Abstract Booklet
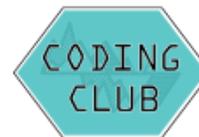## 12th-14th January 2022

Sea Mammal Research Unit

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Contents

Session 1

Spatial Ecology, Foraging Ecology and Behaviour

Environmental Drivers of Harbour porpoise (Phocoena phocoena) Distribution in the Irish Sea.

Leonie Lepple &

Peter Evans

Bangor University

Understanding spatiotemporal variation in cetacean distributions is critical for improving their protective status and area management, as well as preventing habitat loss caused by increasing anthropogenic threats. In the Irish Sea, hotspots in the distribution of highly mobile and widely abundant harbour porpoises (Phocoena phocoena) are relatively well known, but information on the underlying ecological causes is scarce. This study used a collated sightings dataset by the Sea Watch Foundation, from aerial and vessel- based surveys from April to September, 1990 to 2019, to perform habitat association models in four different study areas: the Celtic Deep, Cardigan Bay, North Anglesey, and the Irish Sea Front. Generalised linear models were used to analyse porpoise presence and absence in relation to a set of environmental and survey variables; it was identified that the probability of sighting increased the more time was spent and area covered in the survey. Predominantly, all relationships with the chosen environmental variables were weak but nevertheless significant; porpoises most often occurred when annual temperature variance was <9 °C and depth ranged between 20 - 90 m. Seabed roughness, average salinity, and thermal stratification also indicated preference for particular areas, serving as proxies for localised habitat heterogeneity and subsequent prey availability. The study found that commonly accepted environmental factors from existing literature applied to harbour porpoises in the Irish Sea. These provided valuable insight to their distribution and inferred that porpoises were most likely to occur where prey was abundant and easy to catch.

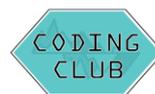## Spatial Ecology, Foraging Ecology and Behaviour

Ecological Consequences of Orca Predation on Seals (ECOPredS): Killer Whales in Scottish Waters.

Julia Sutherland,

Saana Isojunno, Gordon Hastie, Karen Hall, Ross Culloch & Peter Tyack

University of St Andrews

Predators mediate prey populations through consumptive (mortality) and non-consumptive (behavioural) effects. Predation by apex predators such as killer whales (Orcinus orca) have been implicated in the decline of mesopredator populations, (e.g., pinnipeds in north-east Pacific), and predation-risk can alter phenotypically plastic prey traits with the potential to culminate in fitness consequences for individuals and populations. Harbour (Phoca vitulina) and grey seals (Halichoerus grypus) are undergoing contrasting population trends in Scotland, with strong regional declines in harbour seal populations observed in the north and east mainland as well as the Northern Isles. Killer whales are known to predate seals in coastal Scottish waters, however the extent to which they consume specific seal species (harbour vs grey) or age classes (juvenile vs adult) in comparison to other prey species (e.g., harbour porpoise) is unknown. ECOPredS is a collaborative project aiming to address this data gap and further investigate predator-prey interactions of killer whales and seals in coastal Scotland, considering both consumptive and non-consumptive effects. The project utilises a variety of datasets including citizen science (sightings, images, drone footage), acoustic monitoring, seal telemetry, seal population data, and seasonal fieldwork conducted on Shetland to quantify the top-down effects killer whales elicit on regionally vulnerable harbour seal populations. The different data source will be integrated to quantify 1) prey species and age class composition, 2) spatiotemporal variability in prey availability and preference/predation risk, and 3) social foraging tactics. An energy budget approach will aid the estimation of killer whale food requirements. Analysis challenges include citizen science data quality control, uncertainty in prey species identification, representative sampling and missing data. Research outputs will be used to inform the conservation and management of both predator and prey species, and will further understanding of the ecological drivers and consequences of an apex predator-prey interaction in Scottish waters.

Spatial Ecology, Foraging Ecology and Behaviour

Social play and skill development in juvenile male bottlenose dolphins

Kathryn G. Holmes,

Michael Krüzten, Livia Gerber, Simon J. Allen, Amanda R. Ridley, Richard C. Connor, Stephanie L. King

University of Western Australia (visiting University of Bristol)

Play has been defined as spontaneous, exaggerated, repetitive behaviour that occurs in a stress-free environment and includes socio-sexual behaviour. Given the lack of obvious immediate fitness benefits to actors or recipients, the selection forces influencing play behaviour are of great interest. In Shark Bay, Western Australia, male bottlenose dolphins (Tursiops aduncus) form decades-long alliances with unrelated peers. In these alliances, males work together in pairs or trios, engaging in joint action to herd single oestrus females for mating opportunities. Social behaviour among juvenile males and females in this population frequently consists of socio-sexual play, including play herding, in which individuals take turns practising mature male (actor) and female (receiver) roles. Despite the potential role of play in social bonding and high investment in play behaviour by juvenile dolphins, its function remains unknown. Here, we use 40 hours of detailed behavioural observations to investigate the function of social play in the context of an alliance mating system, including whether play allows juvenile males to bond with potential alliance partners and practise future mating skills. We show that males significantly increase time spent socialising over the course of the juvenile period (p = 0.002), during which they engage in socio-sexual play with their male peers. Social play was characterized by males of all ages taking turns in both actor and receiver roles, with social bond strength significantly predicting the rate of joint action by juvenile male dyads (p = 0.006), supporting the practise hypothesis. Males who spent more time socialising together had stronger social bonds (p < 0.0001), supporting the social bonds hypothesis. Sexually mature males form alliances based on social bond strength during the juvenile period, and our results show that social play allows juvenile males to strengthen their social bonds and practise joint action skills with future alliance partners.

Spatial Ecology, Foraging Ecology and Behaviour

Fine Scale Distribution and Encounter Rates of Common Dolphins *Delphinus delphis* in the Istanbul Strait

Tim Awbery,

Aylin Akkaya, Charlotte Smith, Sheryl Bradley, Lewis Hawkins, Tara Terpering, Hallie Repeta, Nuala Hanley, Ally Russel, Laura Rudd and Belen Yıldırım

University of the Highlands and Islands/ Scottish Association for Marine Science

Common dolphins in the Mediterranean have seen great declines in recent decades, with increasing fragmentation of habitats due to numerous anthropogenic stressors. Despite this, in the Eastern Mediterranean, attempts to identify critical areas from common dolphins have been limited. The Istanbul Strait, connecting the Black Sea to the Mediterranean, is one such area with continuous imbrication of human threats and cetaceans. Land- and Boat-based surveys were conducted between 2011 and 2013 with additional opportunistic boats surveys completed in 2017 and 2020. In total 1,630 hours of survey were carried out across all seasons. A custom Python script was used to divide the Strait into 500m x 500m grid cells before totalling survey effort in each cell and calculating seasonal encounter rate. Common dolphins were observed throughout the Strait with seasonal variation in distribution. Virtually the entire Strait was used by dolphins in the summer, with only the northern region used in winter. Encounter rate also varied by season, with the highest mean encounter rate across grid cells of 1.9 individuals/hour in the summer and just 0.07 individuals/hour in autumn. The results presented provide the first baseline seasonal data for the Istanbul Strait and identify the northern area of the Strait as important across all seasons. As previous studies on cetaceans have identified vessel type, vessel speed, intensity of marine traffic, and distance from the dolphin group having an effect on cetaceans, protection is recommended in the north with seasonal management suggested in the central region in spring and summer.

Acoustics

Don't stop the revolution – Humpback whale song revolutions continue to spread from French Polynesia to Ecuador

Josephine N. Schulze

Judith Denkinger, Javier Oña, M. Michael Poole, Ellen C. Garland

University of St Andrews

Cultural transmission of behaviour is an important aspect of many animal communities ranging from humans to birds. Male humpback whales (Megaptera novaeangliae) sing a repetitive, highly stereotyped, socially learnt and culturally transmitted song display that slowly evolves each year. Most males within a population sing the same song type, but in the South Pacific, song 'revolutions' have led to rapid and complete replacement of one song type by another introduced from a neighbouring population. Songs spread eastwards, from eastern Australia to French Polynesia, but the easterly extent of this transmission is unknown. Here, we investigated whether song revolutions continue to spread from the central (French Polynesia) into the eastern (Ecuador) South Pacific region. Similarity analyses using three consecutive years of song data (2016-2018) revealed that song themes recorded in 2016 French Polynesian song matched song themes sung in 2018 Ecuadorian song. This suggests easterly transmission of song from French Polynesia to Ecuador, and vocal connectivity across the entire South Pacific Ocean basin. This study demonstrates songs first identified in western populations can be transmitted across the entire South Pacific, supporting the potential for a circumpolar Southern Hemisphere cultural transmission of song and a vocal culture rivalled in its extent only by our own.

Acoustics

Towards automated classification and categorization of Northeast Atlantic odontocete vocalizations

Tristan Kleyn

University of St Andrews

The production and perception of sound is common to all species of animal, making it a valuable resource for ecology. Passive acoustic monitoring (PAM) enables researchers to collect previous unattainable scales of ecological data across a wide range of habitats.

Acoustics

Variation of sperm whale occurrence and acoustic behaviour in the Western Indian Ocean using a deep learning click detector

Karthik Ashok,

Salvatore Cerchio, Andrew Willson, Suaad Al Harthi, Maia Willson, Luke Rendell

University of St Andrews

Sperm whales have been documented around the western and northern Indian Ocean through recent decades from incidental and scientific data records, such as Russian and Norwegian whaling catches, strandings, opportunistic surveys, and dedicated marine mammal surveys. Although primary observations on this species were conducted, systemic surveys for population assessments are necessary for their regional conservation status. Automated machine learning expedited the study of cetaceans in recent years, from their employment on passive acoustic monitoring data to detect and identify cetacean signals with minimal bias4. Neural Networks (NN) algorithms extract relevant features from large datasets to perform detection and classification tasks at minimal computational costs. Despite proving to efficiently study acoustic behavior of sperm whales such as coda patterns, deep learning algorithms are only efficient on region-specific populations until now. The study aims at assessing population presence and behaviour off Oman and Madagascar and improving the capacity to detect signature vocal patterns of the regional population. A neural network model will be tested on detecting sperm whale clicks and therefore look at seasonality as well as vocal behaviour, following which vocal patterns such as codas may be identified. The substantial scope will ensure that a Neural Network model is available to identify basic population characteristics across multiple temporal and spatial scales. Population-based social structures and ethology can further be understood in a cost-efficient manner. On a conservation level, this research will help develop IUCN Red List regional assessments of sperm whales in the Indian Ocean.

Acoustics

Spatiotemporal variation in harbour porpoise (Phocoena phocoena) detections in Scottish waters

Helen M. Hiley,

Steven Benjamins, Kate Brookes, Paul Thompson & Ben Wilson

University of the Highland and Islands/Scottish Association for Marine Science

The harbour porpoise (Phocoena phocoena) is a small, highly mobile cetacean, which is found throughout the world in temperate waters. They are widely distributed throughout European waters and are the most abundant cetacean in the North Sea, with a population estimate of over 400,000 animals in the North East Atlantic (345373 in the North sea, 24370 West of Scotland). Despite their prevalence, we still know relatively little about the drivers behind porpoise presence across Scotland. Sediment type, time of day, seabed depth, slope, distance to land (50-150m), sea-surface temperature, salinity and velocity have all been found to be important factors when predicting porpoise presence. These relationships also appear to vary with location and time of year so in order to better understand these relationships across Scotland, CPOD data from over 40 locations across 9 years which have been collected as part of a number of different projects (East Coast Marine Mammal Acoustic Study (ECOMMAS), Collaborative Oceanography and Monitoring for Protected Areas and Species (COMPASS), Static Acoustic Monitoring of Scottish Atlantic Seas (SAMOSAS)) will be used to determine trends in porpoise presence and determine what differences, if any, exist across Scotland. A focus will be made on diel, seasonal and foraging/social behaviour of harbour porpoises based on the click train characteristics, and the importance of the above environmental variables will be addressed.
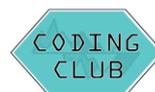
Anthropogenic activities: interactions, disturbance, and risks

Can You Hear Me Now? The COVID-19 Lockdown as a Natural Experiment into the Effects of Vessel Noise on Bottlenose Dolphin Communication

Laura Palmer,

Paul Thompson, Virginia Iorio-Merlo, Nathan D. Merchant, & Stephanie L. King

University of Bristol

The interruption of socio-economic activity during the COVID-19 lockdown provided an unintentional natural experiment into how human behaviour impacts various aspects of the natural world. Anthropogenic noise in the marine environment has increased dramatically in recent decades, with consequences for vocal communication in cetaceans. Several studies have shown that increases in vessel traffic can affect the source level, duration and/or frequency parameters of dolphin whistles, but it is unclear from these studies whether the changes in whistle parameters were driven by shifts within individual whistle types, or switches to different whistle types in the whistle repertoire. In the Moray Firth, Scotland, COVID-19 lockdown measures led to reduced vessel traffic for a period of several months, providing a rare opportunity to assess dolphin vocal plasticity in the context of a sustained reduction in vessel presence. We used passive acoustic data collected from two sites in the Moray Firth in 2018 and during the COVID-19 pandemic in 2020 to assess the effect of noise on the whistle characteristics of bottlenose dolphins. We quantified whistle signal-to-noise ratio and categorised whistle types using an automated adaptive resonance theory neural network with dynamic time warping (ARTWARP). We compared the frequency content and duration of individual whistle types (i) between years and, (ii) between sites, where vessel traffic was differentially affected by the lockdown measures. We found a significant effect of noise on whistle type duration between sites ($p < 0.0001$) and other effects on frequency parameters. We discuss what our findings tell us about adaptability and vocal plasticity in this species.

Anthropogenic activities: interactions, disturbance, and risks

Sweating the small stuff: improving understanding of the presence of smaller vessels in regions of high marine mammal activity around Scotland's coast

Emily Hague,

Alice Walters, Emma Steel, Katie Dyke, Rachel Shucksmith, Kathryn Allan, Karen Hall, Teresa Fernandes & Lauren McWhinnie.

Heriot Watt University

Understanding, and then subsequently monitoring and managing human activities in the marine environment is inherently challenging. Challenges include limited data, a limited understanding of environmental interactions within marine ecosystems, and the inherent complexities of managing species and activities that traverse multiple jurisdictions. In order to assess and understand the degree of impact or potential risk an activity poses, we first must know where and when that activity is taking place. For many 'static' actions, this information is relatively easy to obtain and characterise, but this is not true for all uses, especially 'mobile' actions. For example, vessel activity is highly mobile, and so understanding the potential risk posed in space and time can be challenging. This is, in part, because the vessel tracking system known as 'Automatic Identification System' (AIS) is only legally required to be broadcast by vessels over a certain tonnage or length, working commercially, or carrying a certain number of passengers. This means that without targeted data collection there is only a limited understanding of the presence and distribution of non-AIS vessels, such as small fishing boats, recreational vessels, kayaks and jetskis, despite non-AIS vessels constituting a significant portion of sea users. This is important, as these types of (more commonly non-AIS) vessel may be associated with several potential impacts to marine mammals, including underwater noise exposure, strike, and behavioural disturbance.

We present the Scottish Vessel Project, a collaborative initiative exploring several approaches to determine the proportion, quantity and types of vessel traffic not captured using traditional vessel monitoring techniques. This work will provide a fundamental step towards understanding how much vessel activity is not currently captured within AIS databases, and will allow quantification of the potential spatial and temporal overlap of vessel activity with the whales, dolphins, seals and other wildlife that inhabit Scotland's coastal seas.

Anthropogenic activities: interactions, disturbance, and risks

The closer the better? Changes in the communication of Common dolphins (Delphinus delphis) induced by swimming with dolphin activities

Luana Clementino,

Fadia Al Abbar, Stephanie Barnicoat, Lorenzo Fiori, Laura Gonzalez Garcia, Sean O'Callaghan, Anne Grundlehner, Brendan Godley, & Nick Tregenza

University of Exeter

The short beaked Common dolphin (Delphinus delphis) is amongst the most sighted species in the Azores and is highly targeted by whale watching companies, as well as for swimming with dolphins. These activities have the potential to impact the behaviour of the animals. However, there is limited information on the communication of common dolphins and their vocal responses to these activities. Using a towed hydrophone aboard a research vessel, the acoustic behaviour of common dolphins was monitored in a baseline setting and during simulated approaches as would be undertaken by swimming with dolphin operators. Short term changes in vocalisation type, rate of production and duration of calls were assessed during the baseline period as well as before and after the approaches. Preliminary results indicate an increase in vocal rate production as well as greater diversity of calls produced during the approaches in comparison to the baseline. Additionally, these parameters remained elevated after the approaches. These data afford the first insight into the acoustic behaviour of common dolphins in the absence of proximate boats and provides evidence for short term changes in the communication of this species induced by swimming with dolphin activities. To avoid long-term consequences on common dolphin populations in the Azores, the effects of these interactions call for a monitoring programme to ensure the sustainability of this activity and inform management.

Anthropogenic activities: interactions, disturbance, and risks

Assessing harbour porpoise habitat use in the Rockabill to Dalkey Island SAC.

Fiona Cummins,

Simon Berrow, & Joanne O'Brien

Galway-Mayo Institute of Technology

The Rockabill to Dalkey Island Special Area of Conservation (SAC) was designated for harbour porpoise in 2011. A number of dedicated transect line surveys have been carried out in this area over the last 13 years. In 2008, 2013 and 2016 NPWS tendered surveys were conducted by the IWDG. The results from the 2008 surveys carried out in the waters east of north Co. Dublin and Dublin Bay highlighted the importance of this area for harbour porpoise and led to the designation of this SAC. The 2013 and 2016 surveys were conducted as part of SAC monitoring requirements. Between 2015 and 2017 monthly boat-based surveys were conducted as part of the Greater Dublin Drainage Project (GDD). These surveys have shown that harbour porpoise densities remained stable over a number of years (2008-2013). However, recent surveying effort (2021) indicates that densities have decreased, a trend that has also been identified in other harbour porpoise SACs around Ireland. The aim of this research is to take a deeper dive into these historical datasets in order to assess trends through time beyond density as well as fine scale temporal and spatial habitat use. More detailed information is required for SACs so that we can move these designated conservation areas from being 'paper parks' to actively managed spaces for the species they are dedicated for. It is hoped that the results of this research will aid the transition of the Rockabill to Dalkey Island SAC from a passive to an active conservation area.

Genetics, Physiology and Health

Insights across ontogeny and sex within blubber fatty acid profiles in the northern elephant seal (Mirounga angustirostris)

Aaron Kirkpatrick,

Daniel Crocker, Shane Kanatous, Kerri Smith, Sarah Kienle, & Stephen Trumble

Baylor University

NES are characterized by distinct life history stages, with divergent energetic demands experienced across ontogeny and within sex of each age group. Prior to periods of fasting, that can last up to 4 months, NES must acquire sufficient lipid stores during long at-sea foraging trips to survive the oncoming fast. It is well known that poor body condition and inadequate lipid reserves can be detrimental to the length of fast and future success of an individual. Fatty acid oxidation provides more than 90% of energetic requirements in northern elephant seals (NES) while fasting on land, yet little is known about the composition of fatty acid (FAs) profiles in blubber across ontogeny and sex. Here, we provide a comprehensive insight into the blubber FA compositions of NES within different age classes (weaned pups, juveniles, subadults, adults) and sex. We analyzed 136 samples, spanning from 2012-2016, via gas chromatography-flame ionisation detector. Using PERMANOVA tests, we reported significant differences in blubber profiles between weaned pups in comparison to all other age groups ($p < 0.01$), and additionally adults were significantly different than juveniles ($p < 0.05$). There were no sex differences reported by PERMANOVA. Blubber profiles were highest in monounsaturated (MUFAs) FAs, reflecting the importance of MUFAs play in the blubber layer for thermoregulation and maintaining fluidity of the blubber layer of marine mammals. The individual FAs found in the highest proportions (C16:1, C18:1, C16:0) of the blubber layer were similar to previous studies in marine mammals and appear to be universal across marine mammals. Here, we will provide insights into the ontogenetic differences found across blubber FA profiles and the importance of FAs in a deep diving species adapted for a lipid-based metabolism.

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Genetics, Physiology and Health

Epigenetic ageing reveals changes in age-specific sexual selection in a recovering population of humpback whales

Franca Eichenberger,

Emma L. Carroll, Claire Garrigue, Luke E. Rendell, Debbie J. Steel, Claire Daisy Bonneville, Simon Jarman, & Ellen C. Garland

University of St Andrews

Assessing the variation in reproductive success – the fundamental prerequisite for sexual selection to act upon a trait – is crucial in understanding a species' mating system and can provide insight into population growth. Parentage analyses in cetaceans are rare, and the underlying forces of sexual selection acting on their mating behaviours, including elaborate acoustic displays, remain poorly understood. Here, we combined 22 years of photo-identification and genetic data to assess variation in male reproductive success and population recovery of an endangered humpback whale breeding population located in New Caledonia, in the South Pacific. Paternity analysis of 179 known mother-offspring pairs and 948 adult males revealed low variation in male reproductive success with an average of 1.18 offspring per father over the entire study period. Observed male skew was higher than expected under random mating (FET : p = 0.01) but low relative to other polygynous species, including other aquatically-mating mammals. Differences in male reproductive success were further explored by assigning ages derived from the humpback epigenetic age assay to understand whether age was a factor in male reproductive success. Finally, the male breeding population was preliminarily estimated to consist of 2,266 [95% CI: 1898, 2636] males and showed a growth rate of 1.53% [95% CI: -0.45, 3.56] over the study period . The observed low reproductive skew is in line with findings of other humpback whale populations   and further emphasizes the discrepancy of genetic estimates of paternity and predictions of the proposed polygynous social mating system in this species. Alternative mating tactics and/or female choice may counterbalance within-sex variation in reproductive success and should be considered when investigating the factors affecting male reproductive success and the underlying function(s) of humpback whale song.

Genetics, Physiology and Health

Baleen whale blow - a minimally invasive source of DNA for conservation genetics and kinship analysis?

Éadin O'Mahony,

Janie Wray, Angela Sremba, Scott Baker, & Oscar Gaggiotti

University of St Andrews and University of Copenhagen

In coastal British Columbia, Canada, marine megafauna such as humpback whales (Megaptera novaeangliae) and fin whales (Balaenoptera physalus) are the subject of a history fluctuating between the brink of extinction and steady population recovery. While their populations are in recovery, proposed natural resource ventures in this region will bring new challenges, thus threatening these elusive species. As a tool for strengthening conservation efforts, genetics can and does play a vital role. In an effort to further decrease negative research impact on vulnerable marine mammal species, we explore the successes and challenges of collecting exhaled breath condensate (EBC) from humpback and fin whales using an unmanned aerial system (UAS, or drone), within Gitga'at First Nation territory. Our samples yielded promising results for conservation genetics. Little to no behavioural responses to the sampling technique were observed, with 87% of the 112 drone deployments showing no response at all. EBC was extracted and sequenced targeting mitochondrial (mt) and nuclear (nu) DNA, resulting in an average of 7.5 microsatellite loci sequenced and mtDNA haplotype and sex assignment success rates of 80% and 89% respectively. In turn, using this minimally invasive sampling method, we can better (1) understand its effectiveness for mapping these populations' genetic diversity; (2) generate genetic profiles for individuals; and finally, (3) pair genetic data with photo-identification and social association metadata to analyse the genetic structures of whale social networks. The results of this research show the potential for wildlife conservation and genetics to minimize levels of invasiveness, adopting novel technologies to confront vital challenges faced by conservation efforts.

Genetics, Physiology and Health

Seals as sentinels of antimicrobial resistance: mapping antimicrobial resistance genes in UK waters

Lauren Arkoosh,

Scott Cameron, Kimberley Bennett, & Debbie Russell

Abertay University

Antimicrobial Resistance (AMR) is a pressing concern for human and animal health. Bacteria containing resistance are ubiquitous in the environment, and can spread rapidly because of human and industrial waste, agriculture, and aquaculture. Many of the waste products from these processes eventually make their way to ocean waters, providing AMR-containing bacteria opportunity to disseminate. Pinnipeds are apex predators in UK waters, sampling the entirety of the water column when they forage, making them a useful sentinel species to examine AMR presence in marine environments. Here we extracted data from studies on all pinnipeds in all wild, captive or stranded contexts, including any sample type collected (e.g. faecal, nasal swab, gut content) and assessed for AMR. Fixed search terms were used to identify and extract prevalence data from studies examining AMR in pinnipeds. We examine what AMR has been tested and their prevalence, including the extent of multiple resistances. Early results of the screen presented at this conference last year will also be provided. This should be useful to both scientists and policy-makers to inform future work and assessments regarding AMR in the marine environment.
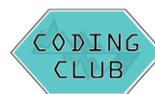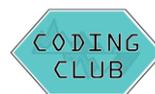
Posters

Acoustic presence of baleen whales in the North Atlantic; a case study using the humpback whale (*Megaptera novaeangliae)*

Catherine Gibson,

Suzanne Back, Jonathan Houghton, & Denise Risch

Queen's University Belfast

This PhD focusses on the use of passive acoustics as a tool for baleen whale conservation and ecosystem management. The thesis will investigate four distinct hypotheses (1) There is a distinct seasonal pattern in baleen whale presence in NI/Scottish waters which can be effectively monitored through passive acoustics; (2) Timings of detections across baleen whale breeding locations can be used to reveal/confirm potential migratory patterns; (3). The spectral characteristics of humpback whale song recorded in Northern Irish and western Scottish waters are significantly different to those in other North Atlantic locations; (4) Through a spatial representation of data, it is possible to highlight regions of risk for baleen whales in local waters. By focusing on the seasonal presence of baleen whales in Scottish and Northern Irish waters, the first chapter aims to build upon preliminary assessments of humpback whale and minke whale occurrence in this region. These results will feed into Chapter two, exploring the timings of humpback whale song across the wider North Atlantic area. This chapter aims to build and ocean basin scale understanding of humpback whale migrations. Chapter three will focus specifically on humpback whale song structure. This work will aim to investigate differences in song from breeding grounds across the North Atlantic. The fourth and final chapter of this PhD is an applied management and marine spatial planning analysis focused on local Northern Irish waters. This work aims to explore potential overlaps of baleen whale occurrence with specific human activities that are considered key threats. Collectively, this PhD aims to develop our understanding of baleen whale seasonal occurrence and connectivity between populations across the North Atlantic.
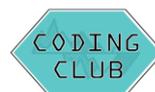
Posters

Changes in molecular pathways in grey seal blubber in relation to their life cycle and fatness

Laura Oller,

Joel Rocha, Ailsa Hall, & Kimberley Bennett

Abertay University

Fat cell size is associated to changes in gene expression and protein content in humans. Particularly, hypoxia inducible factor 1 (HIF1 α) downstream pathways have been linked to comorbidities in human obesity. However, grey seals undergo large fat depot fluctuations during their life cycle without suffering apparent metabolic complications. We investigated if grey seal blubber undergoes shifts in molecular pathways during natural loss /gain fat. Two biopsy samples from mother and pup pairs (n = 6) were collected at early and late lactation, and pups' early weaning. Samples were processed for histology and molecular biology analysis. Seal samples were divided into three sections to investigate adipocyte size and molecular pathways at different blubber depths. Adipocyte area was weakly associated with mass in adult females (LME: $p = 0.04$, R^2marginal = 0.17 R^2conditional = 0.22). Pups' adipocyte area had a strong positive association with mass, although animal identity explained ~25% of the variance (LME: $p < 0.01$, R^2marginal = 0.46 R^2conditional = 0.71). Blubber depth and metabolic state did not explain the adipocyte size variation in either females or pups. Downstream molecular pathways related to hypoxia (HIF 1α), such as OXPHOS complexes protein content, fat tissue remodelling (collagen III & VI), angiogenesis (VCAM-1), metabolism (Glut 4, PPARγ) and cell division (PCNA) were investigated. Analysis of the association between adipocyte size and molecular pathways is underway. Describing molecular shifts in a mammal with naturally high body fat will help identifying key targets for obesity studies.

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Posters

Impacts of anthropogenic activities and environmental change on the foraging ecology and nutritional status of common dolphin and its implications towards sustainable resource management

Sofia Albrecht,

Luca Mirimin, Orla Slattery, Cóilín Minto, Jean-Luc Jung, Emer Rogan, & Sinéad Murphy

Galway-Mayo Institute of Technology

Overfishing has massively depleted several target species in European waters, altering marine food webs and impacting populations of top predators. The common dolphin is one of the most abundant cetaceans in the North-east Atlantic, playing a key functional role as a top predator. Large-scale movements in recent years have resulted in increased numbers inhabiting continental shelf and contiguous waters and increased exposure, at the population level, to the direct and indirect effects of fishing. Due to their high energy requirements, common dolphins target energy-dense prey and increasingly, stranded dolphins are showing evidence of starvation/emaciation. Through availing of samples and data collected by Irish stranding and observer bycatch programmes over a 25-year period and a multi-disciplinary approach, this PhD will investigate temporal changes in diet and nutritional status in this species and identify drivers of change. Work will include conventional stomach contents analysis and progress novel molecular approaches for detecting prey DNA, to assess occurrence of dietary shifts, potential consumption of lower quality prey, annual energy requirements and prey biomass consumption. Spatial modelling will assess spatial-temporal variations in prey energy densities, and potential drivers of dolphin distribution patterns. While nutritional status indicators focusing on stress physiology will provide a greater/deeper/novel understanding of the biological pathways underpinning nutritional deficiencies in cetaceans. Through developing multiple methods of enquiry and generating new data sources and evidence based on a more complete understanding of its dietary consumption, preferences and requirements, interactions with fisheries, and changes in predator-prey dynamics due to overfishing and environmental change, work will inform policy makers and managers on the sustainable use of fishery resources, employment of a nutritional status biodiversity indicator for cetaceans, and the conservation status of common dolphins.
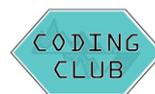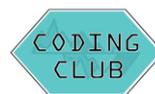
Posters

Assessment of echolocating cetacean and vessel occurrence and behaviour in offshore development sites using a novel passive acoustic monitoring system

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Offshore renewable energy developments are increasing, and so is the need to assess their impact on marine mammals. Sound is used by odontocetes, to navigate, forage and communicate. Offshore renewable energy installations are contributing to the increase in offshore anthropogenic activity, including increased noise. Thus, these installations may impact upon odontocete distributions, foraging and reproductive success. Current marine mammal surveys at offshore renewable developments include using visual and acoustic methods. Visual methods allow for real time monitoring but are limited by weather, sea states and daylight hours. They are also costly as they involve paid observers. Passive acoustic monitoring (PAM) works by detecting the presence of vocalising marine mammals. Thus, it is not affected by the same environmental conditions. However, at present, these devices are deployed and retrieved at a later date for data analysis. Hence, there is a demand for real-time acoustic monitoring. Here, we present NanoPAM, a novel low-cost PAM system designed at Newcastle University. NanoPAM provides data for monitoring of porpoise, dolphin and vessel occurrence in near real-time to the user on land via wifi, long-range-wifi or iridium sat phone. The NanoPAM devices can be deployed independently or in networks of 255 devices covering up to ~450 km2 serviced by a single sea-land communication buoy. This project aims to comprehensively assess the NanoPAM system for monitoring at offshore renewable developments. The objective is to deploy the devices at the Blyth Offshore Wind Farm, Northumberland in a series of field tests to compare its performance against other PAM systems and to ultimately use NanoPAM to assess the effects of offshore wind developments and vessel activities on odontocete occurrence and behaviour.

Posters

Effects of Vessel Presence on Mediterranean Monk Seal (Monachus monachus) Cave Occupancy in the Central Ionian Islands, Greece.

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Mediterranean monk seals (Monachus monachus; hereafter monk seals) are among the most endangered pinnipeds globally. In Eastern Mediterranean waters, monk seal haul outs and pupping sites consist almost entirely of remote and inaccessible marine caves, requiring novel and innovative monitoring methods. Monk seal presence and vessel traffic were recorded at 3 cave sites in the Central Ionian Islands, Greece between 23rd May – 30th November 2019. Seal and vessel presence were recorded using solar powered autonomous camera traps, constructed from open-source hardware and using mobile networks for data transmission. A total of 93,128 images were captured. Of 44,913 images captured within caves, seal presence was manually detected in 9,429 images. Machine-learning application 'Mirador 1.0' was used to detect vessel presence outside caves during daylight hours, totalling 27,322 images and 17,731 vessel detections. GAMs indicated that seal presence declined with vessel presence over both diel and seasonal scales. Seal presence also peaked in September. Local mooring restrictions during pupping months of September and October may be beneficial to the recovery of local monk seal populations.