The Society for Marine Mammalogy
UK & Ireland Regional Student Chapter

Annual Chapter Meeting Timetable & Abstract Booklet

St. Andrews, Scotland | 20-22 January 2016

CONTENTS

TIMETABLE

Wednesday, 20th of January

20:00 onwards	**Ice Breaker at *Rascals Bar***

Thursday, 21st of January

09:00 – 09:10	Welcome Speech by Dr. Ailsa Hall, Director of the Sea Mammal Research Unit, University of St. Andrews (*SOI Lecture Theatre*)
09:10 – 09:40	"Tips for surviving & succeeding in academia" by invited speaker, Dr. Clare Embling, founding member of the UKIRSC and lecturer of marine biology at Plymouth University
Population Biology	Chair: Toby Oliver
09:40 – 09:55	"Photo-identification of the common minke whale (*Balaenoptera acutorostrata*) in Faxaflói, Iceland to establish an abundance estimate using a platform of opportunity." – Jack Ball
09:55 – 10:10	"The social structure of the Icelandic killer whale (*Orcinus orca*) population" – Sara Tavares
10:10 – 10:15	"Using Social Media as an untapped resource for a photo-identification study of Bottlenose dolphins (*Tursiops truncatus*)" – Catherine Hinds
10:15 – 10:20	"Blainville's beaked whales population off El Hierro (Canary Islands): abundance estimation and site fidelity" – Cristel Reyes
10:20 – 10:25	"Cetaceans off the Catalan Coast: A matter of depth?" – Oriol Geralt

10:30 – 10:35	"Photo-identification of Bryde's whales (*Balaenoptera brydei*) in the Hauraki Gulf, New Zealand: updating the photo-catalogue of recognisable individuals and matching them to other regions "
	BREAK
11:00 – 11:45	"Perspectives and prospects in marine mammal field studies" by invited speaker Prof. Mike Fedak, Senior Research Scientist at SMRU
Physiology	Chair: Matt Carter
11:45 – 12:00	"The benefit of being big: body rotations and acceleration over a 3000:1 mass range in cetaceans" – Lucia Martina Martin Lopez
12:00 – 12:15	"Eye in the Sky: The Performance of UAVs as Aerial Photogrammetry Platforms using Harbour Seals in Loch Fleet" – Marie Kearns
12:15 – 12:30	"The Pleiotropic Role of Cetacean Blubber" – Jo Kershaw
12:30 – 12:35	"Heat shock protein gene expression in blubber of grey seal (*Halichoerus grypus*) pups during suckling and the post weaning fast: effects of development rather than contaminant exposure?" – Holly Armstrong
12:35 – 12:40	"Long-term trends in diet and mortality of Moray Firth harbour porpoises in relation to prey abundance: insights from stable isotope analysis" – Tom Bean
	LUNCH
Behaviour	Chair: Holly Armstrong
14:00 – 14:15	"Harbour Seal (*Phoca vitulina*) Habitat Use and Pup Behaviour in County Down, Northern Ireland" – Kayleigh Jones

14:15 – 14:30	"Associations or alliances? Comparisons of social relationships between male bottlenose dolphins (*Tursiops truncatus*) in two UK populations" – Texa Sim
14:30 – 14:45	"Do bottlenose dolphins recognise themselves in a mirror?" – Alina Loth
14:45 – 15:00	"Fifty shades of grey seal (*Halichoerus grypus*) social networks and the ties that bind" – Toby Rosas da Costa Oliver
15:00 – 15:05	"The effect of age, sex and group size on behavioural responses of Northern Resident Killer Whales (*Orcinus orca*) to boat traffic" – Kay Andrews
15:05 – 15:10	"Patterns of association and social structure in *Cephalorhynchus eutropia*" – Lea-Maria Prox

Human Interactions

15:10 – 15:15	"Animal distribution, human activities and marine spatial management" – Cláudia Faustino
15:15 – 15:20	"Do marine mammals react to shipping noise? The exposure and behavioural response of grey seals (*Halichoerus grypus*) to shipping noise" – Leah Trigg
	BREAK
16:00 – 17:30	"Acoustic Technologies in Marine Mammal Science" – Workshop by invited speakers, Dr Danielle Harris, Dr Filipa Samarra, Popi Gkikopoulou and Chloe Malinka Or "Necropsy Techniques" – Workshop by Dr Andrew Brownlow, Head of the Scottish Marine Animal Strandings Scheme
19:30 onwards	**Conference meal at *Zizzi's* restaurant**

Friday, 22nd of January

09:00 – 09:45	"Some tools in the cetacean tool-box - trends, bycatch and acoustics" by invited speaker Dr. Nick Tregenza Director of Chelonia Ltd. (*SOI lecture Theatre*)
Telemetry	Chair: Leticiaà Legat
09:45 – 10:00	"Current correction(s) of horizontal movement trajectories" – Samantha Gordine
10:00 – 10:15	"From pup to predator: ontogeny of foraging behaviour in grey seal pups" – Matt Carter
10:15 – 10:30	"Sexual differences in post-moult behaviour of the Weddell seal (*Leptonychotes weddellii*) in the southern Weddell Sea" – Izzy Langley
10:30 – 10:35	"Estimating haul-out probability of the harbour seal (*Phoca vitulina*) in the Moray Firth" – Annette Coppin
10:35 – 10:40	"How does loud noise from proximate boat passes affect long-finned pilot whale (*Globicephala melas*) behaviour in the Strait of Gibraltar?" – Alicia Cardona Barreña
	BREAK
Acoustics	Chair: Jo Kershaw
11:10 – 11:25	"Structural and temporal analysis of the calling behaviour of an isolated killer whale (*Orcinus orca*)" – Miguel Neves dos Reis
11:25 – 11:40	"Look who's talking: preliminary study to identify vocalizing dolphin using accelerometers" – Diego Rita Espada
11:40 – 11:55	"Preliminary results from a computational multi agent modelling approach to study humpback whale song cultural transmission" – Luca Lamoni

11:35 – 11:40	“The response of herring (*Clupea harengus, C. pallasii*) schools to cetaceans (*Orcinus orca, Megaptera novaeangliae*) feeding calls” – Leticiaà Legat
11:40 – 11:45	“Spatio-temporal variation in click production rates of beaked whales: implications for passive acoustic density estimation” – Victoria Warren
11:45 – 11:50	"Investigation of fin whales using seismic data off southwest of Portugal" – Andreia Pereira
12:00 – 12:05	“Classification of Long-Finned Pilot Whale (Globicephala melas) Pulsed Calls” – Clair Evers
12:05 – 12:10	“Identifying the breeding grounds of humpback whales migrating past the Kermadec Islands from song recordings” – Clare Owen
	LUNCH
14:00 – 16:00	“Seals in Science” – Workshop by Ryan Milne, Pool Facility Technician at SMRU and Chris McKnight, PhD student at SMRU

ABSTRACTS

ACOUSTICS

Structural and temporal analysis of the calling behaviour of an isolated killer whale (*Orcinus orca*)

Miguel Neves dos Reis, Filipa Samarra, Patrick Miller

In this study we catalogued the acoustic repertoire of an individual killer whale in isolation – Morgan – during two different sampling periods over one year. We described Morgan's vocal repertoire based upon analysis of 21,711 discrete call vocalizations, with emphasis on the structure and organization of the repertoire, and how vocalizations were shaped. Morgan's repertoire appeared to be composed of 22 units which could be recombined to create 97 discrete 'call types' that consist of one or two of those units. To quantify the structural constraints of the repertoire we calculated the Kullback-Leibler divergence (or relative entropy $\boldsymbol{D_{KL}}$ ($\boldsymbol{P}||\boldsymbol{Q}$)), which translated into the predictability of having a given unit after another, for two-unit vocalizations (Kullback-Leibler divergence calculates the expected numbers of additional bits that would be used to code samples from the first units (P) using a code based exclusively on the second units (Q)). The observed entropy (0.71 bits) was significantly lower than the maximum possible entropy (4.46 bits), which would have led to **484** different combinations rather than the observed **97**.

Look who's talking: preliminary study to identify vocalizing dolphin using accelerometers.

Diego Rita Espada, Peter Tyack, Mark Johnson

Whistles are one of the most important communication sound types in delphinids, and yet, there is no efficient method to identify the whistling dolphin within a group. The current study presents four mechanisms that would allow the identification of the vocalizing dolphin using attached high sampling rate accelerometers. 1) Ballistic signal (vibration), produced by sound production mechanism. 2) Sound travelling through multiple paths in the body, due to the refraction and reflection. 3) Time delay between the signal produced by the tagged animal that travels through the water and the signal that travels through the water. 4) Difference in the sounds recorded in the near field (produced by the tagged animal) from those recorded in the far field (produced by other animals). A device that recorded acceleration and pressure simultaneously was built and tested using wild dolphins (*Tursiops truncatus*) in Sarasota Bay during a capture-release event. Of the four mechanisms, only the ballistic signal was discarded. The cross correlation between the pressure signal and the particle motion signal of the sound was highest near the blowhole and showed multiple lobes near the dorsal fin. This indicates that multiple signals arrive to the sensors when the sound has to travel through the body. Also, the near field limit was detected at approximately 0.5m from the blowhole. Because the whistles produced by an untagged dolphin are in the far field and do not cross the body of an animal, they would present different characteristics than the whistles produced by the tagged dolphin.

Preliminary results from a computational multi agent modelling approach to study humpback whale song cultural transmission

Luca Lamoni, Michael Mcloughlin, Ellen Garland, Simon Ingram, Alexis Kirke, Michael Noad, Eduardo Miranda, Luke Rendell

The empirical investigation of cultural transmission phenomena in the animal kingdom is often a challenging task, especially if carried out on wild populations with vast home ranges. Humpback whales (*Megaptera novaeangliae*) present a striking example of cultural transmission. Within a population, all males in acoustic contact conform to a similar song; however, this can disappear quickly if a new song is introduced. Our project aims to explore the mechanisms behind the cultural transmission of humpback whale songs using a computational multi-agent modelling approach. This methodology is used to simulate real-world phenomena using digital entities (agents) capable of interacting with each other following pre-determined rules. We created a spatially-explicit model in which agents (whales) move following simple rules derived from flocking algorithms. These rules are implemented to mimic migratory movements observed in the wild. While moving, agents 'sing' their own song and 'learn' other agents songs based on geographical distance and song similarity. Preliminary results suggest that parameters such as agent acoustic active space and breeding ground size influence the degree of population song conformity. Future work will address implementing different learning strategies, a more realistic representation of humpback whale song structure and the introduction of song innovation.

The response of herring (*Clupea harengus, C. pallasii*) schools to cetaceans (*Orcinus orca, Megaptera novaeangliae*) feeding calls

Leticiaa Legat, Volker Deecke

Coordinated schooling is used by many fish species to help reduce predation levels but some large marine predators seem to be 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*) that may serve to modify its schooling behaviour by ensonifying the prey with sounds at the resonant frequency of their swim bladders. The main objectives of this study are to describe and compare feeding calls of both cetacean species and test the hypothesis that these calls alter herring schooling behaviour. The analysis of long-term acoustic datasets of North Pacific humpback whale feeding calls will also provide insights into temporal changes in the calls and on how the group-feeding behaviour is spreading in the North Pacific population as well offering an opportunity to compare the structural similarity between British Columbia and Alaskan feeding grounds. Such comparison will also allow me to expand on the functional analysis of feeding calls in killer and humpback whales.

Spatio-temporal variation in click production rates of beaked whales: implications for passive acoustic density estimation

Victoria Warren, Tiago Marques, Danielle Harris, Len Thomas, Peter Tyack, Mark Johnson

Passive acoustic monitoring has become an increasingly prevalent tool for estimating the density of marine mammals, such as beaked whales, which vocalise often but are difficult to survey visually. Acoustic cue counts, when corrected for detection probability, can be translated into an estimate of animal density by applying an individual cue production rate multiplier. The most direct way to measure individual cue production rates is with animal-mounted acoustic recorders. This study utilised data from sound recording tags mounted on Blainville's (*Mesoplodon densirostris*) and Cuvier's (*Ziphius cavirostris*) beaked whales, in two locations per species, to explore spatial and temporal variation in regular click production rates. Understanding the variation present in these rates is essential to avoid biased density estimates. Spatial, or long-term temporal, variation in click production rate was present during the vocally active periods of both species. Cuvier's beaked whales also exhibited significant spatial and temporal variation in click production rate at a dive cycle level, which is inclusive of silent periods and therefore directly relevant to passive acoustic surveys. These results emphasise the need to undertake concurrent secondary studies to achieve appropriate click production rates for the estimation of density from passively collected acoustic data.

Investigation of fin whales using seismic data off southwest of Portugal

Andreia Pereira, Danielle Harris, Len Thomas, Peter Tyack, Luis Matias

Instruments used for seismic monitoring have been recording baleen whales along with the target data. These long-term datasets, some in offshore waters, provide valuable information for the study of large cetaceans that would otherwise be difficult to obtain due to economic and logistic reasons. Fin whales are classified as 'Endangered' and therefore knowledge of stock structure, population size and spatial and temporal distribution patterns is essential for good management strategies. In Portugal, sightings of fin whales off mainland waters are rare and are insufficient to assess any kind of trend. Therefore, acoustic data, even collected from opportunistic sources such as seismic surveys, are useful for monitoring this species. An array of 24 ocean bottom seismometers (OBS) was deployed between August 2007 and July 2008 in offshore waters southwest of Portugal to study potential tsunami sources. Calls of fin whales were also recorded during this deployment. OBS have been used to answer a variety of ecological and behavioural questions about baleen whales: movement and feeding patterns, sound source levels, effects of anthropogenic and natural sound sources in behaviour, probability of detection of a call and temporal segregation of call types. The aim of this presentation is to give a brief description of my PhD project and to show how seismic data and seismic methodologies can be used for the study and conservation of baleen whales.

Classification of Long-Finned Pilot Whale (*Globicephala melas*) Pulsed Calls

Clair Evers, Peter Tyack

To date, there have been few studies which investigate the vocalizations produced by long-finned pilot whales (*Globicephala melas)* (Nemiroff and Whitehead, 2009). Long-finned pilot whales produce both simple and complex pulsed calls which have been previously defined as containing independently modulated structural elements with an upper and lower frequency component. In short-finned pilot whales (*Globicephala macrorhynchus*), repeated call types have been observed between individuals (Sayigh et al, 2013). This study will use DTAG acoustic recordings collected from two populations of pilot whales in the Alboran Sea and Tarifa. In the Alboran Sea, 33 recordings were collected in August 2010 and 2011, and 85 recordings were collected from Tarifa in 2012, 2013 and 2015. Audio/visual spectrograms will be used to classify calls and compare between individuals and populations. Preliminary analysis will be completed using Adobe Audition and call types will be audited in MATLAB. Call classification will be conducted using human judgement; spectrograms will be presented to the Marine Mammal Masters class who will be asked to compare calls and match similar call types. Contour extraction and automated call categorisation may also be completed in MATLAB using Beluga and ARTwarp. This will allow for comparison between the different classification methods, humans versus computers. Overall, the current study will help to shed light on the functionality of these pulsed calls.

Identifying the breeding grounds of humpback whales migrating past the Kermadec Islands from song recordings.

Clare Owen, Ellen Garland, Luke Rendell

Humpback whales are seasonal migrators, they travel between winter breeding grounds in the tropics and summer feeding grounds in the polar regions. Each breeding aggregation in Oceania represents a demographically distinct population. The East Australian population is recovering quickly after whaling caused a huge decline to whale abundance, however the South Pacific populations are recovering very slowing and thus are classified as endangered. Understanding population structure and migratory routes are fundamental for management and conservation. Male humpback whales produce a series of vocalisations known as songs. The songs are constantly changing, but at any given time most males in a population will produce the same song. The song type can be used to identify the breeding ground of an individual because these areas are acoustically separated. This study will compare humpback whale song recorded off the Kermadec islands in October 2015 with song that has previously been described from populations in the South Pacific, to determine the breeding grounds of these migrating whales.

BEHAVIOUR

Harbour Seal (*Phoca vitulina*) Habitat Use and Pup Behaviour in County Down, Northern Ireland

Kayleigh Jones, Sue Wilson

Harbour seals (*Phoca vitulina*) primarily pup in intertidal rock and estuarine habitats in temperate regions. However, pup behaviour and mother-pup distances and interactions have not been fully documented in different habitats and shore zones. Seal counts were conducted at an intertidal rock habitat and adjacent estuarine habitat during the pupping season in County Down from 1993-2015. To improve understanding of habitat use and pup behaviour, 246 5minute video clips were taken of 218 pups at these sites. Clips were divided into 15s intervals to quantify pup activity, mother-pup distance and interaction frequency at the different sites and shore zones. There was a preference for mothers to pup at the rocky ledge site over the estuarine site (10.4± 0.881 and 8.9± 0.958 pups born each year respectively), possibly due to closer proximity of a foraging area. Pups primarily used the dry zone for resting, the water's edge for suckling and the water for directed movement and contact play. Mothers onshore with their pups generally kept their pups within 1m and were their pups' sole source of socialisation. Most mother-pup nosing interactions occurred in the water and at the water's edge (0.12% and 0.074% of 15s records respectively) and contact play only ever occurred in the water (0.05% of 15s records). These results have implications for impacts of disturbance on pup behaviour across different shore zones. They also highlight the importance of water to mother-pup interaction and the mother-pup bond to social development, which has relevance for pup welfare in rehabilitation centres.

Associations or alliances? Comparisons of social relationships between male bottlenose dolphins (*Tursiops truncatus)* in two UK populations

Texa Sim, Kevin Robinson, Line Cordes, Peter Evans

Alliances are an important aspect of the social relationships between male bottlenose dolphins (*Tursiops* sp.) in a number of well-studied populations. Alliances as mating strategies enable mate location and coercion while ultimately improving the reproductive success of allied individuals. However, the presence of male alliances is not well understood in discrete coastal UK bottlenose (*Tursiops truncatus*) populations from the Moray Firth (MF) and Cardigan Bay (CB). The present study utilised long-term observational data (1997-2014, and 2001-2014, respectively) to determine if male alliances existed in these regions, and whether association patterns were similar or divergent. A total of 66 males from the MF, and 50 males from CB were examined. Non-random preferential associations were established between males from both regions, but associations were stronger in the MF (MF mean HWI= 0.09± 0.05, and 0.03± 0.02 for CB). Significant alliances were determined between five dyads in the MF, and 14 in CB, with the strongest dyad from each population having a HWI of 0.67 and 0.44, respectively. Association stability within the study populations were highly similar, described as 'casual acquaintances', typical for the species occupying a 'fission-fusion' society. Demographic factors such as mortality, emigration and re-immigration may have also affected male associations. That said, differences in the ecology between the two coastal study sites may also be influential in the formation of such associations. The present examination provides further insight into long-term social dynamics between male bottlenose dolphins and broadens our understanding of mating strategies utilised by these animals in UK coastal waters.

Do bottlenose dolphins recognise themselves in a mirror?

Alina Loth, Lorenzo von Fersen, Onur Gunturkun, Vincent Janik

Previous studies suggest that dolphins are capable of self-recognition similar to magpies, elephants, apes, and humans. This was tested by employing various forms of the mirror mark test. Unfortunately, these early tests suffered from methodological problems that made their interpretation difficult. We investigated mirror-guided self-inspection as a potential indicator of self-recognition in bottlenose dolphins by means of a different methodological approach. This included the introduction of standardised test sessions, adequate control mechanisms, balanced markings throughout trials and the simultaneous use of visible and invisible markings to create a similar haptic experience on both body sides. Data analysis of two tested individuals showed that individuals interacted significantly more with the reflective side of the mirror when provided with a visible mark ($P<0.000$, female: N=232, male: N=142) than in any other treatment condition (no or transparent mark, female: N=154, male: N=51). However, neither of the animals showed a body orientation towards the yellow marked side (GLMM; backward model selection was performed and a model without marking treatment as a fixed factor showed the best model fit) and therefore no evidence for mirror self-recognition was found. Our results indicate the suggested methodology is appropriate for mirror-mark tests of bottlenose dolphins. Apart from small sample size, the lack of self-recognition might result from earlier habituation to reflections through exposure to a reflective pool surface and windows. Reported behaviours in front of mirrors from earlier studies may thus be explained by a reinforcement effect when controlling a visual stimulus rather than actual self-recognition.

Fifty shades of grey seal (*Halichoerus grypus*) social networks and the ties that bind

Toby Rosas da Costa Oliver, Patrick Pomeroy

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.

The effect of age, sex and group size on behavioural responses of Northern Resident Killer Whales (*Orcinus orca*) to boat traffic.

Kay Andrews, Volker Deecke

Vessel traffic and its effect on marine mammals is of growing concern as traffic levels continue to rise. The Northern Resident killer whale population of approximately 255 individuals are exposed to roughly 180 vessels a day in Johnstone Strait, British Colombia during the summer months. I investigated whether certain characteristics of killer whales (age, sex and group size) impacted their behavioural responses towards boat traffic. Scan sampling, focal follows and point sampling occurred from an observation site on West Cracroft Island, overlooking Johnstone Strait and the Robson Bight Michael Bigg Ecological Reserve. I recorded Northern Resident killer whale and vessel interactions. Group size was insignificant on behavioural responses seen (P=0.389) and insufficient data was collected on age, improvements for future study are discussed. The sex of the whales was found to significantly impact behavioural responses seen toward boats (P=0.049). Males were most commonly seen to dive underneath boats, whereas females most common response was to change direction. Males also got significantly closer to vessels than females (P=0.001). Male and female difference in behavioural response indicates that females may be more vulnerable to boat traffic. Further research into this could establish the need to adjust guidelines for how to behave around the whales, such as staying greater distances from females. In many instances behavioural responses occurred due to a boat being in the whale's path. Further education to boaters on the existing 'Be Whale Wise' guidelines must be carried out in order to reduce the impacts of boat traffic on killer whales.

Patterns of association and social structure in *Cephalorhynchus eutropia*

Lea-Maria Prox, Marjorie Fuentes Riquelme, Sonja Heinrich

Studies on the social structure of delphinids form an important part of understanding the species' biology and help put into perspective population genetics, disease spread and the use of population units to conserve. Delphinid social organisations have been shown to range from the fluid fission-fusion societies of many small coastal dolphin species to the stable matriarchal societies of killer whales. Here we describe the social structure of the poorly known Chilean dolphin (*Cephalorhynchus eutropia*), a small coastal delphinid from southern Chile. We used long-term individual recognition data collected at Isla Chiloé during a 12 year study period. Individuals were identified and tracked over time using good quality photographs of permanent individual markings on their dorsal fins. A total of 103 individuals were catalogued and used for the analysis of their associations using Half-Weight-Indices and a permutation test. In order to limit the possible bias caused by demographic effects, we included individuals in the analyses which had been present during all years of different subsets of the 12 year study period. Those analyses revealed mostly unstable associations with few long-term bonds. Additionally, cluster analyses were carried out to detect social units within the population, where the matrix of associations was converted into a multidimensional network which presented individuals as points, placing them at distances inversely proportional to their association indices. Those networks showed a clear division into two social units which seem to be related to different ranging patterns. Considering the high re-sighting rates (i.e. site fidelity) of individuals and spatial structuring of the population with fluid associations within social units we propose to create an integrated conservation area covering the entire range of the local population to guarantee the long-term survival of the population.

TELEMETRY

Current correction(s) of horizontal movement trajectories

Samantha Gordine, Gi-Mick Wu, Michael Fedak, Lars Boehme

Horizontal movement trajectories of far-ranging marine mammals such as southern elephant seals are frequently analysed using track-based behavioural metrics to infer foraging activity. However, inferences from animal movement data may be misleading, because it is unclear to what extent oceanic currents distort movements by modulating a animal's swimming velocity. This study investigates how animal movement in hydrographic space differs from the observed movement in geographic space and what the resultant implications for track-based analyses are. Using satellite-derived current estimates and tracking data of southern elephant seals, we developed a new method for current-correcting horizontal movement trajectories of fast-moving, deep-diving marine mammals. We demonstrate that while the current-corrected trajectories differ from the observed trajectories, the magnitude in difference is cumulative. Generally, the observed trajectories are more sinuous. Thus, track-based analyses such as first-passage-time highlight different areas on the observed versus the current-corrected tracks and indicate that the spatio-temporal scales, at which area-restricted-search is meant to occur, differ. Preliminary results reveal that on current-corrected trajectories more intense small-scale area-restricted search takes place. The evidence that observed movement trajectories are shaped as function of active swimming and current velocities implies that greater care should be taken when interpreting animal behaviour, especially when deducing conservation and management strategies from track-based analyses. Our analysis displayed how pinniped movements in hydrographic versus geographic space differ. Further investigations are required to assess how changes in the strength of currents, e.g. by tidal turbines or climate change, may impact the movements and the behaviour of these marine mammals.

From pup to predator: ontogeny of foraging behaviour in grey seal pups.

Matt Carter, Debbie Russell, Kimberley Bennett, Dave Thompson, Phil Hosegood, Clare Embling

Grey seal (*Halichoerus grypus*) pups undergo a post-weaning fast on land and must learn to dive and find food without parental guidance once they leave the breeding colony. First year survival depends on an individual's ability to develop effective foraging behaviour, however our knowledge of the factors affecting this ontogenetic process is limited. Understanding the intrinsic and extrinsic factors that affect the development of foraging behaviour will be key to predicting population-level impacts and designing effective management strategies. Using satellite telemetry, my study aims to decrease this knowledge gap by reconstructing the at-sea movements of 52 recently-weaned pups from six colonies around the United Kingdom. I will share my field work experiences as well as results from the first chapter of my thesis in which I examine changes in foraging trip metrics throughout the pups' first months at sea.

Sexual differences in post-moult behaviour of the Weddell seal (*Leptonychotes weddellii*) in the southern Weddell Sea

Izzy Langley, Michael Fedak, Keith Nicholls, Daniel Costa and Lars Boehme

The population of Weddell seals in the southern Weddell Sea is unique in its proximity to the edge of the Antarctic continental shelf. The purpose of this study was to describe the post-moult distribution of the population, and to understand how this unique habitat is exploited. Twenty Conductivity-Temperature-Depth Satellite Relay Data Loggers (CTD-SRDLs) were deployed in February 2011 on adult and sub-adult seals which collected behavioural and environmental data over the austral autumn and winter. This study found a sexual difference in distribution, with males remaining in shelf waters and females exploiting both on shelf and deep water off the shelf. Males travelled on average 16km per day of deployment, covering an average area of 40,604 square kilometres over the entire deployment. Females travelled an average of 19km per day, covering a larger area of 120,947 square kilometres. On the shelf, males and females dived to similar depths. However, off the shelf females dived significantly deeper, making regular dives into the warm Weddell Deep Water layer at around 400m. A state-space model was used to assign behavioural states to all dive positions recorded. Area-restricted search was described as resident behaviour and more linear travel was described as directed movement. Males were found to spend 81% of their time in a resident state, compared to females at 77%. This sexual difference in the post-moult behaviour of Weddell seals is not seen elsewhere along their circumpolar distribution and provides evidence for behavioural plasticity.

Estimating haul-out probability of the harbour seal (*Phoca vitulina)* in the Moray Firth

Annette Coppin, Line Cordes

Recent advances in satellite telemetry technology have revolutionised our understanding of, and ability to track and monitor wild populations. This understanding is important for the conservation and management of species. Despite currently established Special Areas of Conservation in accorance with the EU Habitats and Species Directive, UK harbour seal (*Phoca vitulina*) populations are in steep state of decline. Populations in some parts of Scotland, such as the Firth of Tay, have declined by as much as 93% in the past 15 years. Fine scale telemetry data gathered from seals in the Moray Firth will be used in conjunction with covariate data to predict haul-out probability in Scottish harbour seal populations. Many extrinsic and intrinsic factors have been shown to affect haul-out probability. By incorporating the eight covariates of age, sex, size & condition, pup status, tidal height, time of day, season and lunar cycle in to one mathematical model, haul-out probability can be precisely calculated, increasing the accuracy of population estimates and the efficiency of survey design, aiding research and conservation efforts.

How does loud noise from proximate boat passes affect long-finned pilot whale (*Globicephala melas*) behaviour in the Strait of Gibraltar?

Alicia Cardona Barreña, Frants Jensen, Peter Tyack

The Strait of Gibraltar has some of the heaviest vessel traffic worldwide and elevated levels of underwater ambient noise. Long-finned pilot whales (*Globicephala melas*) are commonly encountered there throughout the year, but are considered as 'Data deficient' by the IUCN, as 'Vulnerable' in the Spanish National Catalogue of Endangered Species, and listed in CITES Appendix II. This resident population has been studied for over ten years and is estimated to include 300 individuals (Verborgh et al., 2009). However, little is known about how they cope with such noise pollution and if it affects their behaviour. Telemetry data was collected from 2012-2015 by Professor Peter Tyack and Frants Jensen (in collaboration with CIRCE), using DTAGs to investigate their baseline behavioural ecology. Tags' acoustic and behavioural data will be analysed in detail in order to investigate how loud noise exposure from nearby passing boats (PBP) might affect this population. Each tagged animal's behaviour before (control period), during and after each PBP event will be analysed to check for disturbance behavioural reactions relative to these (Peter L. Tyack, 2008), which would suggest that PBP's loud noise disrupts their behaviour (potentially incurring costs of increased energy expenditure and lost feeding opportunities). With the high vessel traffic in the area and limited space available, these costs could affect individuals' health condition and reproductive success in the longer term. Thus, it is crucial to understand how such noise pollution in the area might affect this resident population, and whether this could affect their local conservation status.

HUMAN INTERACTIONS

Animal distribution, human activities and marine spatial management

Cláudia Faustino, Monique Mackenzie, Fernando Morgado

Marine wildlife is facing serious disturbances in their habitat with species being driven to extinction. The recent loss of the Yangtze River dolphin represents the first cetacean extinction due to human activity. The assessment of the spatial overlap between biodiversity, human activity and protection measures is vital towards sustainable marine management and impact mitigation. In my project we aim to use high-priority cetacean species to explore such assessment, working on existing datasets such as the Joint Cetacean Protocol (United Kingdom) and the distribution of Hector's dolphins (New Zealand). Novel state of the art spatially adaptive modelling techniques will be implemented; we will apply a robust methodology currently recommended by Government for quantifying environmental studies in the United Kingdom. We will generate reliable fine scale geo-referenced animal density maps with associated, and defensible, estimates of precision. We will then explore new applications to those methodologies and look at impact scenarios to address pressing marine management decisions around the world.

Do marine mammals react to shipping noise? The exposure and behavioural response of grey seals (*Halichoerus grypus*) to shipping noise.

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

Underwater noise is increasingly recognised as potentially harmful to marine organisms. This is evidenced by its recent designation as a pollutant in the Marine Strategy Framework Directive. Shipping noise is a major contributor to underwater noise and current trends suggest that the number and size of the world's cargo fleet is only set to increase. However, the impact on marine mammals remains poorly understood due to the lack of knowledge on current noise levels, and the many context specific factors that influence an individual's response to noise. This project aims to further elucidate the impacts of shipping noise on grey seals (*Halichoerus grypus*), and this talk will briefly outline the research that will be undertaken over the next three years. Detailed acoustic propagation models, AIS ship tracking data and seal (GPS) telemetry data will be used to understand the spatial and temporal patterns of shipping noise at sites in the UK, and as a result, assess the noise exposure level and behavioural response of grey seals to shipping noise during diving activity throughout the water column.

PHYSIOLOGY

The benefit of being big: body rotations and acceleration over a 3000:1 mass range in cetaceans.

Lucia Martina Martin Lopez, Alex Shorter, Natacha Aguilar de Soto, Peter Madsen, Patrick Miller, Danuta Wisniewska, Mark Johnson

Mechanical mass-specific cost of transport is predicted to decrease as mass$^{-1/3}$ for a given speed and locomotion style meaning that larger animals need to produce less force per kilogram. However, quantitative observations of this relationship have yet to be obtained from free-ranging animals over a large mass range. Here we test the prediction by comparing the steady-swimming kinematics of 11 cetacean species, from porpoises to blue whales, covering a 3000:1 mass range. Animals were tagged with suction-cup DTAGs which include triaxial accelerometers and magnetometers sampled at 50 Hz. Accelerometers measure both specific acceleration (SA, net force per kilogram), and instantaneous orientation. A high-pass filter can separate the mean orientation from the so-called dynamic acceleration (DA), which contains both SA and body rotations (BRs) at the stroking rate. Here we quantify SA by first estimating BRs independently using the magnetometer and then removing these from the DA. After correcting for tag location, we show that the longitudinal and dorsal-ventral SA increase linearly with stroking rate (R^2=0.76 and R^2=0.82 respectively, n=66 individuals) while the BRs are roughly constant. As the stroking rate of swimming animals is proportional to mass$^{-1/3}$ over a large size range, our result matches the predicted force-mass relationship providing experimental evidence that swimming needs proportionally less force and so may be more efficient for big cetaceans. As a consequence DA is dominated by SA in small animals and by BRs in large animals. This highlights the importance of using appropriate methods when comparing energetics across different size animals.

Eye in the Sky: The Performance of UAVs as Aerial Photogrammetry Platforms using Harbour Seals in Loch Fleet.

Marie Kearns, Rebecca Hewitt, Shane Rodwell, Phil Anderson, Julian Martin, Chris McKnight, Paul Thompson, Robert Schick.

Body size is central in the study of survival and reproductive capabilities of marine mammal species. For pinnipeds, acquiring size measurements of individuals has relied on invasive handling and restraint techniques. Photogrammetry is a non-invasive method and Unmanned Aerial Vehicles (UAVs) are the next step in the collection of photogrammetry data. A UAV quadcopter mounted with a DSLR camera was flown over harbour seals (*Phoca vitulina*) from the Loch Fleet population. Length measurements of 12 identified individuals were estimated using the image processor, ImageJ, and a scale bar. Photogrammetric accuracy was tested by comparing these measurements with tape measurements and 3D photogrammetry measurements. While there was no significant difference found between length measurements, there was a significant difference between tape measurements and the other measurement types. Length (CV = 1.01%) and width (CV = 2.89%) measurements were estimated to be precise. To estimate measurements without a scale bar, a method of converting pixels to cm was tested using a model seal of known length (145.92 cm). Preliminary results indicated that while this method was not fully accurate, if UAV stability and object image position were optimised and the UAV was equipped with a SF10/C laser rangefinder, the length of the model seal was estimated to be 147 cm ± 2.32. Future tests aim to identify the leading sources of error in this method. This will allow for the accurate collection of measurement data of harbour seals in the Loch Fleet population, improving long-term monitoring of population trends in this area.

The Pleiotropic Role of Cetacean Blubber

Joanna Kershaw, Andrew Brownlow, Nicholas Davidson, Ailsa Hall

Mammalian adipose tissue is structurally and physiologically complex with both metabolic and endocrine functions. Numerous receptors are expressed and proteins secreted which respond to a variety of endocrine and cellular signals. The proteins secreted, collectively termed adipokines, act both locally and at a systemic level, and growing evidence suggests that marine mammal blubber may function in a similar way to white adipose tissue in other mammalian species. Here, the presence and range of adipokines in harbour porpoise (*Phocoena phocoena*) blubber samples (n=20) collected by the Scottish Marine Animal Strandings Scheme was investigated. Total protein was extracted from blubber subsamples and quantified using a Pierce™ BCA Protein Assay Kit. The blubber extracts were then assayed by 1-D SDS-polyacrylamide gel electrophoresis for subsequent protein identification by nanoflow Liquid Chromatography Electrospray Ionization in tandem with Mass Spectrometry (nLC-ESI MS/MS). Various protein classes were identified, the most abundant of which were enzymes (including acetyl CoA synthetase and alpha-1-antiproteinase), immune proteins (including IgG, IgA and IgM) and transport proteins (including fatty acid binding protein and apolipoprotein). Given the evidence that a range of adipokines are present in harbour porpoise blubber, it is likely that this tissue has an important pleiotropic function, responding to signals involved in the regulation of lipid metabolism and immunity. The adipokinome of cetaceans could therefore be used as a key indicator for assessing the health and metabolic state of individuals.

Heat shock protein gene expression in blubber of grey seal (*Halichoerus grypus*) pups during suckling and the post weaning fast: effects of development rather than contaminant exposure?

Holly Armstrong, Spyridon Stamatas, Maxime Fabry, Sarah Brand, Ailsa Hall, Simon Moss, Paddy Pomeroy, Jean-Pierre Thomé, Cathy Debier, Kimberley Bennett.

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 a physiologically stressful development, taking on 40-60% fat milk and tripling in body mass during the first 18-21 days after birth, before they are abruptly weaned. Pups then fast and rely on their extensive fat reserves until they learn to forage. Previously, we have shown that suckling pups have higher cellular defences than fasting pups, particularly in protein abundance of heat shock protein (HSP) 70, which may have been due to changes in the stress inducible or constitutive isoform of *Hsp70*. Here, we used qPCR to investigate changes in gene expression of a range of *Hsps*, in blubber tissue from early to late in the suckling period, and early to late in the post weaning fast in pups on the Isle of May, Scotland, during October to December 2012 and 2013 (2012, n=12; 2013, n=15). Relative abundance of *Hsp70* mRNA but not *Hsc70* was higher during suckling than fasting (REST2009: $p>0.05$), which supports previous findings at the protein level. Circulating PCB levels did not explain these gene expression changes. We suggest that suckling pups have high levels of *Hsp70* because they are developing rapidly and require the chaperone function of *Hsp70* for correct folding of newly synthesised proteins. As most mortality on the colony happens pre-weaning, additional stressors encountered during suckling may not be well tolerated. Developmental state may dictate whether animals experience stress as distress or eustress. Understanding how grey seals respond to natural and anthropogenic physiological stress at a cellular level, particularly during periods of rapid development, will help identify the conditions that these animals experience as distress, and could help predict individual, population and species level responses to environmental change.

Long-term trends in diet and mortality of Moray Firth harbour porpoises in relation to prey abundance: insights from stable isotope analysis.

Tom Bean, Andrew Brownlow, Jason Newton, Fiona Read, Jean-Pierre Lacaze, Graham Pierce

Harbour porpoise have high daily energetic demands (Yasui and Gaskin, 1986) which makes them vulnerable to prey depletion (MacLeod et al., 2007, 2014). Climatic variation and fishing pressure can influence prey distribution and abundance. It is possible that changes in prey abundance contributed to the shift in porpoise distribution in the North Sea between 1994 and 2005 as documented by Hammond et al. (2002, 2013). The Scottish Marine Animal Stranding Scheme (SMASS) holds historic data on harbour porpoise strandings in Scotland since 1992. When possible, necropsy has assessed cause of death and blubber thickness to derive condition indices and collected tissue samples. Skin samples from approximately 250 porpoises (10 animals x 25 years) will be processed for stable isotope analysis (SIA) using standard techniques (e.g. Fernandez et al., 2011). Local samples of the main prey species, including sandeels (*Ammodytes marinus*), whiting (*Merlangius merlangus*) as well as clupeids will also be processed for SIA to indicate the North Sea isoscapes. SI data from porpoises will be interpreted by reference to SI values from prey samples collected in the present study and the literature. The combination of stomach content and stable isotope analysis in a set of samples from 1992 to 2015, coupled with SIA of selected prey samples, will provide the most complete assessment of the dietary changes of harbour porpoise in Scotland yet available. A desired outcome of this project is a validation of the use of SI data to infer diet of harbour porpoise.

POPULATION BIOLOGY

Photo-identification of the common minke whale (*Balaenoptera acutorostrata*) in Faxaflói, Iceland to establish an abundance estimate using a platform of opportunity.

Jack Ball, Volker Deecke

The common minke whale has a cosmopolitan range and is the most abundant baleen whale. In Iceland the population declined from 44,000 in 2001 to 14,420 in 2009. Since 2006 whaling operations have been hunting minke whales on a small scale with quotas set around 229 whales but catching an average of 41 minke whales each year. As the whaling is targeting a species in decline it is important to collect more data about the population size and trends. This study uses platforms of opportunity through the use of whale watching boats to perform a photo-identification based mark-recapture study to establish an abundance estimate within Faxaflói, South-West Iceland in the summer of 2014. The study area encompasses a small area within the bay which is restricted to the movements of the whale watching vessel. The study revealed that at the peak of summer (June), when the abundance is at its highest, there were 52 minke whales in the study area. May recorded 47 whales and July 25. There were 10 whales which were resighted across the entire study period and on at least 5 different occasions, this may show site fidelity but further study is needed in all areas to establish trends. This study provides a framework for localised studies which could be undertaken through the nationwide whale watching infrastructure already in place across Iceland. This will create a monitoring network of cetacean feeding grounds which is not as resource intensive as national aerial surveys.

The social structure of the Icelandic killer whale (*Orcinus orca*) population

Sara Tavares, Filipa Samarra, Patrick Miller

The only study upon the social structure of North Atlantic killer whale populations, from Beck et al. (2011), suggested that Icelandic fish-feeding killer whales had a different distribution of association levels from the Scottish and Pacific mammal-eating populations. In Iceland, the large numbers of individuals found in aggregations makes visual observations of groupings unreliable guides to overall social structure. The goal of this multi-year study was to quantitatively describe the social structure of the Icelandic population based upon photo-identification. Since members of the same group frequently occur in the same/adjacent photographs, we defined a temporal association criterion by maximum-likelihood estimation of photographic bouts. Combining cluster and social network analysis, we examined the association patterns of 198 individuals. The Icelandic population exhibited a high value of social differentiation and non-random associations. Most associations were weak (half-weight index below 0.2) but many individuals had a few stronger ties with some of their associates. There is an apparent fluidity and variability in social preferences, with some clusters having homogeneous relationships and others comprising very diverse ones. Temporal patterns revealed a mixture of long and very short-term associations, indicating that this population has some degree of fission-fusion. Our results show that individuals associate at different rates than the Pacific fish-eating population, known to form well-defined groups of long-term stable associates. This suggests an entirely different view of killer whale social structure from what has been described in the literature and that their sociality can be much more dynamic than generally inferred from broad ecology.

Using Social Media as an untapped resource for a photo-identification study of Bottlenose dolphins (*Tursiops truncatus*).

Catherine Hinds

Bottlenose dolphins (*Tursiops truncatus*) are abundant and widespread in Irish waters and they are known to occur all year round. Protected under the EU Habitats Directive, there are increasing demands for cost-effective and novel methods for long term monitoring. Photo-identification is an extremely useful tool, it allows us to try and understand the population dynamics and social structure of these animals, and we can begin to look at site fidelity, preferred habitats and migratory routes. Social media and photo sharing sites are fast becoming popular channels for the general public to 'post' images of encountered cetaceans. Could social media provide an invaluable resource to study these animals? Using the images found on social media and photo-sharing sites, and existing photo-identification catalogues from the Hebridean Whale and Dolphin Trust, Manx Whale and Dolphin Watch and the Irish Whale and Dolphin Group, this study aims to investigate the occurrence and site fidelity of bottlenose dolphins around the coast of Northern Ireland and Donegal and as a result assess whether social media can be a useful data source for citizen science. 3 main social media and photo-sharing sites have been used in preliminary data collection and this has resulted in 404 images and 72 video clips of 147 encounters to date, the project will continue to gather more data and cross match the images with existing catalogues.

Blainville's beaked whales population off El Hierro (Canary Islands): abundance estimation and site fidelity.

Cristel Reyes, Natacha Aguilar, Agustina Schiavi, Phil Hammond.

Beaked whales (Fam. Ziphiidae) appear to be highly sensitive to some acoustic sources, which can lead to mass strandings. The lack of knowledge about the population dynamics of these species impedes the assessment of potential population-level effects of stranding mortalities. El Hierro (Canary Islands) holds a resident coastal population of Blainville's beaked whales all-year around. One of the few photoID long-term monitoring has been taking place since 2003 (on-going, www.cetabase.info). Animals with regular to very good photos and recognizable marks in the same area of the body comprises 56 Blainville´s beaked whales. Of the recognizable animals, 40% of the individuals were observed only once during the last decade. Some of these whales may be transients, i.e. they visited the area only once, while others may have been in the area and passed unnoticed, move to other regions of the island or may return to El Hierro after some years. The remaining part of the population can be considered as the core residents (TEST3.SR p<<0.01). Software MARK was used for abundance estimations based on mark-recapture models. The low sample size of marked whales did not allow using standard open population models such as POPAN or Jolly-Seber, nor advanced methods such as Robust Analysis, to analyze the full dataset. This analysis is on-going, and suggests Bayesian statistics as the better approach for small resident populations as used by Claridge (2013).

Cetaceans off the Catalan Coast: A matter of depth?

Oriol Giralt, Montse Valls, Vicki Miller, Barbara Roldan, Oscar Valiente, Cristian Ramallo, Mireia Fernández, Blai Ruiz

There are eight resident species of cetaceans in the Mediterranean Sea, each of them living in different habitats and occurring at different water depths, depending on the region. Stranding recordings and sighting data have demonstrated that different species of cetaceans live along the Catalan coast. The present study was focused on the cetaceans distributed off the central Catalan Coast, in the Northwestern Mediterranean Sea. Eighteen cetacean sightings surveys were conducted between March and June 2014, for a total of 121 hours, covering 1,240 kms. A total of 32 sightings were made, of 4 different species of cetaceans: striped dolphins (*Stenella coeruleoalba*), bottlenose dolphins (*Tursiops truncatus*), fin whales (*Balaenoptera physalus*) and Risso's dolphins (*Grampus griseus*). One-Factor Anova analysis was conducted in order to see if the different species of cetaceans were distributed at different depths. The results showed significant differences between species. Risso's and striped dolphins occurred in deeper waters, whereas bottlenose dolphin sightings were distributed in shallower waters and fin whales occurred in intermediate waters.

Photo-identification of Bryde's whales (*Balaenoptera brydei*) in the Hauraki Gulf, New Zealand: updating the photo-catalogue of recognisable individuals and matching them to other regions

Ophelie Humphrey, Krista Rankmore

The Bryde's whale (*Balaenoptera edeni*) is currently listed as data-deficient by the IUCN due to poor understanding of their distribution and abundance. A likely important part of their habitat is the Hauraki Gulf, New Zealand, where these whales are reported year-round. These sightings, alongside those of other marine mammals, support an important whale-watching tourism industry. Tourism boats provide a useful platform for opportunistic photo-identification surveys as well as dedicated research vessels. Such methods have been used to estimate the Hauraki Gulf population of Bryde's whales. Estimates range from 159 to 113, the latter being the most recent estimate based on photo-ID surveys conducted until 2013. Our aims are to expand upon the current catalogue of individual Bryde's whales in the Hauraki Gulf. This is to be done using geo-tagged photos from 2013 – 2015 and also using photos collected opportunistically from neighbouring areas. Once the catalogue is up-to-date it can be used to measure population abundance and dynamics such as site fidelity, emigration rates and apparent survival. The Hauraki Gulf, off Auckland, constitutes New Zealand's busiest shipping waters, which puts the Bryde's whales at risk of ship strike and entanglement. 44 Bryde's whale-deaths have been recorded in the Gulf since 1989, of which 85% (of known causes) were due to ship-strike. This unsustainable rate has led to the Bryde's whale being classified as 'nationally critical' in New Zealand waters. Given the impact of ship traffic, it is important to continue long-term photo-identification monitoring of Bryde's whales in this crucial area.