UKIRSC XI Annual Conference 2017

Plymouth University

18-20th January

TIMETABLE and ABSTRACT BOOKLET

CONTENTS

TIMETABLE

Wednesday, 18th January

20:00 – 22:30   **Conference Ice Breaker at the National Marine Aquarium**

Thursday, 19th January

08:30 – 09:00   Registration

09:00 – 09:10   Welcome by Dr. Clare Embling from Plymouth University

09:10 – 10:00   *"Seals as models for obesity: insights and challenges from champions of fat deposition"* Dr. Kimberley Bennett from Abertay University

Behaviour and Movement   **Chair : Holly Armstrong**

10:00 – 10:15   *"Grey seal pup dispersal patterns: Individual differences and implications of marine energy installations in Wales."* Will Kay

10:15 – 10:30   *"Sex and region differences in the movement and ontogeny of diving behaviour in grey seal pups."* Matt Carter

10:30 – 10:45   *"Do grey seals have friends? A multilayer network analysis on grey seal social structure."* Toby Rosas da Costa Oliver

BREAK

11:15 – 12:15   *"Fur, Feathers, Fish and Fisheries: The role of predators in monitoring and managing the Southern Ocean Ecosystem."* Dr. Iain Staniland from the British Antarctic Survey.

Speed Talks	Chair : Matt Carter
12:15 – 12:20	*"Development of an Acoustic Mass Stranding Alert System."* Alex Carroll
12:20 – 12:25	*"The Ontogeny of Sexual Segregation in Antarctic Fur Seals (Arctocephalus gazella)."* Kayleigh Jones
12:25 – 12:30	*"A review of cetacean reproduction."* Patricia Casanovas Gamba
12:30– 12:35	*"Whales from space: studying baleen whales by satellites."* Hannah Cubanyes
12:35 – 12:40	*"Population genetic structure of grey (Halichoerus grypus) and harbour (Phoca vitulina) seals in north-western European waters."* Kristina Steinmetz

LUNCH BREAK

Acoustics	Chair: Toby Rosas da Costa Oliver
14:00 – 14:15	*"Interspecific comparison of cetacean feeding calls: convergent evolution?"* Leticiaa Legat
14:15 – 14:30	*"An adaptive grid to improve the efficiency and accuracy of modelling anthropogenic underwater noise and its impact on marine mammals."* Leah Trigg
14:30 – 14:45	*"When Conformity and Novelty Collide: Patterns of Song Complexity in Humpback Whales (Megaptera novaeangliea)."* Jenny Allen
14:45 – 15:00	*"Automated tracking of dolphin whistles."* Pina Gruden
15:00 – 15:15	*"Impacts of military sonar on delphinid vocalisation behaviour."* Gemma Starmore

BREAK

15:45 – 17:00	**Themed round table discussions with Q&A sessions**:

- *"Working as an MMO and PAM Operator"*
Loraine Grant (Seiche Training)
- *"How to survive your PhD"*
Dr. Rebecca Ross and Dr. Sarah Lane (Plymouth University)
- *"Writing and publishing papers"*
Dr. Kimberley Bennett (Abertay University)
- *"Working in marine mammal science after your post-grad"*
Dr. Clare Embling (Plymouth University)

19:30 onwards   **Conference Meal at The Stable**

Friday, 20ᵗʰ January

09:00 10:00   *"Cornwall Wildlife Trust, Protecting Cornwall's Cetaceans"* Abigail Crosby from the Cornwall Wildlife Trust.

Physiology and Genetics	**Chair : Leticiaa Legat**

10:00 – 10:15   *"Long-term trends in diet and mortality of Moray Firth harbour porpoise (Phocoena phocoena) in relation to prey abundance: insights from stable isotope analysis."* Tom Bean

10:15 – 10:30   *"Analysis of environmental adaptation in bottlenose dolphin (Tursiops truncatus), using microsatellites and functional genes."* Kypher Shreves

10:30 – 10:45   "*Anti- and pro-oxidant gene expression and oxidative damage in the blubber tissue of grey seal (Halichoerus grypus) pups during suckling and the post weaning fast.*" Holly Armstrong

BREAK

Population Biology   **Chair : Leah Trigg**

11:30 – 11:45   *"Learning about Trinidad & Tobago's cetacean populations through its stranding record."* Alësha Naranjit

11:45 – 12:00   *"Temporal variation in social structure of Indo pacific humpback dolphins (Sousa chinensis) off the west coast of Taiwan."* Wen Hou

12:00 – 12:30   **Poster Viewing Session**

LUNCH BREAK

14:00 – 16:00   **"Impact – how to hit the communication sweet spot!"**
Workshop Paul Cox from the Shark Trust.
Interactive workshop on conservation psychology and
how to get people to care about science!

ABSTRACTS

ACOUSTICS

When Conformity and Novelty Collide: Patterns of Song Complexity in Humpback Whales (*Megaptera novaeangliea)*

Jenny Allen, Ellen Garland and Michael Noad

University of Queensland, Australia and University of St Andrews, Scotland

Vocal learning is a key component to the study of non-human culture, focusing on the songs of birds and cetaceans. Changes in complexity within songs are often linked to male fitness, either physically or cognitively. However, cultural traits often require a balance between novelty and conformity. Novelty drives the changes that make a song more complex, while conformity can serve as a means of group identification. Humpback whales (*Megaptera novaeangliea)* provide a unique opportunity to assess the intersection of these factors. Their song is highly complex and contains a striking balance of conformity and novelty. While the song evolves progressively, every few years there is a population-wide cultural 'revolution' in which the song is suddenly and radical changed. This study examined patterns of complexity in the song of the east Australian population over a period of 13 years using common metrics to assess complexity within the song over time. Complexity was found to increase as the song evolved over time, but decreased when cultural revolutions occurred. This pattern extended to the theme level within the song's hierarchical structure, though at a lower rate than overall song complexity. This implies that complexity within a song's themes is not the only source of increasing novelty within the song. Individuality within songs was also to increase along with complexity as the songs evolved. These results indicate that individuals are the drivers behind changes made within the songs, and that the 'fitness' indicated by the song is likely learning ability or cognitive capacity.

Interspecific comparison of cetacean feeding calls: convergent evolution?

Leticiaa Legat and Volker Deecke.

University of Cumbria

Coordinated schooling is used by many fish species to help reduce predation levels but some large marine predators are exploiting this anti-predator strategy to capture their prey. Icelandic killer whales (*Orcinus orca*) and North Pacific humpback whales (*Megaptera novaeangliae*) have independently developed distinct low frequency call types used while preying on herring (*Clupea harengus* and *C. pallasii*). The calls seem to modify herring schooling behaviour, providing energy savings and enhanced feeding success for the predators. The main objectives of this study were to describe and compare feeding calls of both cetacean species, and test the hypothesis of a convergent evolution on this behaviour. The project involved three field seasons in subsequent years to collect high-quality feeding calls and behavioural data from Icelandic killer whales and North Pacific humpback whales, and presents the first results of interspecific comparison on this vocal behaviour.

An adaptive grid to improve the efficiency and accuracy of modelling anthropogenic underwater noise and its impact on marine mammals.

Leah Trigg, Feng Chen, Georgy Shapiro, Clare Embling and Simon Ingram

Plymouth University

Increasingly, underwater anthropogenic noise is considered detrimental to marine mammals. Consequently, noise-generating activities are potentially subject to regulatory procedures such as environmental impact assessments and continuous noise monitoring. Underwater noise modelling is a primary tool for assessing and predicting noise levels and their impact on marine mammals. However, acoustic propagation models are time consuming to execute and process. This problem can be addressed by grouping noise sources together using a grid. Optimal grid size is a balance between achieving the greatest efficiency by using a large grid size, and achieving the greatest accuracy by using a small grid size. In order to achieve efficient and accurate noise level predictions, this work developed a novel adaptive grid where the grid size changes in relation to the distance between a sound source (a ship) and a receiver (a seal). This talk will describe the adaptive grid, demonstrate its superior computational efficiency and accuracy, and describe how the grid will be applied to telemetry data collected from grey seals (*Halichoerus grypus*) to assess the noise exposure level and behavioural response of grey seals to shipping noise during diving activity throughout the water column.

Impacts of military sonar on delphinid vocalisation behaviour

Gemma Starmore, Connor Ryan, Lauren Hartny-Mills, Jordan Gordon and Clare Embling

Plymouth University

Increased anthropogenic noise in the oceans and the potential impact on marine mammals is a growing concern. Military sonar is just one source of underwater noise, but it can have severe consequences on marine mammals. This study investigated the impact that exposure to military sonar has on the vocal behaviour of dolphins. The Hebrides off the west coast of Scotland are an important area for marine mammals and are also the location of the Joint Warrior Exercise (Europe's largest military training exercise). Acoustic recordings of both marine mammals and military sonar were made during the exercise between the 12th and 14th of October 2014. The differences in the vocal characteristics of dolphins exposed to military sonar to the vocal characteristics when not exposed were analysed and statistically tested. There was no difference in the frequency of dolphin acoustic detections when exposed to military sonar ($p = 0.99$). However, there were significantly less vocalisations when the dolphins were in the presence of sonar ($p < 0.05$). There were also significant differences in the whistle characteristics of dolphins when exposed to sonar, including higher whistle inflections ($p < 0.001$) and higher, wider-ranging frequencies ($p < 0.05$). The results described above provide preliminary evidence that military sonar does affect the characteristics of dolphin vocalisations. The long term consequences of this are unknown and should be investigated further.

Automated tracking of dolphin whistles

Pina Gruden and Paul White

University of Southampton

The automated detection of marine mammal calls is a first and crucial step for many applications, such as behavioural research, real time monitoring, abundance estimation and mitigation. Here, we present a Gaussian Mixture Probability Hypothesis Density (GM-PHD) filter, an automated multi-target tracking technique, to track dolphin whistle contours. A large data set consisting of six dolphin species and over 9000 whistles is used to test the GM-PHD detector's performance. The performance of this detector is also compared to the performance of the whistle detector from Pamguard, a widely used open source software tool. The results show the GM-PHD detector successfully tracks overlapping whistles from the noisy recordings and it appears to be a powerful tool for simultaneous, real-time tracking of dolphin whistle contours.

Development of an Acoustic Mass Stranding Alert System

Alexandra Carroll, Laela Sayigh, Mark Baumgartner, Jim Partan, Alessandro Bocconcelli, Tammy Silva, Katie Moore and Michael Moore

University of St Andrews

Cetacean mass stranding events (MSEs) are a poorly understood reality, particularly along the shores of Cape Cod in Massachusetts, USA. We are exploring the potential for acoustic cues to provide advance warning of individuals about to strand. We analyzed data from an acoustic monitor in Wellfleet Harbor to determine if whistle detections are correlated with MSEs. In these preliminary findings, an acoustic detection was defined solely as the presence of odontocete whistles; click trains and buzzing were noted, but not included in the analysis. Of the 19 stranding events documented so far, 73.7% occurred within 1-4 days of an acoustic detection, with 64% of those detections occurring before the stranding event. More importantly, acoustic detections occurred 1-4 days before all four MSEs that occurred during the study period. If this trend holds during further testing, acoustic monitoring could notably improve the capability of rescue organizations to successfully intervene before animals strand.

Judas fish: estimating the effect of eavesdropping killer whales in acoustic tagging projects on fish in British Colombia.

Naomi Tuhuteru, Sophie Smout and Volker Deecke

University of St Andrews

Salmon population in British Colombia (Canada) have been monitored using Ultrasonic Coded Transmitters (UCT's) since 1980. These UTC's are surgically implanted and transmit a signal registering an animals unique ID if it approaches a receiver within 500 meter. Studies have found evidence of marine mammals being able to detect these UCT signals in phocids and odontocetes and a captive study found grey seals used the information to guide foraging decisions. Other studies suggest orcas may be able to detect the sound of the UCT's. Agent based models have been used to gain understanding between acoustically sensitive predators (orcas) and tagged fish (Chinook Salmon) in a simulated area resembling the Queen Charlotte and Johnston Straits in British Columbia. It suggests that the encounter frequencies can reach significant levels under certain geographical conditions like narrow straits and river estuaries. The encounter frequencies were a function of detection range, which can differ significantly between pinnipeds and odontocetes. However, empirical data on the detection ranges in odontocetes is currently lacking. This study will analyse orca movement and implement movement rules derived from Dtag data deployed on orcas in British Colombia to specify an agent based model. This study aims to assess how orcas may be using the sound of acoustic pingers on fish as a cue for finding prey and what the impacts on prey mortality could be.

BEHAVIOUR and MOVEMENT

Sex and region differences in the movement and ontogeny of diving behaviour in grey seal pups

Matthew Carter, Brett McClintock, Clare Embling, Kimberley Bennett, Philip Hosegood, Dave Thompson and Deborah Russell

University of St Andrews and Plymouth University

First year survival in long-lived predators is naturally low and variable between years, and has a profound effect on population dynamics. Grey seal (*Halichoerus grypus*) pups are abandoned on the natal colony after a brief (15-21 days) suckling period. Survival at sea depends on the development of successful foraging skills before energy reserves are depleted. Little is known about this critical early stage in pup development; however both sex and regional differences have been reported in first year survival of grey seals which may be driven by differences in foraging behaviour. Indeed, sex differences have been observed in juvenile foraging behaviour. Here, we deployed biotelemetry devices on 52 recently-weaned pups from two subpopulations (North Sea and Wales). We investigated, for the first time, how movements and diving behaviour of pups changed during their first months at sea. We used trip and dive metrics as measures of pup behaviour relevant to foraging. We examine how this process varies as a function of intrinsic (sex) and extrinsic (region) factors.

Grey seal pup dispersal patterns: Individual differences and implications of marine energy installations in Wales.

William Kay, James Bull, Tom Stringell and Luca Börger

University of Swansea

Dispersal plays a fundamental role in population dynamics and gene flow. Natal dispersal in young animals typically covers vast areas and has large impacts on individual fitness and population structure. Despite their biological importance, little is known of the early movements of juveniles, which can represent up to half of the total population in long-lived species. This lack of knowledge is particularly pertinent to marine predators, such as grey seal pups (*Halichoerus grypus*), that move alone and with no information from their parents. Such information however is key for understanding and predicting the responses of animals to climate change or human activities such as marine energy developments. We present data from a recently discovered, historical mark-recapture record of newly-weaned grey seal pups in Wales. These previously unpublished records, spanning 1954-1971, document the early movements of 256 individuals from over 1300 originally marked. Movements are recorded for up to a year following weaning offering a novel understanding of natal dispersal. The squared displacement modelling method is used to quantify movement types between individuals and relate these to biological and demographic covariates; including sex, colony and environmental conditions. Results indicate that individuals cover huge ranges during their first few months at sea; travelling as far as Northern Ireland, France and Spain. There is large inter-individual variation and a notable difference in strategies of pups from different colonies. Density kernels are overlaid on proposed and leased sites for marine renewables to quantify the spatio-temporal overlap of these, to understand potential impacts of such interactions.

Do grey seals have friends? A multilayer network analysis on grey seal social structure

Toby Rosas da Costa Oliver and Paddy Pomeroy

University of St Andrews

Social structure is a consequence of living in groups and provides a framework in which important events such as reproduction or information transfer occurs. The aggregation of recognisable individuals, along with site fidelity and social recognition, gives the opportunity for individuals to interact and associate non-randomly, forming the requirements for sociality to evolve. To improve our understanding of this evolutionary role in grey seals (*Halichoerus grypus*), it is necessary to investigate the relationships and underlying associations and/or interactions of breeding females. Photo-ID, positional and behavioural data from breeding colonies across the UK were collected in 2014 and 2015 using two different methodologies to define associations. Preliminary results from both methodologies indicate that caution must be taken when defining associations, as the resulting sociality they describe may be very different.

Identifying important marine areas for pinnipeds – a comparison of approaches

Lea Brandes, John Arnould, Alastair Baylis, Andrew Hoskins, Carey Kuhn, Iain Staniland and Jonathan Green

University Centre of the Westfjords, Iceland and the University of Liverpool

Given the widespread decline of species and threats to habitats across the globe, identifying important areas for conservation is now more important than ever. With ever-improving technology, the use of tracking data has recently contributed valuable information on the movement and habitat use of marine organisms, and has allowed for insight into habits and habitats of animals such as pinnipeds that are difficult to study. Pinniped PTT and GPS data from four species were analysed using an analytical approach used to identify Important Bird and Biodiversity Areas ('IBA approach'). Similarities in foraging patterns and attendance cycles allow for comparison between seabirds and female pinniped movement patterns during their breeding season. The IBA approach was compared to three commonly-used methods of spatial analysis; Kernel Density Estimation (KDE), Minimum Convex Polygon (MCP), and Time-spent-in-Area analyses. The 50% home range was used to analyse the size of areas and the percentage overlap between areas identified by different methods. The IBA approach and other methods were all able to effectively identify important areas, though the areas identified by all four methods differed in their extent and exact location. MCP differed the most from the other methods. Advantages and disadvantages of each method should be taken into account in conservation management. Future developments could include broadening of the approach to incorporate a wider range of pinniped species.

Long-term trends in diet and mortality of Moray Firth harbour porpoise (*Phocoena phocoena*) in relation to prey abundance: insights from stable isotope analysis

Thomas Bean, Andrew Brownlow, Nicholas Davison, Jean-Pierre Lacaze, Jason Newton, Fiona Read, Mariel Ten Doeschate and Graham Pierce

University of Aberdeen

Harbour porpoise (Phocoena phocoena) have high energetic demands and are vulnerable to prey depletion. Individual dietary responses of porpoises to changes in prey abundance remain poorly understood at the population scale. Stable isotope analysis (SIA) was used to give new insights to harbour porpoise diet, including responses to historical changes in prey availability. Insights represented a longer timeframe than previously available from studies of stomach contents. Carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope ratios in harbour porpoise were analysed in skin samples taken from stranded individuals in the Moray Firth, between 1992 and 2015. Stable isotope ratios were also measured in 10 fish species previously identified as prey from stomach contents. Generalised additive models (GAMs) identified significant inter-annual variation of porpoise $\delta^{13}C$ values, which were highly correlated to the abundance of sandeel (Ammodytes spp.) and whiting (Merlangius merlangus). It is hypothesised that porpoises maintain trophic level by moving between inshore and offshore foraging habitats depending on prey availability. Healthy and reproductively active individuals were found to target inshore prey of a lower trophic level, likely sandeel. Therefore, high mobility supports survival but reduced prey quality may lower fitness, especially in adult individuals. As a result, long-term population impacts including reduced productivity are likely to follow reduced sandeel abundance.

Analysis of environmental adaptation in bottlenose dolphin (*Tursiops truncatus*), using microsatellites and functional genes.

Kypher Shreves, Stefania Gaspari and Andre E. Moura

University of Lincoln

Given the marine environment of cetaceans, geographical barriers to gene flow are relatively rare. Despite this, fine-scale population structure has been described in multiple cetacean species. This study will test the hypothesis that environmental adaptation is a driver of fine-scale population structure in Adriatic *Tursiops truncatus*. Multilocus microsatellite data from a published study was used to investigate patterns of genetic differentiation between *a priori* defined groups, based on known difference in various environmental factors. Microsatellite genetic diversity suggests gene flow is limited between Adriatic basins, with the northern most basins being the most differentiated. Comparison of Deep vs Shallow water environments resulted in the highest number of private alleles between *a priori* defined groups, while Depth by Meter displayed the highest F_{ST} levels between groups. Outlier selection tests resulted in 6 loci under balancing selection across four of the environmental comparisons, with three loci reported for more than one comparison. One of these loci was found to be located within the first intron of the NOSTRIN gene. NOSTRIN plays a critical role in nitric oxide synthesis and trafficking, which is thought to relate with diving physiology. However, balancing selection at this gene in the Deep vs Shallow environmental comparison may suggest that, previously reported differentiation between deep and shallow water environments is not due to differences in diving ability. The results of this study suggest that environmental differences are related with patterns of genetic differentiation at genes with ecologically relevant functions, but the exact mechanisms still require further study. Current research is investigating differentiation patterns at candidate functional genes. This includes NOSTRIN identified in this study, but also others with functions relevant to local environmental differences. Understanding differentiation in genes potentially under direct phenotypic selection, could be invaluable in our understanding of the drivers of population differentiation in cetaceans.

Anti- and pro-oxidant gene expression and oxidative damage in the blubber tissue of grey seal (*Halichoerus grypus*) pups during suckling and the post weaning fast

Holly Armstrong, Ailsa Hall, Simon Moss, Paddy Pomeroy and Kimberley Bennett

Plymouth University

The ability to respond adequately to stress is crucial to fitness and survival. Cellular defences play key roles in protecting against natural and anthropogenic stressors. Grey seal pups experience rapid physiological changes during development. They feed on 40-60% fat milk, triple in body mass during their first 18-21 days of life, and undergo a post weaning fast of up to four weeks. High fat intake, rapid fat deposition and prolonged food deprivation can stimulate reactive oxygen species production in other species. We used qPCR to investigate changes in gene expression of pro- and antioxidant enzymes in blubber tissue during suckling and fasting in pups on the Isle of May, Scotland, during October to December 2013 (n = 15). Glutathione peroxidase (GPx), superoxide dismutase (SOD) and NADPH oxidase 4 (NOX4) were significantly upregulated during the post weaning fast, whereas catalase (CAT) and glutathione-S-transferase (GST) were down regulated during this period (LME; $p > 0.05$). There was no difference in malondialdehyde (MDA) concentration, an index of oxidative damage, during suckling or fasting. MDA was not related to gene expression changes. This suggests antioxidant defences are important and effective in avoiding oxidative stress in blubber during fasting. These mechanisms mirror those in muscle tissue of fasting Northern elephant seal pups. Our data highlight that suckling is not associated with higher antioxidant gene expression, despite high fat intake and rapid fat tissue expansion. The ability of pups to avoid ROS production and oxidative damage in blubber under these conditions warrants further attention.

The Ontogeny of Sexual Segregation in Antarctic Fur Seals (*Arctocephalus gazella*)

Kayleigh Jones, Iain Staniland, Stephen Votier and Norman Ratcliffe

University of Exeter and the British Antarctic Survey

Sexual segregation has been widely studied in terrestrial animals, particularly ungulates, but understanding is still developing in marine mammals. Sexual segregation in seals has mostly been explained by sexual size dimorphism and the constraints of parental care on females. However, sexual segregation occurs from early life in Antarctic fur seals (*Arctocephalus gazella*), as male and female pups display preferences for different habitats at a breeding site at Bird Island, South Georgia. At this breeding site, sexual segregation in foraging has been observed in adult seals during the mating season, and after mating when males disperse from the breeding colonies whilst females remain to provision their pups. The foraging distributions of juveniles and males are poorly understood and deploying tracking devices can provide insight to their movements. Stable isotopes $\delta^{13}C$ and $\delta^{15}N$ in whiskers and teeth provide records of changes in foraging niche, which can be used to determine how sexual segregation develops throughout life. This study aims to fill research gaps by determining annual distributions of male and female Antarctic fur seals, identifying and comparing patterns in foraging niches throughout development, and exploring underlying drivers of sexual segregation.

A review of cetacean reproduction

Patricia Casanovas, Manel López Béjar, Noelia González Orti and Antonio del Niño Jesús

University of Zaragoza, Spain

It is well known throughout the whole globe that there are massive climate changes and most of them are due to the human kind. Those changes affect directly to the earthlings, including cetaceans leading them to almost their extinction and others to their growing populations without the control of their extinct predators. How does this variation affect cetaceans? First, we should study the base of their reproduction and which variables affect them. Here is a bibliographic review on cetacean's reproduction with data from Marsh and Kasuya (1984), Rolland (2001), Oien and Haug (1992). This review highlights aspects of cetacean reproduction with the objective to summarize the most important things that influence it including environmental aspects that influence cetacean's reproduction such as biotoxins and contaminants, and feeding and reproduction patterns in some species like *Balaenoptera physalus, Eubalaena glacialis* and others of that same family.

Investigating microplastic trophic transfer in a marine top predator

Sarah Nelms, Brendan Godley, Tamara Galloway, Dan Jarvis and Pennie Lindeque

Plymouth University and the University of Exeter

The widespread contamination and degradation of the marine environment by plastic debris is now recognised as a significant threat to many aquatic species. Microplastics (plastic particles <5mm in size) are of particular concern due to their small size and therefore, increased bioavailability to a wide range of marine biota. Once ingested, microplastics are known to cause a number of detrimental impacts, including a reduction in feeding capacity, energy reserves and reproductive output. In addition, their large surface-area-to-volume ratio means they are susceptible to the adsorption of hydrophobic contaminants, such as heavy metals and polychlorinated biphenyls (PCBs), from surrounding seawater. Upon ingestion, these, and other chemicals added during production, may cause sub-lethal effects on the organism. Ingestion may occur by one of two pathways; directly through accidental consumption, or indirectly as a result of trophic transfer, passed from contaminated prey to predator. Trophic transfer of microplastics has been observed for a number of low-trophic level organisms in laboratory conditions, yet there is little direct evidence for it in high trophic-level taxa, such as marine mammals. Previous studies investigating wild pinnipeds found microplastic particles within scat (faeces) and inferred that trophic transfer from fish prey was the source. *In natura* studies, however, face difficulties when dealing with contamination of samples and differentiating between directly and indirectly ingested microplastics. The ethical constraints of subjecting large organisms, such as marine mammals, to laboratory investigations hinder the resolution of these practical constraints. Here, we are able to resolve some of these constraints. By analysing scats from captive adult grey seals (*Halichoerus grypus*) fed on wild-caught fish, the issue of contamination and the possibility of direct plastic consumption are lessened. We therefore hypothesise that any microplastic particles found within the scats are as a direct result of trophic transfer from contaminated prey.

Cetacean and marine litter distributions in western Scotland, a spatial risk analysis.

Karley Khan and Clare Embling

Plymouth University

Entanglement and ingestion of anthropogenic generated marine litter poses a major threat to cetacean species, however the cryptic nature of the problem makes in-situ studies difficult. Western Scotland is one of the most important habitats for a diverse range of cetacean species, many of which are protected by European legislation. This study aims to identify spatial areas for potential overlap between marine litter and cetaceans in western Scotland. Data collection took place during 2014 via dedicated boat-based systematic surveys. Marine litter was sighted throughout the survey region and within the vicinity of 133 cetacean sightings. A significant ($p < 0.001$) but weak correlation ($\varphi = 0.21$) was found for the spatial distribution of cetaceans and marine litter. The highest-risk areas occurred between Little Minch, the Small Isles and the Isle of Mull. Plastic was the most prevalence item observed (66.2%), with over one-quarter comprised of various plastic pieces. This study highlights key areas for marine spatial management and monitoring prioritization for stranding response networks.

POPULATION BIOLOGY

Temporal variation in social structure of Indo pacific humpback dolphins (*Sousa chinensis*) off the west coast of Taiwan

Wen Hou and Lien-Siang Chou

National University of Taiwan

Temporal variations in social structure of small delphinids are lacking for most species. This study investigated temporal variation of "Critically Endangered" population Indo-pacific dolphins, *Sousa chinensis*, in Taiwan. Based on long-term working on photo-ID (photo-identification) study, 33 individuals with equal or more than ten sightings during two periods (2008-2010, 2012-2014) of study were selected. To estimate the social differentiation of this population and individual social dynamics, half-weight association index, hierarchical cluster analysis and temporal analysis were applied. Population was highly differentiated ($S =$ 1.101 in 2008-2010, $S = 0.93$ in 2012-2014) and formed northern and southern communities with 17 and 16 dolphins respectively in the 1st period. In 2nd period, social groups became three with new group formed between northern and southern communities. The composition of coloration age stages, breeding status, location and range use pattern in each social community were different. The new formation group included 11 individuals, seven from northern community, four from southern community. All individuals from northern communities did not show significant change in range use. Among four individuals which came from southern community, some were females and some shifted their core area. The formation of new group could be either related with range use change or reforming associations. To understand the mechanism of social dynamics, future research should include information of life history and other environmental factors, such as distribution of prey resource, which could have influence on their range use and social association of these dolphins.

Learning about Trinidad & Tobago's cetacean populations through its stranding record

Alësha Naranjit, Howard Nelson, Simon Oliver and Andrew Lawrence

University of Chester

Cetacean research around Trinidad and Tobago has been sporadic and fragmented, resulting in limited available information for conservation management of cetaceans in this area. This project focuses on improving knowledge of species diversity, distribution and evidence of threats by examining the country's stranding record. It also attempts to identify any spatial and temporal trends in the data. Stranding events were collated from published scientific and non-technical literature, unpublished documents, websites, social media, citizen science reports and specimens. Seventy-five verifiable records of cetacean strandings in Trinidad and Tobago were found between 1953 and 2016.These provided new information on species diversity and temporal presence in the area. Data analysis to identify geographic stranding 'hotspots', seasonality, relationship to oceanographic conditions and evidence of threats is ongoing.

Population genetic structure of grey (*Halichoerus grypus*) and harbour (*Phoca vitulina*) seals in north-western European waters

Kristina Steinmetz, Sinéad Murphy, Oliver O'Cadhla and Luca Mirimin

Galway-Mayo Institute of Technology

Grey (*Halichoerus grypus*) and harbour (*Phoca vitulina*) seals are the only two pinniped species occurring in Irish waters where their population structure and genetic diversity is currently unknown. Furthermore, mortality due to past phocine distemper virus outbreaks may have decreased genetic diversity of harbour seals, which would make populations less adaptable and more vulnerable to threats. Using contemporary and historical samples, this project aims to assess population structure and long-term changes in genetic variability following such epizootics. Preliminary tests successfully isolated DNA from scat (faecal) samples, showing that non-invasive sampling can provide insights into population structure on a genetic level. Scats and hair were collected at two breeding sites (Inishshark, Inishkeas) during the 2016 *H. grypus* pupping season. DNA has successfully been isolated from hair collected during these trips as well as from hair collected from seals in rehabilitation. Different methods for collection and preservation of scat, hair and bone samples are being tested both in the wild and in captivity. Historical samples, including skeletal material stored in museums, will be used to investigate current and past genetic diversity levels, population structure and the potential impact of two epizootic events. This study will provide information on connectivity and reproductive isolation among geographical areas, thereby filling the knowledge gap necessary to identify management units required for indicator assessments under the Marine Strategy Framework Directive.

Whales from space: studying baleen whales by satellites

Hannah Cubaynes, Peter Fretwell and Gareth Rees

University of Cambridge and the British Antarctic Survey

A new, innovative method is emerging in the field of wildlife monitoring: the use of very high resolution (VHR) satellite imagery. It has the potential to fill information gaps (*e.g.* occupancy, population size and trend), in particular for inaccessible and remote areas. Such knowledge is critical to advise on more suitable and effective conservation measures. Knowing that VHR satellites offer a spatial resolution at sub-meter resolution, large animals could be detected in open space. Due to their large size, baleen whales are an ideal candidate to test the applicability of VHR satellite imagery in marine conservation. Hence, this project will build on the previous work of Fretwell *et al.* (2014), who tested this for one species of *Mysticeti*, the southern right whale (*Eubalaena australis*). The present research will primarily be extended to three other whale species (fin whale, *Balaenoptera physalus*; humpback whale, *Megaptera novaeangliae*; Grey whale, *Eschrischtius robustus*) with four main problems to be addressed: 1) species differentiation; 2) how deep below the sea surface whales can be detected; 3) the feasibility of population size and trend surveys; as well as 4) automated detections. To address each problems, images from the WorldView3 satellite will be analysed, which currently provides the best available spatial resolution (*i.e.* 31 cm).