



University of
St Andrews



Uk and Ireland Regional Student Chapter of the Society for Marine mammalogy

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Book of abstracts



Hebridean
Whale &
Dolphin
Trust





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Ecology I & II



Improving our understanding of the population ecology of Eastern North Pacific blue whales

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Eastern North Pacific blue whales (*Balaenoptera musculus*) are believed to be the most recovered blue whale population post commercial whaling but there is considerable variation in abundance estimates. Estimates from closed mark-recapture models based on photo-identification data estimate population size as 1,898 (CV=0.085) with a slightly increasing trend since early 1990s. Conversely, species distribution models fitted to count data from visual sightings in periodic line transect surveys estimate the population size at 670 (CV=0.43) and show a declining trend over the same time period. A shift in the distribution of the population could explain this variation and this project will use available data to examine this hypothesis. Furthermore, alternative methods of estimating abundance which account for spatial variation will be used to try and generate a more confident estimate of population size and stability. Survival is also a useful life history parameter when assessing a population, as changes in survival trends can be indicative of an impending impact on overall population size. Consequently, survival will be estimated to inform the stability of this population and future modelling of population dynamics. The project will integrate substantial long-term data sets from scientific surveys and opportunistic sightings to provide outputs that will not only inform management of this population but could also deliver insights that support conservation measures for less recovered populations of blue whales.



Site fidelity of common bottlenose dolphins (*Tursiops truncatus*) in a highly industrialized area of the Galveston Bay estuary

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Coastal common bottlenose dolphins (*Tursiops truncatus*) that inhabit urban estuaries are exposed to a myriad of anthropogenic threats. To manage and conserve these populations, it is imperative to understand their habitat use and residency patterns. In this study, we evaluated the site fidelity of common bottlenose dolphins in upper Galveston Bay (UGB), a heavily industrialized area of the Galveston Bay estuary. We aimed to identify groups within the population with varying affinity to UGB and to determine if there are resident dolphins in UGB. The Galveston Bay Dolphin Research Program conducted monthly photo-identification surveys in UGB between January 2016 and December 2019. We identified 442 distinct dolphins within UGB and used their sighting histories to calculate occurrence, permanence, and periodicity. These site fidelity metrics were incorporated into a cluster analysis that revealed three groups. Group 1 (n=192, 43%) consisted of individuals with the highest site fidelity to UGB and were classified as year-round or seasonal long-term residents. Group 2 (n=141, 32%) were transients and Group 3 (n=109, 25%) were short-term users of UGB. This study identified resident dolphins in UGB, and we recommend that this group be monitored closely, as they are particularly vulnerable to stressors in the upper estuary.



Is the Chagos Archipelago one of the last tropical refuges for cetaceans?

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The Chagos archipelago consists of five islands and several submerged atolls and banks in the tropical Indian ocean, including the Great Chagos Bank the largest atoll in the world. With a uniquely isolated and globally important marine ecosystem, a no-take Marine Protected Area (MPA) was established in Chagos which extends to the 200 nmi boundary, covers an area of 640,000 km². Corals and fish communities of the region have been studied extensively, however, cetaceans remain poorly studied. Sparse knowledge that exists on cetaceans has been predominantly opportunistic. While some acoustic data exists, the absence of visual identification and the long-range propagation of sounds underwater makes species identification and spatial determination tricky. In this project, we aim to estimate the abundance and density of cetaceans within the MPA, and their habitat usage using distance sampling methods and spatial density models. This is being done using opportunistic sightings data from platform-of-opportunity surveys aboard a patrol vessel as well as acoustic data from an array of hydrophones. The remoteness of the archipelago and its complicated geopolitics provide unique challenges for scientific exploration and an equally unique opportunity for comparison with other regions in the Western Indian Ocean, especially given its protection from threats such as bycatch. This study will determine the importance of the Chagos Archipelago for cetaceans and whether this no-take MPA is one of the last tropical refuges for cetaceans in the Indian Ocean.



Grey seal predation of marine mammals: what do we know and what could it mean?

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The predation of marine mammals by Atlantic grey seals (*Halichoerus grypus*) has been recorded throughout their range but its potential effect on populations has yet to be quantified. Here, we utilised 11 years of strandings information from the Scottish Marine Animal Strandings Scheme, along with citizen science reports from the SMRU sealpred project, and population estimates from the Sea Mammal Research Unit, to investigate the level of grey seal predation in regional populations of UK seals, and better understand how it may relate to harbour seal declines. Between 2010 and 2021, possible grey seal predation was assigned the cause of death in 68% of grey seal, 45% of harbour seal, and 19% of harbour porpoise cases, and was recorded across Scotland in all seven seal monitoring units (SMUs). Both grey and harbour seals had the highest odds of predation in the East Scotland SMU (odds ratio, OR = 1.89, 95% CI = 1.27, 2.81 & OR = 4.99 [2.50, 9.99] respectively). Predation of harbour seals in East Scotland reached a peak in 2010 at 2.4% of the predicted population estimate. The two species differed in age class, with the odds of predation higher in young, post-weaning grey seals (OR = 7.29 [4.75, 11.19]), and adult harbour seals (OR = 2.81 [1.51, 5.22]), but predation cases for both peaked in their asynchronous breeding seasons. We have so far identified at least four adult male grey seals in the Firth of Forth alone who have been observed preying marine mammals, and these direct observations suggest that strandings data underrepresents grey seal predation by at least 67%. This work is a critical first step to better understand interactions between UK seals, but also contributes to our broader understanding of interspecific interactions, providing insight into potential drivers behind population declines.



The When and Where of Strandings in India- identifying temporal trends and hotspots of marine mammal strandings along the Indian coastline.

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Strandings of marine mammals can be a result of biological, anthropogenic or environmental factors. Studying this phenomena is a cost effective tool to understand species life history, threats to the populations and overall ocean health. We collated data from numerous reports, publications and open databases through a period of 269 years (1748 to 2017) and identified distinct spatial and temporal trends of strandings along the Indian coastline. This study also demonstrates use of a spatial analysis tool Emerging Hotspot Analysis (EHA) in identifying regions of high priority for conservation and management action. There was an increase in strandings during June-September along the west coast and during December-January along the east coast throughout the study period. Rates of strandings were found to be higher at Mumbai (0.38 strandings/km), Kozhikode (0.28 strandings/km), Tuticorin (0.4 strandings/ km), Rameshwaram (1.82 strandings/km), Chennai (0.32 strandings/km) and Bhubaneswar (0.26 strandings/km). EHA identified new and consecutive hotspots along the north-west coast, and sporadic hotspots along the south-east coast of India. We recommend establishing regional stranding response centres at the identified hotspots coordinated by a National Stranding Centre with adequately trained personnel and central funding support.



Abundance and distribution of Atlantic spotted dolphins (*Stenella frontalis*) in Santos Basin, Southwestern Atlantic

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The Atlantic spotted dolphin is a common Delphinidae species in the Southwestern Atlantic Ocean. The possible existence of a geographically and genetically isolated population in the southeastern and southern of Brazil raises ecological and conservation concerns. Here we investigated distribution and estimated density and abundance of Atlantic spotted dolphins in the Santos Basin, southeastern Brazil, where anthropogenic activities likely pose risks to the dolphins. Data collection followed line-transect surveys, resulting in 13 boat-surveys between 2015 and 2021. A total of 125 groups of Atlantic spotted dolphin were recorded, mainly over the continental shelf waters of Santos Basin (< 200 m). Distance sampling analysis indicated abundance and density to vary between surveys, with the highest estimates for the summer in 2019, and the lowest for the winter in 2020. Dolphins were recorded mainly on the continental shelf ($n = 111$), followed by on the slope ($n = 9$) and in oceanic waters ($n = 5$) regions. Groups were recorded in all months (except July), mainly in autumn ($n = 51$) and summer ($n = 42$) austral seasons. This is the first abundance estimate of the Atlantic spotted dolphins in Southwestern Atlantic Ocean using distance sampling.



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

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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 seals (*Phoca vitulina*) are undergoing strong regional declines of unknown causes in the north and east mainland Scotland, 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 investigate whether killer whale predation could be playing a role in the observed harbour seal declines, through both consumptive and non-consumptive predator-prey interactions. 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. Here, I present recent findings from field observations, and discuss analysis challenges associated with citizen science data quality control, uncertainty in prey species identification, representative sampling and missing data.



Are minke whales respecting the line on the map that we've drawn for them?

Tim Awbery, Denise Risch, Ben Wilson, Lauren McWhinnie, Lauren Hartny-Mills and Joseph Onoufriou

Scottish Association for Marine Sciences

Minke whales are often encountered in western Scottish waters but despite them being regularly sighted during summer months and the recent implementation of the Sea of Hebrides Marine Protected Area, we have little understanding of their habitat usage and movements. The current study employed visual surveys along random line transects conducted between 2003 and 2019 onboard *Silurian*, the Hebridean Whale and Dolphin Trust's research vessel. Due to weather, finances and other logistics, survey effort was not homogenous across the survey area preventing the usage of traditional distance sampling methods. Density Surface Models incorporate distance sampling into traditional species distribution models to correct these models for observer bias. Density Surface Models were used to ascertain the relative importance of a range of static and dynamic environmental variables. These models were then used to generate predictions of minke whale distribution and abundance for each month of the summer season. The monthly models showed a general south-north movement and a general movement inshore as the season proceeded. The northern region appears to be the most important for minke whales in September whilst the area surrounding Stanton Bank (south-west) appears to be the most important earlier in the season. Minke whales mainly appeared to use the Marine Protected Area in June and July but were largely present in other areas during the rest of the season. These results add to our understanding of minke whale movements in western Scottish waters and should in future be considered in spatial planning and conservation management.



Distribution of cetaceans in Irish waters using aerial survey data 2015-2017 and 2021-2023

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The ObSERVE programme is an Irish Government initiative established in 2014 with the aim of providing information on the distribution and abundance of seabirds and marine mammals in Ireland's inshore and offshore waters. Given the upcoming expansion of marine renewable energy in Ireland, it is critical to obtain reliable information to assess seasonal use of the area, particularly for sensitive marine species. Extensive aerial surveys were conducted within Ireland's EEZ the summers and winters of 2015-2017 (Phase I). Phase II commenced in 2021 and will be completed by the end of winter 2022. Standard line-transect methodology was used for the aerial surveys, with a search area extending out to 500 m on both sides of the aircraft for all cetaceans. A total distance of 16,802 km and 20,295 km were covered on effort in 2015 and 2016, respectively. Survey effort for 2021 was 12,263.45 km and 19,275 km for the summer of 2022. In Phase I, 1,844 cetacean sightings were recorded, with at least 19 species observed throughout the survey area. At present, a total of 1,009 cetacean sightings were logged and 19 species encountered in Phase II. Using the data collected from the ObSERVE programme, we aim to achieve the objectives of (i) modelling the habitat of harbour porpoises, an Annex II species of the EU Habitats Directive, and comparing different spatial resolutions of multiple environmental covariates to identify which better predicts their distribution; (ii) assessing the effects of prey fish, fishing and vessel activities on the distribution of harbour porpoises; and (iii) delineating areas of ecological importance for cetaceans. Key outputs are expected to provide valuable information for harbour porpoise conservation efforts and marine spatial planning, and novel insights into cetacean ecology in Irish waters.



Life in the Tropics: investigating latitudinal movements of killer whales with stable isotopes

Maeva Terrapon, Rona McGill, Jason Newton, Cory Matthews, Philip Hammond and Sascha Hooker

Killer whales (*Orcinus orca*) are large apex predators which are distributed globally. Many high-latitude populations have been extensively studied due to their high site fidelity and coastal habitat, but very little is currently known about the ecology of tropical populations.

Stable isotope studies of marine mammals have already proven to be very useful to investigate ecological questions about cryptic and under-studied species, primarily focusing on dietary analyses using carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$). More recently, the oxygen ($\delta^{18}\text{O}$) isotope has been used as an indicator of large-scale movements of marine mammals based on correlation with seawater salinity and latitudinal variation at ocean basin scales, with higher $\delta^{18}\text{O}$ concentration levels in warm waters compared to the cold waters in high latitudes. Oxygen is integrated with low fractionation levels into tissues such as tooth dentine, which accumulates on the tooth of killer whales in annual growth layers that once deposited remain unaltered.

Killer whale teeth from stranded individuals found in tropical and sub-tropical locations globally will be sectioned and drilled to extract dentine powder from each visible growth layer of a tooth. Individual time-series of oxygen isotope levels in dentine will be obtained by stable isotope analysis to investigate seasonal and annual variations in an individual isotopic signature. The known large difference in water isotope values between high and low latitudes will be observed in isotope profiles from migrating animals and will confirm or refute the existence of latitudinal large-scale movements in killer whale populations encountered in the tropics. This information is not only important to better understand the ecology of killer whales in tropical waters globally, but also to help identifying the potential connectivity between temperate and tropical killer whale populations.



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Virtual presentations



Patterns of specificity in whale-lice: geographic and phylogenetic influences

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Whale-lice (*Cyamidae*; *Isocyamus*, *Cyamus*, *Balaenocyamus*, *Neocyamus*, *Syncyamus* and *Scutocyamus spp.*) are ectoparasitic amphipods found exclusively on cetaceans, where they feed on their epidermis and are transmitted by contact. The available records suggest a variable degree of whale-lice specificity, with some species occurring on one or two cetacean species and other parasitizing a broad range of hosts. However, patterns of specificity have never been quantified, and the factors accounting for differences in specificity are poorly known. We explored this issue based on geographical and phylogenetic evidence. First, we performed a systematic review of existing whale-lice records and georeferenced them whenever possible, obtaining 357 data points from 121 scientific articles. For each whale-lice species, we also plotted the distribution range of their cetacean hosts to visualize distribution boundaries and possible areas of host-switching. Second, we examined the phylogenetic relationships among cetacean hosts for each whale-lice species. We found that some species parasitize phylogenetically related cetaceans even at geographically isolated areas (e.g., *Cyamus gracilis*, *Syncyamus aequus*), whereas others colonize phylogenetically distant cetaceans that share particular geographic regions (e.g., *Cyamus boopis*, *C. catodontis*, *Isocyamus delphinii*, *I. deltobranchium*, *Neocyamus physeteris*). A puzzling result was that some whale-lice are associated to cetaceans that are both geographic and phylogenetically separated (e.g., *Cyamus monodontis*). It is possible that misidentification may have occurred in some cases (e.g., wrongly assuming the same identity of whale-lice specimens found in disparate hosts or localities); however, the possibility of cryptic speciation within this family should be addressed in future studies.



Cambodian coastal cetaceans: abundance, distribution, and bycatch

Sarah Tubbs

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Irrawaddy dolphins, Indo-Pacific humpback dolphins and Indo-Pacific finless porpoises are commonly occurring coastal cetacean species in Cambodia. These species are classified as Endangered, Vulnerable and Vulnerable, respectively on the IUCN Red List and face specific threats from fisheries bycatch (often in Illegal, Unreported and Unregulated fisheries), habitat degradation and prey depletion. Whilst the species are protected by national fisheries law, lack of species-specific baseline data on abundance, distribution, and threats, hinders the establishment of tailored and effective management strategies. The current project seeks to fill these baseline knowledge gaps throughout the coastal waters of the Cambodian coastline. Line-transect (distance) and capture-recapture (photo-id and SIGID) techniques will be used to estimate abundance. Estimates will be compared for validation, to investigate differences and to inform future method selection. Explanatory and predictive habitat modelling approaches and long-term passive acoustic monitoring techniques will be used to investigate spatio-temporal distribution. Fisher questionnaires will be used to investigate fishery and species-specific bycatch rates. Combined findings will be used to conduct evidence-based conservation status assessments. Gained knowledge can be used by resource managers to guide conservation efforts and to shape and monitor species management strategies.



Cultural evolution of close-range killer whale calls

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The killer whale (*Orcinus orca*) is a model species for cultural evolution studies in cetaceans because these whales are easily recognizable individually and possess culturally transmitted repertoires of stereotyped call types, called vocal dialects. Resident (fish-eating) killer whales in the North Pacific live in stable matrilineal groups; both males and females stay in the natal group for life. New groups form through a gradual fission of a matriline after matriarch's death. The stable social structure facilitates long-term studies of the evolution of vocal repertoires. Previous studies were mostly focused on long-range killer whale calls, which are more stereotyped and group-specific. Here we present analysis of similarity patterns of close-range calls in order to estimate whether they change in time in similar ways as long-range calls.

We analyzed more than 16 hours of recordings of resident killer whales sounds, recorded during 13 FEROP (Far East Russia Orca Project) expedition seasons from 2005 to 2022 in Avacha Gulf (Eastern Kamchatka, Russia). We used recordings obtained during encounters with only one matriline at a time in order to describe the specific repertoire of each matriline. We extracted close-range call types K1 and K12 and created a detailed subtype classification for each of these call types. We used a custom-made MATLAB script for manually tracking frequency contours and compared them using dynamic time warping. We also analyzed the occurrence patterns of different subtypes across matrilineal groups and compared them to the occurrence of long-range calls. We will discuss how the patterns of similarity and occurrence of long-range and close-range calls are alike and different, and what this implies about their cultural evolution.



Evaluation of the presence of Mediterranean Monk Seal sounds in underwater acoustic recordings at Madeira Archipelago (Portugal)

Sebastian Muñoz-Duque, Paulo Fonseca, Manuel Vieira and Clara Amorim

Ghent University (IMBRSea)

The Mediterranean monk seal *Monachus monachus* is one of the most threatened pinnipeds in the world. To devise appropriate monitoring and conservation measures, knowledge on behaviour and life history of the species is required. Little is known, however, about the underwater vocalizations produced by this seal and studies on their potential use for monitoring the presence of the species have not been conducted in the Mediterranean Sea or the Northeast Atlantic, areas encompassing the current distribution of the species.

The Madeira Archipelago (Portugal) holds a small population of this seal. To evaluate the potential use of Passive Acoustic Monitoring (PAM) to monitor its presence, long-term acoustic recordings were carried out in the Marine Protected Area (MPA) of Desertas Islands, a place where the seals are recurrently observed, and in the Garajau Partial Nature Reserve with anecdotal observations registered. The recordings were obtained throughout the summer (June-September) of 2021. Although during the 1980s the population was restricted to the archipelago Desertas Islands, recent observations have shown an increasing presence in the southern areas of Madeira Island (including Garajau). Putative seal sound types found in the recordings will be described and contrasted bioacoustically with the species' aerial vocal repertoire available in the scientific literature as well as with descriptions of underwater vocalizations of the close seal species (*Neomonachus schauinslandi*).

If underwater vocalizations of the monk seal are found in the recordings, this study will shed new light on the underwater vocal repertoire of this endangered species and will provide the basis for a long-term passive acoustic monitoring program in the Madeira archipelago.

The study will be included on a thesis proposal framed by the International Master of Science in Marine Biological Resources program (IMBRSea).



Investigating the spatial interactions between bottlenose dolphins (*Tursiops truncatus*) and marine vessels across the coastline of Montenegro, South Adriatic Sea

Evie White, Anthony Knights, Aylin Akkaya and Tim Awbery

University of Plymouth

Marine vessel disturbance is known to affect cetacean species globally and is particularly prevalent in coastal waters. This disturbance is multidimensional as it causes both physical and acoustic disruption, which can be very invasive for odontocetes. Montenegro's booming tourist industry and large artisanal fishing fleet, highlight the importance of studying the relationship between marine traffic and bottlenose dolphins (*Tursiops truncatus*) in its coastal waters. Additionally, examining variables across the country will uncover key sites of importance where enforced conservation management must be implemented to minimise interactions. Data was collected from land-based surveys, these were completed at predetermined locations between 2016 and 2021. Dolphin presence likelihood across the north, middle and southern regions of the Montenegrin coastline was tested via a multinomial logistical regression. An ANCOVA tested sighting duration with increasing vessel abundance during surveys, and a proportional test was used to highlight spatial patterns. The multinomial logistical regression results showed a significant relationship between region and dolphin presence, with the North displaying the highest likelihood of presence. Additionally, results showed that bottlenose dolphins remained at sites despite an increase in vessel abundance during surveys, these patterns varied across the north, middle and southern regions. Further analysis uncovered that only <20% of marine vessels within close proximity of focal groups were within the zone of disturbance (<400m). This final test displays a clear pattern of vessel evasion, and that despite persistence, avoidance is occurring. This study highlights that bottlenose dolphin presence is continuing in Montenegro despite ongoing boating disturbance, this underlines the ecological importance of its marine habitats for this species. It is of the utmost importance that further strategies to minimise marine traffic and dolphin interactions are implemented in Montenegro, particularly in the Boka-Kotorska Bay due to this being an area of intense overlap.



An investigation of parasite infections of common dolphins, *Delphinus delphis*

Sewwandi Alwis, Katie O'Dwyer, Sinead Murphy and Sofia Albrecht

Atlantic Technological University

Parasites play an important role in the natural history of cetaceans. Study of parasites of marine mammals is important as they represent a substantial facet of biodiversity, cause diseases, are useful markers providing information on host ecology, biogeography and phylogeny and they impose threats to public health as well as economy (Aznar et al, 2002). A range of both micro- and macroparasites have been identified in cetaceans (Bressemer, Van Waerebeek, and Raga, 1999; Aznar et al, 2002) but we still know little about many of these and there are many more yet to be discovered.

Of the 24 cetacean species reported in Ireland, the common dolphin (*Delphinus delphis*) is a resident species and shows year-round presence and it is the most frequently reported species stranded on the Irish coast (Conservation Plan for Cetaceans in Irish waters, 2009). Through previous work examining stranded common dolphins at the host organisation, it has been observed that several of the samples have a high incidence of parasites in the stomach with a possible association between parasite load and the presence of stomach ulcers. Therefore, it is of great importance to investigate the parasite community and the possible effects of parasitism on the health status of common dolphins.

This master's thesis will examine the parasite species present, quantify parasite loads and analyse the histology of infectious stomach tissue from the samples collected from the stranded common dolphins around the Irish coast. The work will contribute important insights to ongoing work investigating the health status of these dolphins around Ireland.



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Acoustics



Information content in bottlenose dolphin whistles during a cooperative task

Mackenzie Meier, Pernille M. Sørensen, Abigail Haddock, Emily Guarino, Kelly Jaakkola and Stephanie L. King

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A select number of species have demonstrated the recognition of their partner's role, referred to as actively coordinated collaboration, when performing cooperative behaviour. Yet, there is a lack of data on the underlying mechanism(s) of collaboration in nonhuman species. Bottlenose dolphins are known to actively coordinate cooperation with a partner and rely on vocal communication to mediate social relationships and maintain group cohesion. We previously demonstrated that common bottlenose dolphins can use vocal signals to aid success in a cooperative button pressing task. Here, we further analysed acoustic patterns of whistle type use. With acoustic data from hydrophone arrays, and sound-and-movement recording tags (DTAG3) attached to each dolphin, we demonstrate how the vocal information shared changes as a result of animal location, behaviour, and stage of the cooperative task. Additionally, we explore how whistle exchanges enable precise coordination. This study will lead to a more comprehensive understanding of vocally mediated behavioural coordination in dolphins, thereby adding to our understanding of cooperation facilitated via vocal communication in the animal kingdom.



What's in a whistle? Towards an accurate acoustic classifier for UK delphinid species

Tristan Kleyn, Vincent M. Janik, Denise Risch, and Julie N. Oswald

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Passive acoustic monitoring (PAM) is a cost-effective and non-invasive tool for surveying delphinid presence but is hindered by a lack of reliable means for acoustically identifying (classifying) species. The challenge of acoustically classifying delphinid species is significant, due to high intra-specific variability in their vocalizations. Narrowband, tonal whistles are a common type of vocalization produced by delphinids, known to exhibit high variability at the individual level and thus making species classification of whistles difficult. Developing accurate algorithms for identifying delphinid species by their whistles would greatly benefit acoustic monitoring by allowing reliable estimates of species abundance and distribution from sound recordings alone. This study attempted to identify seven species of delphinid present in UK waters by their whistles using random forest analysis. Fifty-one time-frequency variables were measured from 2660 whistles detected in towed hydrophone recordings in UK waters. Using novel recordings for testing, the classifier predicted species from individual whistles with an average accuracy 17.3% (sd = 2.1%) higher than chance. Classifying instead at the encounter-level, which is more appropriate for the aims of acoustic surveys, improves accuracy by 9.2% (sd = 4.1%). New methods, including using deep neural networks to classify whistles, classifying species by proportions of whistle types observed, and combining information from clicks, whistles, and burst pulses for classification, will be explored to improve classification accuracy. The current classifier, as well as future improvements, will soon be publicly available for use in the ROCCA (Real-time Odontocete Call Classification Algorithm) module in the open-source software PAMGuard. Development of acoustic species classifiers not only provides new tools for passive acoustic surveys, but also advances our understanding of species-level differences in vocal repertoires. This work will serve as an important base for comparison as we continue to collect more data and develop alternative methods in machine learning.



The Error Rate of Acoustic Detections of Cetaceans in the Black Sea

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The F-POD, an echolocation-click logging device, is commonly used for static passive acoustic monitoring of odontocetes. There are three species of cetaceans living in the Black Sea's common dolphin, bottlenose dolphin and harbour porpoise. Since 2020 twenty F-POD loggers have been used in the BlackCeTrends project by Bulgaria, Romania, Turkey, Georgia, and Ukraine with the aim of investigating trends in the populations of the cetaceans of the Black Sea. Custom FPOD.exe software and KERNO-F Classifier were used to detect cetacean click trains. Acoustic data from the BlackCeTrends project consists of 9 billion raw data clicks in total, of which 385 million were classified by KERNO-F as Narrow Band High Frequency clicks (harbour porpoise clicks), 91 million as dolphin clicks, 5 million as clicks from boat sonars and 45 million clicks were placed in trains of unclassified origin. Such data volumes require a reliable fully automated system of analysis. This is the first assessment of the error-rate of this automated analysing system. To estimate the error-rate 8600 NBHF Detection Positive Minutes were individually inspected and assessed. This assessment considered multiple features of both trains and their time context to give higher reliability than the automated process. In the NBHF DPM 36 were identified as false positive DPMs produced by sonar, and 2 as produced by dolphins. The porpoise false-positive rate arising from sonars is assessed to be 0.2% of sonar minutes, and the rate from dolphins is much lower. The overall false positive rate of 0.4% errors is an acceptable level for this study of porpoises in the Black Sea and supports the use of the automated data without editing.



A dolphin whistle classifier for the Southwest Atlantic Ocean

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Marine Biotechnology Post Grad Program - IEAPM/Federal University Fluminense & Academic Visitor at University of St. Andrews

Passive acoustic monitoring can greatly enhance the ability of researchers to survey marine mammals. However, when acoustic data is collected autonomously without concurrent observation of the animals it remains a difficult task to classify species vocalizations. This is the case for dolphins that produce a variable repertoire of whistles with similar spectral characteristics across species. The use of machine learning techniques to build acoustic classifiers has proven a promising tool to address this task. In this work we present the effort to train and test a dolphin whistle classifier for Southwest Atlantic species. We used a dataset of over 5,000 whistles collected from 14 line-transect cetacean visual and acoustic surveys between 2015-2021 (PMC-BS/Petrobras) using a towed hydrophone array in Brazil (23°-28°S) over an area of 350,000km² (30-2500m depth). Only visually confirmed single-species encounters were included in the analysis. Whistles were manually selected using RAVEN 1.5 and 50 parameters were measured using ROCCA (Real-time Odontocete Call Classification Algorithm) in PamGuard. Each encounter (school) was considered an independent sample. A random forest classifier was trained using a training dataset that was balanced across species (122 encounters and 770 whistles from 7 species - *Stenella frontalis*, *S. longirostris*, *S. attenuata*, *S. clymene*, *Steno bredanensis* and *Delphinus sp.*). The testing dataset was variable according to the amount of data available for each species. Encounters were classified based on the highest proportion of whistles classified as one species. A preliminary evaluation of the results shows that when the proportion of whistles classified as one species was as low as 0.4, most encounter classifications were correct. Using this approach, 17 encounters out of 24 in the test dataset were correctly classified (70%). This work is an important step towards using whistles as a dolphin species identification tool in cetacean surveys in the Southwest Atlantic Ocean.



One Size Fits All? Adapting and deploying trained CNNs in new acoustic environments for marine mammal detection

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As the quantity of passive acoustic data collected for the monitoring of marine mammals increases, deep learning (DL) has become one of the most exciting tools in the field for extracting information of interest. Bioacoustics has benefitted from DL through the development of species detectors and species-specific classifiers. In our work we use Convolutional Neural Networks (CNNs) to move beyond the binary presence/absence of a marine mammal signal and attempt to extract ecologically relevant higher-level ecosystem information. To date this work has used CNNs to detect delphinid vocalisations and anthropogenic sound sources relevant to their conservation in the West coast of Scotland.

The ability to apply developed models to new acoustic environments with confidence can provide higher level trends in the presence of specific sound sources over time, enable the model to learn from a wider range of data and aid in the task of labelling site-specific data for new model development. However, variation in the regions ambient soundscape, species presence temporally and new unseen sound sources alter the model's performance.

This talk aims to provide an overview of the data considerations necessary for deploying a model in a new marine environment, relevant to applications of deep learning in the field of marine ecology. We present an overview of some of the pitfalls and considerations necessary when deploying a model in a new oceanic soundscape, and present current work on model re-training with site specific data. This work applies a model developed in the west of Scotland to the West coast of Ireland, the Gulf of Mexico and the Pacific Ocean off of the Oregon coast for the detection of delphinids and site-specific anthropogenic sound sources.



Characterisation of sperm whale *Physeter macrocephalus* acoustic behaviour along the Irish Atlantic Margin

Kirstianna Morin and Joanne O'Brien

Atlantic Technological University

The ObSERVE project is a government-funded acoustic survey conducted along the Irish Atlantic margin to assess the importance of shelf habitats for cetacean species. Results from this project found that sperm whale acoustic signals were present throughout the entire sampling period, with significant variation in temporal occurrence between different sites within the study area. This supports the hypothesis that sperm whales are one of the most abundant great whale species in the deep waters of offshore Ireland. However, this study only looked at the occurrence of sperm whale calls and did not analyse the acoustic behaviour of these acoustic signals. Sperm whale acoustic signals are known to be highly linked to specific foraging and communication behaviours. Previous studies have determined 3 categories of sperm whale clicks that are each highly linked to different foraging and communication behaviours. This study will use PAM data from the ObSERVE project to classify the acoustic behaviour of sperm whales along the Irish Atlantic margin into 3 broad categories (1) feeding, (2) socialising, and (3) travelling. Differentiating the temporal occurrence of acoustic signal behaviour is an important next step to further understanding sperm whale habitat use in the study area. Additionally, this information could help to inform conservation and management decisions within the study area that is known to be an active area for human activity.



Variation in the frequency and time parameters of the signature whistles of a captive group of bottlenose dolphins (*Tursiops Truncatus*)

Christina (Rosie) Day

University of St-Andrews

Bottlenose dolphins (*Tursiops Truncatus*) have an extensive communication system, of which the signature whistle is but one of many vocalisations. However, signature whistles are of particular interest in cetacean behavioural research as they convey identity with the frequency modulation patterns, which is rare in non-human animals, and their development is influenced by this species vocal learning capabilities. The frequency modulation patterns of signature whistles are known to remain stable for many years however, little is known about the stability of the time and frequency parameters of these whistles. This project identified and compared the signature whistles of the group of 13 bottlenose dolphins at the Oceanographic dolphinarium, Valencia from 2017 and 2022, to investigate if these parameters displayed changes. Signature whistles were identified with a temporal pattern of signature whistle sequence-based method (SIGID) and confirmed with an automated classification system (ARTwarp). The ARTwarp categorisation showed little agreement with the SIGID categorisations. It was found that the frequency and time parameters had changed between the recording years. These changes could be caused by changes in the acoustic environment or influenced by the extensive vocal learning abilities of this species. To confirm the exact source, further research is required, about the social structure of this group and the impact of adding individuals. These results suggest that time and frequency parameters are not stable in bottlenose dolphin signature whistles.



Soundscape Analysis and Comparison of the inner and outer parts of the Kongsfjorden (Arctic fjord, Svalbard)

Elia Betschen, Giuseppa Buscaino, Maria Ceraulo and Elena Papale

Ghent University (IMBRSea)

My thesis project will consist of analysing recordings collected from two sites within the arctic Fjord. The two sites are located on the outer Fjord (defined as Atlantic site), and close to the inner glacier of the Fjords (defined as Arctic site). Data were collected from 2014 to 2020 by two synchronized autonomous recorders placed at each site. Monitoring this area will give us an update on the occurrence of marine mammals and other marine species as well as if and how the receding sea ice and changes in anthropogenic activities have caused an impact. It is important to recognize any potential impact of this fjord as it presents a foraging hotspot for marine mammals, as well as breeding grounds for the bowhead whale and ringed seal among others. From these analyses, I hope to conduct a preliminary investigation of the possible effects of climate change in the fjord as well as biological trends from 2014-2020.



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Physiology, Biomarkers and genetics



Phylogenetically controlled life history trait meta-analysis in cetaceans reveals unexpected negative brain size and longevity correlation

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The identification of patterns in trait evolution is essential to understand the interaction of evolutionary forces, and provides useful information for species management. Cetaceans are a phylogenetically well-resolved infraorder of mammals that exhibit distinct trait variation across behavioural, molecular and life history dimensions, yet few researchers have applied a meta-analytic or comparative approach to these traits. To understand cetacean trait evolution, we used a phylogenetic generalised least squares approach to examine the cognitive buffer hypothesis (CBH). A large brain should buffer individuals against environmental challenges through increasing survival rates, and a longer lifespan should buffer individuals against the cost of extended development for larger brains according to the CBH, leading to an expected positive correlation between brain size and lifespan. In contrast to this expectation, observed in taxa such as primates, we found a negative correlation between brain size and lifespan in cetaceans. This suggests cetaceans experience selective pressures different from most other mammals in these traits but may be more similar to some social mammalian carnivores which also display alloparenting. We also provide a comprehensive dataset to explore additional aspects of trait evolution but which would greatly benefit from studies on behavioural ecology across cetaceans and increased focus on data deficient species.



Investigating faecal cortisol metabolite levels in harbour (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) in rehabilitation.

Michal Zatrak, Kirsty Shaw, Matt Geary and Robyn Grant

Manchester Metropolitan University

Juvenile harbour and grey seals are commonly rescued and admitted for rehabilitation following stranding. However, transportation in vehicles, the captive environment and human contact in the form of assisted feeding and invasive medical treatment are all likely to be new stressors for these vulnerable seals. Mammals commonly increase their cortisol levels when stressed. After acute stress, cortisol levels usually return to their baseline levels. However, chronic stress causes prolonged release of cortisol and has a significant impact on individuals, including affecting their growth, reproduction, immune system, disease resistance and fitness. Hence, stress levels encountered by seals in captivity may have a negative impact on their welfare and potentially decrease their survival probability. This study focuses on investigating faecal cortisol metabolite levels in rehabilitating harbour and grey seals to establish how these individuals cope with stress. Faecal samples and CCTV footage from rehabilitating seal pups at the Welsh Mountain Zoo and Tynemouth Seal Hospital were collected on a daily basis from the day of admittance of the seal until the day of release. Faecal samples were used to validate a new enzyme-linked immunosorbent assay (ELISA) to enable cortisol metabolite quantification. CCTV footage was analysed using the behavioural observation research interactive software (BORIS) to yield behavioural time budgets. Mixed effect regression models will determine whether sex, season, individual differences, time in captivity, feeding methods and/or behavioural time budgets affect seal cortisol levels. By identifying factors that lead to increased cortisol levels and potentially chronic stress, rehabilitation processes could be further optimised to increase seal welfare in ex-situ settings and help improve their survival odds.



Using compound-specific stable isotope analysis to estimate trophic discrimination factors and trophic position in the Northwest Atlantic harp seal.

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University of Liverpool

Shelf seas are highly productive and biodiverse ecosystems that support >90% of global fisheries. Accurately quantifying trophic structure and interactions within shelf sea food webs is important for understanding food web ecology, conservation biology and informing ecosystem management. Trophic position (TP) is a useful metric for these purposes, which can be estimated using the $\delta^{15}\text{N}$ of trophic and source amino acids within animal tissue. An important component to the TP calculation is the trophic discrimination factor (TDF), which describes the enrichment of trophic amino acids with each trophic step. Initial work introduced a 7.6‰ enrichment for glutamic acid, but subsequent studies suggested this value was not consistent between trophic levels. This means that if a single TDF value is applied through an entire food chain, it could lead to incorrect estimates of trophic position and the food web structure more broadly. In this study, TP was calculated for 11 marine species, including harp seals, using bulk stable isotope analysis. These values were used to estimate the TDF of glutamic acid (a trophic amino acid) with respect to phenylalanine (a source amino acid). Preliminary findings show that TDFs (Glu-Phe) for zooplankton, pelagic fish, benthic fish and harp seals were 7.7‰, 4.4‰, 4.0‰ and 2.4‰, respectively. Mean $\delta^{15}\text{N}$ of phenylalanine in harp seals was enriched by 3.1‰ compared to lower trophic guilds, despite the expectation of little to no enrichment in this source amino acid. Contraction of TDFs may therefore be due to a combination of effects: 1) a decrease in the fractionation of Glu and 2) a degree of trophic enrichment in Phe. This has major implications for our understanding of trophic position and food web structure and reinforces the notion that employing a single TDF may not be appropriate. Instead, TDFs should be carefully chosen based on the target taxa to avoid underestimating TP.



Reconstructing the health and trophic history of ringed seals using metabolically inert tissues

Alice Lowry, Steven Ferguson, David Yurkowski, Justine Hudson, Tera Edkins, Sophie Smout, Claire Mahaffey, Rachel Jeffreys

University of Liverpool

Stable isotope analysis of animal tissues has become a valuable and well-established technique that has been applied to assessing trophic interactions, animal movements and physiology. Advancements in analytical techniques now allow the analysis of isotopic ratios from individual compounds within organic material, which has greatly increased the resolution and insights from stable isotope analyses in ecological studies. For example, comparisons of the $\delta^{15}\text{N}$ values of individual amino acids allow for more robust estimations of the trophic position of organisms, without the need for direct measurements of baseline primary production. However, the data obtained from stable isotope analysis can represent vastly different timescales depending on the metabolic activity of the chosen tissue and it can only ever provide snapshot of an organism's trophic history if only single sample is taken per individual. Metabolically inert, keratinaceous tissue structures such as teeth, claws, hair and vibrissae offer notable advantages for stable isotope studies as they remain biochemically unchanged on deposition and usually grow continually. This provides an unbroken record individual's biochemical history that can be reconstructed by taking samples from multiple sections of the same tissue.

In the Canadian Arctic, changes to ringed seal foraging ecology, behaviour and markers of 'health' have been found and correlated with changes in the environment. As the Arctic continues to warm, ringed seal populations may be significantly affected by changes to in the abundance and distribution of their preferred prey species. However, the specific relationships between the diet of individual ringed seals and their overall health or physiology remain unclear. The primary objective of this project is to develop a novel method for reconstructing both the trophic history and 'health' of individual ringed seals over the first 7-12 years of their life by sampling growth layer groups (GLGs) in their claws. Compound specific stable isotope analysis (CS-SIA) of amino acids will be used to provide fine scale trophic information and multiple biomarkers of health will be measured and compared.



Using molecular approaches to investigate the metabolic regulation of cetacean blubber tissue under different physiological challenges

Alexandra Tranganida, Joanna Kershaw and Davina Derous

University of Aberdeen

Cetaceans are exposed to and impacted by multiple human-caused disturbances. Understanding the consequences of these disturbances on cetacean health, particularly on individuals that are at vulnerable physiological states, is necessary for the establishment of effective regulations for their conservation and protection. However, there are currently limited ways of assessing health status of diving, free-ranging animals. Body condition and blubber thickness have traditionally been used to assess animal health and nutritional state, but recent studies suggest that these are not always informative measurements. Investigating changes in energy metabolism, driven by human-caused disturbances and habitat degradation, can help understand the impacts on the survival and reproductive success of an animal. Measuring metabolic processes in live wild marine mammals is challenging due to the practical difficulties and ethical considerations associated with sample collection. Stranded animals therefore provide an invaluable source in studying cetacean physiology under different life stages and health conditions.

In this project I will be using metabolomics (i.e., the study of small molecules that are the intermediate and end products of metabolic processes) and other molecular approaches on blubber tissue samples from stranded animals with different levels of stress exposure. By analysing blubber tissue samples from chronically stressed, e.g., where cause of death is starvation and acutely stressed individuals, e.g., where cause of death is acute trauma, I will identify and compare metabolic pathways involved in each group. Full-depth blubber samples will be used, as blubber is vertically stratified, and morphological and functional differences exist between different layers. With this approach we will gain knowledge on the regulation of blubber metabolism under different physiological conditions and identify potential molecular markers that can be used to assess the health status of free-ranging animals.



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Human pressures



The Effect of Vessel Noise on Harbour Porpoise Behaviours

Rachel Lennon

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Anthropogenic activity is causing global species decline, with a 40% loss of biodiversity in the ocean. One significant driver of decline is anthropogenic noise which is especially pronounced in the ocean where sound travels greater distances than on land. Vessel noise is a primary factor of underwater noise and impacts acoustically driven animals and their behaviours. The effects of vessel noise on odontocete behaviour has infrequently been studied despite frequency overlap in vessel noise and odontocete vocalisation ranges. This knowledge gap makes it difficult to appropriately mitigate against negative impacts. This study looked at the effect of vessel presence and speed on harbour porpoise communication in Middlefart, Denmark by analysing changes in buzz call rates. Buzz calls are associated with foraging and socialising, therefore, a reduction in buzz calls indicates changes in behaviours that may have energetic costs that impact the health of exposed animals. The results of this study found that harbour porpoises are affected by vessel presence with a reduction in up to 12% of buzz calls when a vessel is present. When vessels travel at less than 10 knots, buzz calls increase by 2% with each knot. Whereas, when vessels travel over 10 knots, buzz calls decrease by 2% with each additional knot. Therefore, a recommended threshold speed of 10 knots is suggested to mitigate the negative effects on harbour porpoises that must trade-off foraging and social communication in an attempt to evade noise. This study provided an understanding of the impacts of underwater anthropogenic noise on cetaceans and supports the need for further conservation efforts to mitigate these detrimental effects.



Examining the human-predator interface of the North Sea: interactions between 2 species of seal and offshore energy structures

Maria Clara Iruzun Martins, Matt Carter, Sally Rouse, Thomas Bodey, Debbie Russell

University of St-Andrews

Offshore man-made structures (MMS) such as oil and gas (O&G) platforms, pipelines and wind energy developments are present in shelf seas worldwide with areas of high concentration such as the North Sea. A key concern is the change in number and type of MMS in the North Sea, which has potential impacts on the marine ecosystem and marine mammals.

Previous studies have shown that MMS can have a multitude of impacts on marine mammals from the construction phase, which has potential for hearing damage and long-term behavioural responses, through to operation and decommissioning and removal. However, once MMS are in place, they can act as artificial reefs, where mobile invertebrates and fish aggregate. In turn, previous studies have shown some species of marine mammals such as harbour porpoises (*Phocoena phocoena*) and grey (*Halichoerus grypus*) and harbour (*Phoca vitulina*) seals using these structures for foraging or resting grounds. However, it is not fully understood how these artificial reefs impact marine mammals and if they play a role in their distributions and movements.

In this study, we aim to investigate how grey and harbour seals overlap with these structures using high resolution GPS data. By running hidden Markov models to infer behavioural states, we aim to detect temporal and spatial overlaps with O&G platforms, pipelines, and wind turbines to fully understand the prevalence and potential drivers of this behaviour.



Improving understanding of vessel activity in Scotland's coastal waters

Emily Hague, Matt Pine, Gregory O'Hagan, Patrick O'Hara, Alice Walters, Emma Steel, Katie Dyke, Juliane Lehmann, Diego Piedra-Garcia, Carsten Hilgenfeld, Rachel Shucksmith, Teresa Fernandes and Lauren McWhinnie

Henriot-Watt University

Understanding, and then subsequently monitoring and managing human activities in the marine environment is inherently challenging. Challenges include inadequate data, a limited understanding of environmental interactions within marine ecosystems, and the inherent complexities of managing mobile species and activities. 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 simple to obtain and characterise, but this is not true for all uses, especially “mobile” activities. Vessel activity is highly mobile, and so understanding potential risk 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 certain vessel types. Without targeted data collection, there remains a limited understanding of the presence and distribution of non-AIS vessels, such as small fishing boats or recreational vessels, despite non-AIS vessels constituting a significant portion of maritime traffic. This has important conservation management and policy implications, as these vessel types are associated with several potential impacts to marine wildlife, including underwater noise, collision, and behavioural disturbance.

To address this, the Scottish Vessel Project is a collaborative initiative exploring several data collection approaches to build a more holistic overview of vessel traffic in coastal Scottish waters. The project utilises land-based watch data (through WDC Shorewatch and the Orkney Marine Mammal Research Initiative), collects and analyses AIS and time-lapse camera data, and utilises ship noise models to predict minimum AIS vessel underwater noise contributions. This provides a fundamental step towards improving our understanding of the total volume/presence of vessels, and their potential associated impacts, in Scotland's coastal seas. This understanding is imperative to provide managers and decision-makers information to support the sustainable management of our coastal spaces.



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Cetaceans, vessels and climate change

Ferrari Valeria, McWhinnie Lauren, Alexander Karen, Bell Michael, O'Hara Patrick, Pearce Kim

Henriot-Watt University

Cetaceans are subject to multiple environmental stressors, including climate change and increasing anthropogenic pressures, such as fishing, release of toxic chemicals and litter, and vessel traffic. These stressors can lead the shifts in cetacean distribution by altering habitat suitability (reduction in prey availability, changes in water temperature) or they can force populations to abandon even key areas of their range in order to avoid disturbance (such as vessel noise). Other stressors (like bycatch, entanglement, vessel strikes) may not result in the movement of animals away from an area but instead lead to injury and even death of individuals, reducing population size. This PhD project will focus on British Columbia, Canada, and explore the use of aerial surveys to effect of vessel presence on cetacean species. We will initially employ these long-term, year-round opportunistic surveys to fill the knowledge gaps in cetacean distribution in British Columbia and give a first assessment for offshore waters, that are typically not covered by dedicated or citizen science surveys. In a second step, we will use this distribution to identify major areas of conflict between cetaceans and human activities, and suggest possible management measures.



Exploring geovisualizations as place-based planning tools for collaborative marine and coastal management.

Chris Reilly

Henriot-Watt University

Stakeholder engagement is a critical part of marine and coastal planning, yet planners often report challenges in facilitating and adequately consulting stakeholders in the process. Despite the huge role of the world's oceans in each of our lives, there are many factors that come into play including ocean literacy that create a barrier in participation in such processes. The aim of this PhD is to develop realistic 3D geovisualizations using advanced mapping techniques that will encourage participation and help stakeholders understand the potential environmental, social and economic implications of various management strategies.

When creating these geovisualizations it is paramount to produce the most useful models, as they take time and resources to complete. Based in Orkney, this coastal community provides the perfect setting to trial models during development with various stakeholder groups to create an understanding of what works best. The research will investigate themes including sense of place and realism when developing these models, which previous research has determined plays a critical role in their success.

The potential applications of such models are boundless. The primary theme this project will focus on is to raise stakeholder knowledge and to provide the opportunity to visualise the consequences of climate change; notably SLR, coastal erosion and vegetation change. The model also aims to introduce various nature-based solutions as options to consider when creating a management plan. The potential for other researchers to use such a tool during planning in areas such as aquaculture, renewable energy and marine conservation will also be highlighted.

The interdisciplinary nature of this project aims to tackle these issues with broad thinking to better understand the factors that are preventing higher levels of engagement and to design the most effective models.



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Posters



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Monitoring cetacean presence and movement using passive acoustic monitoring

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Aquasearch, France

The bay of Fort-de-France is central to Martinique's economy and sees important flows of both people and goods throughout the year. The bay is thus under important acoustic pressure from anthropogenic activities yet is a known habitat to 11 different species of cetaceans. The main objective of this study is to better understand the role this habitat plays in different cetacean populations. Three fixed passive acoustic recording stations are deployed at the bottom of the bay. A convolutional neural network detecting cetacean vocalizations and a set transect line allows for both acoustic and visual monitoring of different cetacean species.



Assessing seal presence in the seas around Ireland, Western Scotland and Northern Ireland for future designation of a cross-border MPA network

Yaiza Pilar Pozo Galvan and Joanne O'Brien

Atlantic Technological University

Marine mammals can constitute a key element in marine ecosystems, affecting the community structure and function when present. Around a quarter of the global marine mammal species are classified as Threatened and a fifth of them as Data Deficient on the IUCN Red List. In order to preserve them, we need first to fill this gap of knowledge, allowing us to implement effective conservation measures as Marine Protected Areas (MPAs). Harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) can be found in the Northern Hemisphere coastlines and in the shores of the North Atlantic Ocean, respectively. Both species are protected by the EU Habitats Directive (Annex II) and other international agreements. The SeaMonitor project, which is pioneer in Europe, aims to support and protect vulnerable marine life by deploying oceanographic instruments as gliders and acoustic receivers to create spatial models and Management Plans in the seas around Ireland, Western Scotland and Northern Ireland. This study will be focused on the acoustic data collected from seals and their environment across a 24-month period and across multiple locations, which will be processed and compared with the results of new studies on seal vocalisations to model pinniped distribution and habitat-use. In addition, estimations of the abundance and density of their populations will be calculated. All this will be possible with the use of programs as QGIS, RStudio, Logger, Maxent and PAMGuard*. Due to the uniqueness of the project, additional research questions can be addressed once the data are being manipulated, and with the final objective of providing enough information to ensure the adequate management measures of the species.

**The use of these or other programs cannot be known for certain until data exploration.*



The effect of fast craft presence on Harbour porpoise detection within a coastal Marine Protected Area

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and Suzanne Beck

Queen's University Belfast and Agri-Food and Biosciences Institute (AFBI)

Recreational vessels have the potential to disturb marine life, this may be due to the noise emitted by the vessel, the behaviour of the user or the presence of the vessel itself. Fast crafts are a group of recreational vessels including personal watercrafts which not only emit noise but often circle around areas for extended periods of time and, have the added complexity of unpredictable movements at high speeds. The elusive harbour porpoise *Phocoena phocoena*, have been found to exhibit strong reactions to vessel presence. Coupled with the erratic behaviour typical of fast crafts, there are growing concerns on the impacts of fast crafts on harbour porpoise. The Department of Agriculture, Environment and Rural Affairs for Northern Ireland, have received a number of complaints about fast crafts disturbing marine wildlife in Marine Protected Areas. This could be due to the increase in recreational activities from late 2020 when travel restrictions were put in place due to the Covid-19 pandemic. To investigate the extent of fast craft presence in Northern Ireland acoustic data was gathered from a single line static acoustic mooring within the Skerries and Causeway MPA. Data from July-August 2019 -2021 was scanned manually for the hourly presence of fast crafts. Detections were confirmed both visually and acoustically. Further analysis will consider the difference in fast craft hourly presence across years and an investigation of the timing of fast craft events with harbour porpoise click detections. It's anticipated that the results of this project will give an insight into the influence of fast craft events on porpoise acoustic detections and consequently facilitate effective MPA management and inform policy.



Diving respiratory air volume of southern elephant seals (*Mirounga leonina*): Estimation and implications

George Sato, Taiki Adachi, Christophe Guinet and Patrick Miller

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The function of diving respiratory air volume (DRAV) of deep-diving phocid seals is poorly understood due to the paucity of methodology to estimate DRAV among exhaling divers. To reveal how phocid seals adjust their DRAV prior to each dive, a method for estimating the DRAV of free-ranging phocid seals was developed based on a biomechanical model that incorporated swim speed, acceleration, depth and pitch angle collected from data loggers. DRAV was estimated for Southern elephant seals (*Mirounga leonina*) using descent glides at shallow depths where gas volume can largely affect the animals' buoyancy and its gliding speed. The DRAV estimates were validated by examining the stroking intensity at shallow depths. Given that the seals reduced their stroke intensity during the start of descent, a significant positive relationship between stroke intensity in the initial descent and DRAV confirmed that the estimates were reliable. Dive-to-dive variation in DRAV was found. A significant positive relationship between DRAV and dive duration was discovered, suggesting that seals retained more air in their respiratory tract to prolong their dive duration. In addition, assuming that the locomotory swimming cost is a function of the total buoyancy force from DRAV and tissue density, it was hypothesized that seals should adjust their DRAV in response to their tissue density to minimize swimming cost. We found a statistically significant trend that more denser seals dove with larger amounts of air. This study advocates the importance of DRAV for understanding the diving physiology of exhaling divers.



Proposed project to evaluate the seasonal distribution and abundance of baleen whales in the southwest UK using acoustic monitoring

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The presence of baleen whales in the southwest UK (SWUK), particularly minke and fin whales, have been documented from the 1980s, however very little scientific literature exists to support these observations. Both minke and fin whales have unique sub-populations in the central/eastern region of the North Atlantic, very little is known of the seasonal distribution and abundance of either species, specifically during winter months. Data organized by the Cornwall Wildlife Trust have summarized visual observations from citizen science and wildlife tours for decades. These data show a distinct peak in minke whale sightings during summer months, while fin whales peak first in summer and a second time in winter. As survey effort is significantly higher during summer months and limited to good viewing conditions, a seasonal bias may exist limiting the power of these data in determining seasonal distribution or abundance. The proposed study will involve placing moored acoustic recording units (MARU) throughout the SWUK to acoustically detect minke and fin whale presence; strategic methodology will allow for relative species abundance estimates in addition to seasonal presence suggesting movement patterns on large-scale migrations between north and south, or small scale between shallow, coastal waters during summer and deeper, offshore regions during winter. Both minke and fin whales are under threat from whaling activity, vessel strike, and prey reduction due to fishing activity. Understanding seasonal movement and identifying habitat use will create a necessary baseline from which we can monitor changes in population abundance and movement ecology over time due to climate change and anthropogenic threats. This project is currently in the planning stage to be implanted as a PhD and I invite any suggestions, advice, or interests of involvement.



Ensemble Species Distribution Models of Fin and Humpback whales in the Irish Exclusive Economic Zone

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Fin and humpback whales are the largest baleen whale species most commonly occurring in the Irish Exclusive Economic Zone (EEZ), although the drivers of their known distribution in these waters are not clear. Using presence-only data (1999-2021) from multiple sources, including citizen science, we constructed predictive Species Distribution Models (SDMs) consisting of ensembles of five different algorithms for these species in spring, summer, autumn and winter months. We determined the relative importance and whale presence response curves for eight environmental variables, including Sea Surface Temperature, concentration of Chlorophyll-a, eastwards seawater velocity, northwards seawater velocity, mixed layer thickness, bathymetry, seafloor slope and distance to shore. Ensemble Species Distribution Models (ESDMs) predicted a marked south-west distribution for humpback whales that were more likely to occur during the summer than in winter. Throughout the year, they were more likely to occur within a narrow band of approximately 50 km from the shore. The thickness of the mixed layer seemed to be the main distribution driver in autumn. Fin whales were predicted to have a clear south distribution in waters close to the shore, although they were also likely to occur offshore during spring and summer months at the edge of the continental shelf. Most spread fin whale distribution around Ireland was predicted in autumn months when, similarly to humpbacks, the thickness of the mixed layer had the highest relative importance. Our results show that presence-only data obtained from different sources over long periods of time can be used to build robust predictive distribution models alongside with a variety of environmental variables and applying several types of algorithms, including regression and machine learning. This study and similar ones can help the development of future marine spatial planning, identifying relevant areas for large baleen whales in Ireland and elsewhere.



Comparing the performance of C-PODs and F-PODs in monitoring the acoustic activity of harbour porpoise (*Phocoena phocoena*)

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Passive acoustic monitoring (PAM) is a cost-effective method for monitoring cetacean populations over time compared to other techniques such as aerial and ship-based surveys or photo-ID. The C-POD (Cetacean POrpoise Detector) has been an integral tool in many passive acoustic monitoring programmes globally for more than a decade, providing standardised metrics of occurrence that can be compared across time and space. However, the development of the new F-POD (Full waveform capture Pod) devices with increased sensitivity, improved train detection, and reduced false positive rates represents an important methodological change in the collection of data, particularly when being introduced into existing monitoring programmes and time-series as C-PODS are phased out. Here we compare the performance of the C-POD with that of its successor, the F-POD, in a field setting. Between April 2021 and July 2022, a C-POD and F-POD were co-deployed to simultaneously record echolocation clicks. While similar trends in detection were found for both devices across the recording period, we found the C-POD detected only 58% of the detection positive minutes (DPM), recorded by the F-POD. Differences in detection rates were not consistent through time, making it difficult to apply a correction factor or directly compare results obtained from the two PODs, with important implications for long-term monitoring. Generalised additive models (GAMs) were used to investigate. No differences were found in environmental correlates of porpoise occurrence, but the C-POD failed to detect sufficient foraging buzzes to identify temporal patterns in feeding behaviour shown by the F-POD. Our results suggest that the switch to F-PODS will have little effect on determining broad scale seasonal patterns of occurrence, but may improve our understanding of finer-scale behaviours such as foraging. We highlight how care must be taken interpreting F-POD results as indicative of increased occurrence when used in time-series analysis.



Eye up high, aerial identification to aid traditional sperm whale (*Physeter macrocephalus*) photo-identification

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Photo-identification is a standard technique for monitoring cetacean populations globally. While the technique initially relied on the ventral surface of tail fluking whale species to differentiate between individuals using colouration/scarring and also notch marks. Dorsal fin scarring, notches and skin lesions have also been used to identify individual whales. Sperm whales are typically identified using the trailing edge and ventral surface of their tail fluke as they descend on a deep dive. The dorsal fin also occasionally provides opportunities to identify whales while they remain resting at the surface given most identities are established as the whale deep dives. However, sperm whales are marked elsewhere along their bodies but are typically not within the line of sight for boat-based researchers. The advent of drones in marine mammal research has enabled new research avenues to be explored non-invasively while flying overhead, including in the identification of several dolphin and whale species from dorsal surface identifiable features. From March-June 2020 field research was carried out on the sperm whales present in and around the Bleik Canyon off the coast of Andenes in Northern Norway. While the collection of morphometric data was the primary aim of this research effort, opportunistic behavioural and identification data was also gathered. 22 whales were flown over and were identified using both photographs taken with DSLR cameras from the research vessel and using 1 multicopter quadcopter Phantom 4 Pro drone. The DSLR photo-identification images were taken as standard but the aerial identification images encompassed the entire whale's dorsal surface (depending on the sea conditions) where scarring, skin lesions, deformations and notches were used to identify individuals. These identifiable features helped to determine whether a whale was previously encountered before it dived which may help the decision-making process in the field when multiple whales are at the surface.



The effects of coastal recreation on the disturbance behaviours of seals at haul-out sites in Scotland

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The increased use of coastal areas for recreation during the COVID-19 pandemic has led to concern of increased levels of disturbance to marine wildlife. Seals use the coastal environment for haul-out behaviours associated with thermoregulation, breeding success and survival, with disturbance leading to increased heart rate and energetic costs signified by disturbance behaviours such as vigilance and fleeing. Our study aimed to understand the relationship between coastal recreation and disturbance of harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) across two sites in Scotland: an urban site, and a rural site with designated protected status. We collected 355 behavioural observations during potential disturbance events across May and June 2022. Using Generalised Linear Mixed Models (GLMMs), we investigated the relationship between the number of seals exhibiting disturbance behaviours (vigilance or fleeing) at each site and (1) the distance of recreation to the haul-out; (2) the type of recreation; and (3) the abundance of recreational activity. There was a curvilinear relationship between the number of disturbed seals and the distance of recreational activity from the haul-out, and the intensity of disturbance was highly dependent on the type of activity. As recreationists approached the haul-out, disturbance increased across most recreation types, although there was variation between sites. A rapid increase in the rate of disturbance was observed in response to land-based activities at 50m and paddle boat activity at 100m. The response to power boats varied between sites, highlighting the complex relationship between disturbance and site dynamics. These findings suggest that current regulations do not offer protection to haul-outs in Scotland, with more conservative guidelines required to mitigate disturbance. Further research into the physiological and population-level effects of recreational use of haul-out sites across life-history stages and species is required to understand the consequences this may have for seal populations in Scotland.



A new project studying cetacean behaviour, distribution, and abundance in relation to planned and operating offshore wind farm sites in Ireland

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Offshore renewable energy (ORE) is on the rise and is an important energy source to reach climate goals. As top predators and indicators of marine ecosystem health, it is important to understand how cetaceans would be affected by this global change. Well established operating offshore wind farms may contribute positively as artificial reefs, as they have the potential to attract fish communities' and thus prey species. But the concomitant anthropogenic noise, from construction of wind farms, such as pile driving activity, may have a detrimental effect on cetaceans. Cetaceans depend on bioacoustics for a range of behaviours' such as communication, foraging and navigating. Loud noises have potential to disrupt these behaviours, and in worst cases cause fatal injuries or behavioural disruption. To monitor cetacean health, it is important to understand how they use the areas of interest for ORE, and use that information as a basis for planning construction phases.

In my PhD project I will study the ecology of cetaceans in Irish waters, in relation to planned and operating offshore wind farm sites. Using a variety of acoustic devices and analytical techniques, I will gather baseline data of behaviour, distribution and abundance of whales, dolphins and porpoises. As part of this - using newly developed, less expensive hydrophones and techniques along with interdisciplinary methods - we aim to push the development of cetacean monitoring in relation to ORE, towards more affordable and accessible methods.



#UKIRSC23



Investigating methods for a multi-faceted approach to determine distribution and habitat use of harbour porpoise (*Phocoena phocoena*) to inform management.

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Harbour porpoises are the UKs most numerous cetaceans, predominantly occurring in coastal areas. Specifically, around the Shetland archipelago limited information is available regarding harbour porpoise spatial and temporal patterns, behaviour and habitat use, and the extent of co-occurrence to current anthropogenic activities. However, the limited ad-hoc reports that are available have determined that they occur all year round and unusual mega-pods of over 100 have been documented.



Investigating environmental drivers of cetacean occurrence in a cross-border region, the Malin Shelf, using data collected during a transnational European fishery survey

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Irish and Scottish waters are important habitats for cetaceans in Europe. Despite a rich species diversity, relative cetacean abundance over the Malin shelf seems rather low compared to hotspots documented further north off the Hebrides, and west and south of Ireland. It remains unclear whether this uneven prevalence accurately portrays an ecological discontinuity or arises from a lack of published results and low survey effort in that transborder area. Since summer 2016, the multi-disciplinary Western European Shelf Pelagic Acoustic Survey (WESPAS) has been extensively and systematically covering the entire region of the Malin Shelf, monitoring marine megafauna, seabird, fish stocks, zooplankton and oceanographic conditions. It is to date the most comprehensive and longest on-going time series for visual observations of marine mammals in the area. Here, we used the WESPAS dataset to investigate cetacean distribution and habitat preferences over the Malin and Hebridean shelves. Minke whale (*B. acutorostrata*) and common dolphins (*D. delphis*) were the most frequently sighted species in the region. Both species occurrence was modelled within a Bayesian Additive Regression Trees (BART) framework against selected environmental and biological variables. No correlation was observed between cetacean occurrence and prey biomass measured on the echosounder. Minke whales distribution was better explained by oceanography, proxies for discontinuities between water masses, front locations, and primary productivity. Common dolphins similarly showed preferences for stratified shelf waters, but also affinities for fine substrates. Hotspots identified by the models northwest of Scotland were consistent with published literature around the Hebrides. Predictions extended to the entire region shed light on potentially important habitats along the Islay front and in mid-shelves waters north of Donegal, which were undocumented so far due to data deficiency. Ultimately, results from this study will contribute towards informing strategic management and conservation in this cross-border area.



Voluntary control of vocal utterances in bottlenose dolphins (*Tursiops truncatus*)

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Volitional control of vocalisations in animals has been debated for nearly 100 years. Studies through the 20th century showed that vocalisations of non-human primates, birds, dolphins, and other species could be brought under stimulus control (produced in presence of a stimulus and withheld in its absence) but this did not convince everyone of true, human-like volition rather than affected emotional-state driven vocalisation.

A new framework for testing volitional control of vocalisations in non-human species using visual discrimination was introduced in 2013 and in this study tested for the first time on bottlenose dolphins (*Tursiops truncatus*). We found that the dolphins: 1) have strong control over the onset and withholding of their vocalisations; 2) produce said vocalisations in a temporally relevant manner; 3) have strong control over the call type produced; 4) and the ability to control vocalisations does not diminish with age as seen in some primate species.



Assessing the potential of social media and citizen science for the advancements of conservation efforts

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Citizen Science is an emerging field of public scientific engagement and can be a powerful tool for data collection. Social media is at the forefront of data aggregation in this area. In this study social media has been proven to provide a valuable dataset for the conservation of bottlenose dolphins in the Shannon Estuary. Social media visual posts from Facebook, Twitter, Instagram and TikTok over the last 5 years have been collected and graded based on their quality. Searching under hashtags such as #ShannonDolphins or #ShannonEstuary among others, gave a total of 84 videos and 55 photos. 41 posts were valuable for Photo ID, 89 for Behavioural studies and 54 for other potential studies. The overall percentage of applicable data was 90.62%, which shows that social media can make a helpful contribution to conservation studies. Therefore, with the correct implementation and instruction, social media can become a primary source of data. This is a very small example of the potential that citizen science has to provide constant data of an animal population.