by which the risk of Lyme disease in humans may be reduced. We also present the methodology for a planned study which aims to elucidate the relationship between mammal community structure, tick pathogen prevalence and the epidemiology of Lyme disease in Ireland.

First evidence for the role of water turbidity in grey seal bycatch

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3. South West Regional Inshore Fisheries Forum.
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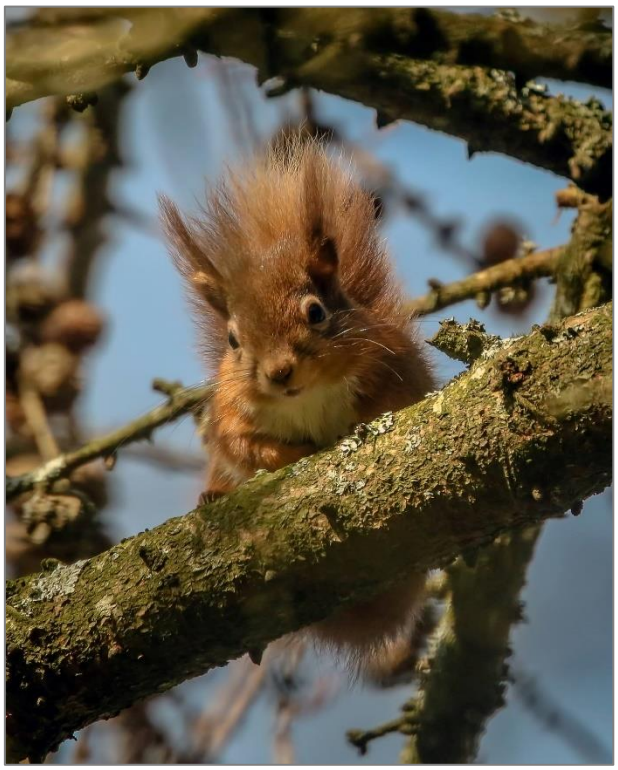
Keywords: Bycatch; gillnets; grey seal; earth observation; turbidity

Bycatch of protected species in static net fisheries is a global conservation concern and is currently considered the dominant anthropogenic threat to many marine mammal species worldwide. Effective bycatch mitigation remains challenging, contingent on an understanding of the underlying mechanisms that cause individuals to become entangled. We combined data collected by scientific observers and fishers to identify predictors of seal bycatch in static net fisheries along the west, southwest, and south coasts of Ireland. We first analysed the broad regional and seasonal trends in seal bycatch before identifying environmental variables that could potentially explain these patterns. Based on negative binomial generalised linear mixed effects models, the rate of seal bycatch significantly varied with season and region, and decreased at greater distances to major seal colonies and lower water turbidity. Our results suggest that distance to major seal colonies was a significant driver of the observed regional differences in seal bycatch rates, and water turbidity a major driver of seasonal trends. These findings will enable us to identify future bycatch risk and target mitigation measures accordingly. This is the first study to identify the effect of water turbidity on bycatch of a protected marine species. Increasing net visibility in turbid waters may provide a novel approach to mitigating against protected species bycatch in static net fisheries.

FINAL WORDS



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If you have any feedback, please email us at: allirelandmammalsymposium2019@gmail.com

The AIMS 2019 Committee

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