



United Kingdom and Ireland Regional Student Chapter  
of the Society for Marine Mammology

Annual Conference 2015

Bangor University

TIMETABLE and ABSTRACT BOOKLET





## CONTENTS

<b>Conference Timetable</b>	<b>3</b>
<b>Abstracts</b>	<b>7</b>
<b>Acoustics</b>	<b>7</b>
<b>Behaviour</b>	<b>9</b>
<b>Distribution and Movement</b>	<b>13</b>
<b>Fisheries Interactions</b>	<b>18</b>
<b>Physiology and Pathology</b>	<b>21</b>
<b>Population Biology</b>	<b>28</b>





## TIMETABLE

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### Wednesday, 21<sup>st</sup> of January

20:00 onwards Ice Breaker at *Feral Cat* in Bangor

### Thursday, 22<sup>nd</sup> of January

09:00 – 09:15 Welcome Speech by Prof. Chris Richardson, Head of the School of Ocean Sciences, Bangor University (*Brambell A12*)

09:15 – 10:15 “Studies addressing Conservation Management of Bottlenose Dolphins in Wales” by invited speaker, Dr. Peter Evans, Director of SeaWatch Foundation

BREAK

#### Behaviour

11:00 – 11:15 “Fifty shades of grey seal (*Halichoerus grypus*) social networks: using photo-ID, positional and behavioural data to quantify sociality” – Toby Rosas da Costa Oliver

11:15 – 11:30 “The short-term responses of sperm whales (*Physeter macrocephalus*) to the attachment of suction-cup tags” – Victoria Warren

11:30 – 11:35 “Ontogeny of foraging behaviour in grey seal pups” – Matt Carter

11:35 – 11:40 “Use of telemetry to infer social association in harbour seals” – Hilari Dennis-Bohm

#### Population Biology

11:40 – 11:55 “The reproductive histories and inter-birth calving intervals of female bottlenose dolphins in northeast Scotland” – Texa Sim



11:55 – 12:00 “Group composition and kinship of southern right whales (*Eubalaena australis*) at the sub-Antarctic Auckland Islands, New Zealand” – Helena Voet

12:00 – 12:05 “Population structure and behaviour of Moray Firth bottlenose dolphins” – Alex Wakefield

12:05 – 12:10 “The role of phenology on the reproduction and survival of grey seal pups” – Roma Banga

LUNCH

### Physiology & Pathology

14:00 – 14:15 “Investigation of spatio-temporal trends in skin lesions of bottlenose dolphins in Wales” – Elena Akritopoulou

14:15 – 14:30 “Sampling epidermis for the monitoring of tissular trace elements in Mediterranean striped dolphins” – Marcel Clusa

14:30 – 14:45 “A non-invasive methodology for measuring proxies of stress in wild breeding grey seals (*Halichoerus grypus*)” – Naomi Brannan

14:45 – 15:00 “Blubber as an endocrine organ in marine mammals” – Jo Kershaw

15:00 – 15:05 “Eustress and distress in marine mammals: understanding the causes of cellular stress and consequences for tissue function and whole animal health” – Holly Armstrong

15:05 – 15:10 “A comparison of fossil and recent cetacean brain morphologies in the genera *Globicephala* and *Lagenorhynchus*” – Amber Coste

15:10 – 15:15 “Quantification of vitamin D3 as a potential measure of cetacean body condition” – Meredith Sherrill

BREAK



16:00 – 17:30 “Marine renewables: implications for mammals” – Workshop by invited speaker, Gemma Veneruso, SEACAMS (*Thoday Room F1*)

20:00 onwards Conference meal at *1815* restaurant in Bangor

## Friday, 23<sup>rd</sup> of January

09:00 – 09:45 “Why evidence matters: marine mammal conservation in Wales” by Dr. Tom Stringell, Natural Resources Wales (*Brambell A12*)

### Acoustics

09:45 – 10:00 “The response of herring (*Clupea harengus*, *C. pallasii*) schools to cetaceans (*Orcinus orca*, *Megaptera novaeangliae*) feeding calls” – Leticiaà Legat

10:00 – 10:05 “Using acoustic tags as a method of identifying caller identity” – Phinn Onens

### Fisheries Interactions

10:05 – 10:20 “Modelling the impacts of grey seal predation on West of Scotland fisheries” – Vanessa Trijoulet

10:20 – 10:25 “Age-class structure and sex ratio of bottlenose dolphin (*Tursiops truncatus*) foraging groups – the combined influence of fisheries & aquaculture” – Garry Kett

10:25 – 10:30 “Testing an automated seal detection system to control the use of acoustic deterrent devices at fish farms” – Katherine Whyte

BREAK

### Distribution & Movement

11:00 – 11:15 “A photo-ID study of the Risso’s dolphin (*Grampus griseus*) in Welsh coastal waters and the use of Maxent modelling to examine the environmental determinants of spatial and temporal distribution in the Irish Sea” – Anna Stevens



- 11:15 – 11:30 “Horizontal and vertical movements of the grey seal, *Halichoerus grypus*: Potential implications of underwater marine renewable energy devices” – Chloë Jennings
- 11:30 – 11:35 “Site fidelity of humpback whale cow/calf pairs on the east coast Australia” – Ophelie Humphrey
- 11:35 – 11:40 “Differences in post-moult migration patterns of Weddell Seals in the southern Weddell Sea” – Izzy Langley
- 11:40 – 11:45 “Modelling suitable habitat for Chilean dolphins (*Cephalorhynchus eutropia*) and Peale’s dolphins (*Lagenorhynchus australis*) in Southern Chile” – Annie Post and Julia Haywood
- 11:45 – 12:00 "Passive Acoustic Monitoring as a tool for Marine Mammal Mitigation" by conference sponsors, Seiche Training
- 12:00 – 12:30 “Drivers of dynamics in vertebrate populations” by invited speaker, Dr. Line Cordes (Bangor University)
- LUNCH
- 14:00 – 15:30 Tour of the School of Ocean Sciences and Research Vessel Prince Madog by Prof. Chris Richardson (*Menai Bridge*)
- BREAK
- 16:30 – 17:30 “Corkscrew Seals: Solving the problem of an unobserved event” – Workshop by invited speaker Joe Onofriou, SMRU (*Thoday Room F1*)



## ACOUSTICS

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

**Leticiaà Legat - University of Cumbria**

**(Supervisor: Dr. 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 while providing energy savings and enhanced feeding success for the predators. The project involves two field seasons in subsequent years to collect high-quality feeding calls and behavioural data from Icelandic killer whales and North Pacific humpback whales as well as obtaining data on the size distribution of targeted herring schools to see if whales modify call structure depending on the size of targeted fish. Following preliminary data analysis we plan to conduct playback experiments of natural and synthesized cetacean feeding calls to herring schools in net pens to assess the herrings' behavioural response in a controlled environment.



## Using acoustic tags as a method of identifying caller identity.

Phinn Onens – University of St Andrews

(Supervisor: Prof. Peter Tyack)

Despite advances in our understanding of cetacean acoustics identifying caller identity proves challenging given the constraints of the environment. We analysed both echolocation clicks and discrete calls made by matrilineal groups of northern resident killer whales, *Orcinus orca*, using data collected via acoustic recording tags. Acoustic data were supplemented with visual observations describing individuals, proximity of individuals within the focal group and behavioural patterns. When visual separation of individuals occurred, determined as distances greater than 500m, acoustic recordings were examined and call parameters recorded. Emerging patterns were assessed to see if attribution to particular individuals were possible. The isolation of calls and echolocation clicks to certain individuals could expose intraspecific differences in vocal structure, highlight novel applications of tagging technology and enhance our current understanding of the mechanisms behind behavioural change.



## BEHAVIOUR

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### ***Fifty shades of grey seal (*Halichoerus grypus*) social networks – using photo-ID, positional and behavioural data to quantify sociality.***

**Toby Rosas da Costa Oliver – University of St Andrews**

**(Supervisor: Dr. 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*), the investigation of the relationships and underlying associations and/or interactions of breeding females within, in between and outside the breeding season, is necessary. Photo-ID, positional and behavioural data from three breeding colonies across the UK (North Rona, Ramsey Island, and Donna Nook) were collected to compare sociality across different breeding habitats. Preliminary results indicate that females on a colony with daily movement of <20m a day are more likely to show non-random interactions and associations.



## The short-term responses of sperm whales (*Physeter macrocephalus*) to the attachment of suction-cup tags.

Victoria Warren – University of St Andrews

(Supervisors: Prof. Peter Tyack and Dr Mark Johnson)

Animal-mounted data logging devices are commonly used to study the behaviour, physiology and ecology of free-ranging marine mammals, in addition to their fine-scale responses to controlled stimuli. However, it is important to consider whether the data collected are representative of natural behaviour, or biased by a reaction to the instrumentation attachment. Data from 31 suction-cup DTAG deployments on sperm whales (*Physeter macrocephalus*) were analysed to consider whether any tagging effect was evident within dive parameters. Statistical models were created for each of five response parameters. Covariates for dive index were added to assess whether model fit improved when the order of dives was taken into account. The models indicated that, subsequent to tagging, the first and second dives of a sperm whale were significantly shorter than average by 111 seconds and 26 seconds, respectively. Geometric models provided the best fit for parameters regarding maximum dive depth and the number of buzzes per minute suggesting that the effect of tagging decayed over time. Descent speed and the depth difference between the first regular click and first buzz (the initial prey search time) were not significantly affected by tagging. Shortened dive durations and reduced buzz rate indicate a potential energetic cost to tagging due to lost foraging opportunities. The DTAG has a frontal cross-sectional area <3% of that of a sperm whale, so is unlikely to add much to the transport cost of an animal. The decaying nature of the effect suggests that animals may have been responding to the cumulative research exposure associated with tag attachment rather than carrying the tag per se. The method developed here could be readily applied to other deep-diving marine mammals to better understand the impacts of tagging.



## Ontogeny of foraging behaviour in grey seal pups.

**Matt Carter – Plymouth University and University of St Andrews**

**(Supervisors: Dr. Clare Embling, Dr. Kimberly Bennett, Dr. Debbie Russell and Dr. Phil Hosegood)**

As human exploitation of the marine environment increases, improving our understanding of human impacts on apex predators will be critical. The UK is home to 38% of the world's grey seals (*Halichoerus grypus*). Although grey seals are protected under the EU Habitats Directive anthropogenic impacts on this species, particularly juveniles, are poorly understood. Developments in bio-logging technology and analytical techniques have allowed us to reveal a great deal about the at-sea distribution and habitat preferences of seals around the British Isles. However, the majority of studies have focussed on adults. The ontogeny of habitat preference and foraging behaviour in pups remains poorly understood. Grey seal pups undertake a post-weaning fast on land and must learn to dive and find food without parental guidance once they leave the breeding colony. This study will investigate how habitat preference and foraging behaviour develops with age, sex and experience. I will integrate telemetry data from pups tagged at breeding colonies around the UK with oceanographic models to determine how naïve grey seal pups learn to find and exploit foraging habitat. This study aims to reveal areas which may be considered as critical habitat for the survival of grey seals where anthropogenic activities must be regulated to avoid population-level consequences.



## Use of telemetry to infer social association in harbour seals.

Hilari Dennis-Bohm - University of St Andrews

(Supervisors: Dr. Bernie McConnell and Prof. Peter Tyack)

My thesis topic involves using telemetry data from ARGOS tags to infer social associations among Harbour seals (*Phoca vitulina*). Focusing specifically from data obtained at haul-out sites and during foraging trips into the Wash, square-mouthed bay on the eastern coast of England. The objective is to determine if these associations occur more frequently than by chance. We are interested in their social behaviour as very little is known about these types of behaviour outside the breeding season for most pinniped species and the UK offers a prime habitat to study and monitor these populations. The goal of the project is to see if Harbour seal movement and ultimately behaviour is influenced by conspecifics, certain individuals or not linked to group behaviour at all.



## DISTRIBUTION and MOVEMENT

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### **A photo-ID study of the Risso's dolphin (*Grampus griseus*) in Welsh coastal waters and the use of Maxent modelling to examine the environmental determinants of spatial and temporal distribution in the Irish Sea.**

**Anna Stevens – Bangor University**

**(Supervisor: Dr Peter Evans)**

The Irish Sea has been identified as an area containing habitat important to Risso's dolphins (*Grampus griseus*). This study aimed to identify individual Risso's dolphins observed in Welsh waters and to determine the effects of environmental factors on the distribution in the Irish Sea. The creation of a photo-ID catalogue and database enabled the identification of 144 individuals in Welsh waters, from which it was estimated that a minimum of 162 individuals were encountered between 2003 and 2014. 32 mother-calf pairings were observed, suggesting the area's importance for mating and parturition. Site fidelity in terms of re-sightings rates was relatively low (12.5%). Home range sizes varied between individuals, as revealed also by comparisons with catalogues from five other research bodies from western Britain and Ireland. Fifteen individuals were matched with the Whale and Dolphin Conservation (WDC) Bardsey Island catalogue, indicating mostly localised home ranges, but evidence for large-scale migrations was also found with two matches with the Hebridean Whale and Dolphin Trust's (HWDT) catalogue. These results indicate that Risso's dolphins seen in Welsh waters are part of an open population. Environmental determinants of distribution were examined using Maxent species distribution modelling. The most important variables were bathymetry on a large-scale and, chlorophyll  $\alpha$  concentration and salinity on a fine-scale. These factors affect primary production and prey abundance either directly or indirectly through their influence upon oceanographic features. Slope was surprisingly the least important factor affecting distribution. The coastal waters around the Isle of Man, Anglesey, Bardsey Island and west Pembrokeshire were identified to be the most important for Risso's dolphins within the Irish Sea: these areas should therefore be the focus of future conservation efforts in the region to ensure the long-term protection and viability of the population.



## Horizontal and vertical movements of the grey seal, *Halichoerus grypus*: Potential implications of underwater marine renewable energy devices.

Chloe Jennings – Swansea University

(Supervisor: Dr. James Bull)

The UK grey seals (*Halichoerus grypus*) comprise up to 95% of the European population and 40% of the world population. The species has been listed in Annex II, European Habitats Directive and the management of seals in the UK is subject to the Conservation of Seals Act, 1970. Underwater renewable energy devices such as tidal turbines and wave devices could be the future for a growing energy demand. Spending roughly 85% of their time in the water, grey seals could potentially suffer large consequences because of these devices. The study looks at the horizontal and vertical movements of grey seals in relation to the future locations of these devices. Tag data provided by SMRU shows the diving behaviour and horizontal movements of 35 grey seals including 17 pups and 18 adults. Number of days of tracking varied from 9 to 336 days with a total of 683,000 dives recorded. A model using a 5 mile radius around each of the 20 future underwater renewable sites around Wales was used. In total, seals came into the 5 mile radius zone of at least 1 of the renewable sites 84,181 times. 11.2% of the time seals were within this 'danger' zone of the future sites. 61.6% of pups were found to be diving to the seabed on their dives. This compares to 59.4% in adults. This study will further analyse the water column use by grey seals, comparing this to the location of the underwater devices within the water column. Results will indicate possible future implications of the devices to grey seals and possibly inform conservation planning.



## Site fidelity of humpback whale cow/calf pairs on the east coast Australia.

Ophelie Humphrey - University of Southampton

(Supervisors: Dr. Scott Sheehan, and Dr. Michelle Blewitt)

Fluke identification photographs documenting an individual female humpback whale were assessed using a regional ID catalogue collected between 2001 and 2010. The catalogue contains images representing both the northern and southern migrations from five locations between Eden NSW in the south to Hervey Bay Queensland in the north. Research to date suggests the area of Jervis Bay NSW, offers a sheltered environment for southward migrating humpback whales. From September to November each year, humpback whale cow/calf pairs stay from one to twelve days, with an average of three days during peak season in mid-October. On the 18th of October 2008, a humpback whale cow/calf pair was recorded within Jervis Bay. Photographic images of the cow showed clear recognisable markings on her fluke and behind the dorsal. In 2010, using the same photographic techniques, a re-sighting of the same individual on the 18th of October was documented, along with a new calf. Photographic records of this individual in 2010 showed short-term residency within Jervis Bay until the 20<sup>th</sup> of October. This dataset, whilst small, offers new information on the reproductive rate of an individual humpback whale and possible preference for Jervis Bay as a suitable resting area for southward migrating humpback whale cow/calf pairs on the east coast Australia.



## Differences in post-moult migration patterns of Weddell Seals in the southern Weddell Sea.

Izzy Langley - University of St Andrews

(Supervisor: Dr. Lars Boehme)

For my Masters project in 2015, I will be looking at the differences in post-moult migration patterns of Weddell Seals in the southern Weddell Sea. I will be analysing broken-stick dive data and will be comparing Time At Depth (TAD) indexes between males and females, and between different oceanographic regimes.



## **Modelling suitable habitat for Chilean dolphins (*Cephalorhynchus eutropia*) and Peale's dolphins (*Lagenorhynchus australis*) in Southern Chile.**

**Annie Post and Julia Haywood – University of St Andrews**

**(Supervisor: Dr. Sonja Heinrich)**

Habitat modelling is a useful tool for the conservation of threatened species. Establishing connections between populations and their preferred environment, enable predictions of occurrence to be extrapolated from known study areas. The Chilean dolphin (*Cephalorhynchus eutropia*) and Peale's dolphin (*Lagenorhynchus australis*) are two small cetaceans that are relatively unknown in comparison to other cetacean species. Previous work on these two dolphin species has established relationships between dolphin presence and physical features in a small study area in Chiloé, Chile. Anthropogenic presence in the region is increasing in the form of aquaculture, specifically mussel and salmon farms. Increasing our understanding of this species, including the preferred habitats is crucial to appropriately inform policy decisions. This study proposes to use previously described relationships between the Chilean and Peale's dolphins, and their environment, to predict likely suitable habitat along an extended section of coast. By determining the likely dolphin 'hotspots' where aquaculture farms are proposed, research efforts can be focused onto these areas to determine the likelihood of anthropogenic impacts. If this method proves successful for these two species, it may have further applications for other marine mammals.



## FISHERIES INTERACTIONS

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### **Modelling the impacts of grey seal predation on West of Scotland fisheries.**

**Vanessa Trijoulet – University of Strathclyde**

**(Supervisors: Dr. Robin Cook and Dr. Alex Dickson)**

Nowadays, a controversy exists between fishermen and conservationists about the role grey seals may have played in the decline of the groundfish stocks around UK. Currently, opinions are still divided, and it seems that further studies need to be done to measure the economic impact of seals on fisheries and to propose future seal and fishery management. We developed a bioeconomic model able to quantify the economic impact of grey seal predation on West of Scotland fisheries for cod, haddock and whiting. The biological model accounts for seal predation and fishermen catches and is linked to an economic model estimating fisheries revenues and costs. The model includes a multifleet component which enables us to be as close as possible to the current organization of the West of Scotland fisheries. Three bioeconomic models are tested. The baseline model assesses seal impacts on fishermen's revenues in the long term assuming a constant fishing mortality. Two dynamics models are also tested to determine seal impacts when fleet behaviour is considered: the closed fishery model where the fleets maximize their net profits and the open-access model where the revenues are dissipated at the equilibrium. Cod is the fish the most impacted by seal predation so its collapse in the long term has to be avoided to observe any possible seal impact. The open-access model predicts cod collapse regardless of the number of seals so no impact is observed in this scenario. The baseline and closed fishery models show that drastic changes in seal population can induce huge changes in fleet revenues but also highlight the minor seal impacts for realistic change in seal population. Consequently fleet revenues may be increased by grey seal management, but this strategy can only be successful by applying complementary fisheries regulations to avoid cod collapse in the long term.



## **Age-class structure and sex ratio of bottlenose dolphin (*Tursiops truncatus*) foraging groups – the combined influence of fisheries & aquaculture.**

**Garry Kett – University College Cork**

**(Supervisor: Dr. Emer Rogan)**

Bottlenose dolphins utilise a wide variety of foraging strategies, and these often involve fisheries and aquaculture. Previous studies that have focused on interactions with either bottom trawlers or aquaculture sites identified that these induce significant effects on bottlenose dolphin group size and structure. Individual preferences for fish-farm foraging with strong evidence for matrilineal transmission of acquired strategies have also been described. However, few data exist on the combined effect of trawler following and fish-farm attendance on social composition of local communities. This is especially lacking in the Adriatic Sea which has expanding fisheries and aquaculture industries, and is, at the same time, a vital habitat for bottlenose dolphins. It is therefore important to quantify the ecological implications of these ever-expanding industries. This study investigated how group structure and composition i.e. age class structure and sex ratio, of three neighbouring but distinct communities of bottlenose dolphins, are affected while utilising three foraging strategies; trawler-following, fish-farm attendance, and open-water foraging. Boat-based photo-identification surveys were carried out in three regions of the Croatian Adriatic Sea, each with a varying degree of trawler and aquaculture activity, over the summer months of 2013 and 2014. From 736.8 hours of search effort 407 sighting events took place. Of these, 42 sightings included animals foraging behind trawler vessels, and 20 at fish-farm cages. With these data, comparative analysis of the age-class structure, percentage of males and females, and percentage of mother-calf pairs for each category of foraging-effort has been undertaken. The results increase our understanding of how fishing and aquaculture effect the social configuration of bottlenose dolphin communities, which has powerful implications for conservation management and assessing critical habitats for this population.



## Testing an automated seal detection system to control the use of acoustic deterrent devices at fish farms.

**Katherine Whyte – University of St Andrews**

**(Supervisor: Dr. Simon Northridge)**

Depredation by common and grey seals has been reported as a significant problem at some Scottish aquaculture facilities, in particular at salmon farms. Acoustic deterrent devices (ADDs) are widely used as a means of deterring these animals from fish farms by producing outbursts of underwater noise to frighten away or cause discomfort to the animal. However, a number of problems can be associated with ADDs operating continuously including habituation of seals to the ADD and habitat exclusion for acoustically sensitive species such as the harbour porpoise. I aim to present an early outline for my Master's thesis which will involve testing a new detection system for fish farms which would enable ADDs (or any other deterrent system) to be turned on only when the presence of a potential marine predator is detected.



## PHYSIOLOGY and PATHOLOGY

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### Investigation of spatio-temporal trends in skin lesions of bottlenose dolphins in Wales.

Elena Akritopoulou – Bangor University

(Supervisor: Dr. Peter Evans)

Over the last 20 years, skin lesions in different populations of bottlenose dolphins have been studied worldwide using photo-ID techniques, with lesions categorised according to their colour and texture. Climate change and anthropogenic activities appear to contribute to their appearance and development. The prevalence of skin lesions has been used, among others, as a health indicator. Cardigan Bay hosts the largest coastal bottlenose dolphin in the UK. This study aimed to investigate spatio-temporal trends in skin lesion prevalence on the Welsh dolphins over the period 2001-14 using photo-ID techniques. The possible effect of age, gender, residency and sea surface temperature (SST) on skin lesion prevalence and extent was explored. Overall, 260 individuals were analysed for 15 skin lesion categories, of which nine were observed regularly over time. The most common were tooth rakes/scars (84% of individuals), white lesions (44%) and cloudy lesions (23%) were some of them. 73% of individuals were affected by at least one type of lesion and 56% by more than two different types. Skin lesions were more prevalent of females than males. In contrast to some other studies, skin lesions were less prevalent on calves than upon adults. No significant association was found in skin lesion prevalence between SST, geographical area, or between residents, visitors and transient individuals. The presence of dark fringed spots (DFS) and white fringed spots (WFS) (lesions from which pox viruses and herpesviruses have been isolated previously) and the analysis of photographic data indicated the possible presence of pox-viruses and/or tattoo lesions in the Welsh dolphin population. Further systematic and quantitative study of the prevalence and extent of skin lesions is needed in order to assess whether skin lesions actually impact survival or reproductive rates of this bottlenose dolphin population.



## Sampling epidermis for the monitoring of tissular trace elements in Mediterranean striped dolphins.

Marcel Clusa – University of Barcelona

(Supervisors: Dr. Asunción Borrell and Dr. Àlex Aguilar)

Trace elements accumulate in epidermis, liver, kidney and muscle tissues in cetaceans. However, contrarily to internal tissues, epidermis can be sampled using minimally-invasive techniques. We investigate the patterns of trace element tissue concentrations in relation to individual sex and length and the degree of inter-tissue equilibrium between epidermis and the main internal organs of the Mediterranean striped dolphin (*Stenella coeruleoalba*). With it, we aim to test whether epidermis is a suitable tissue to predict trace element concentrations of internal tissues in cetaceans. We focused on trace elements with high potential toxicity (mercury and cadmium) or biological significance (zinc, copper and selenium). In contrast to what was found for Cu and Zn, the concentrations of Hg, Cd and Se in epidermis were positively correlated with the levels found in the internal tissues sampled probably due to their capacity to bioaccumulate. Thus, we conclude that sampling and analysing epidermis is appropriate to monitor and predict the concentrations of Hg, Cd and Se in internal tissues but not for Cu and Zn.



## **A non-invasive methodology for measuring proxies of stress in wild breeding grey seals (*Halichoerus grypus*).**

**Naomi Brannan – Durham University**

**(Supervisor: Dr. Sean Twiss)**

Organisms cope with stress by making behavioural and physiological adjustments to overcome aversive stimuli. Individuals vary in their capacity to cope, exhibiting distinct trait characteristics in response to stressors that are stable over time and across situations; these consistent individual differences (CIDs) in behavioural and physiological stress responses are referred to as coping styles. Previous studies on the stress responses of grey seals (*Halichoerus grypus*) to novel stimuli reveal CIDs indicative of coping styles. However, evidence thus far has been purely behavioural. Physiological characteristics of coping styles are reflected in the neuroendocrinology associated with the hypothalamic-pituitary-adrenal (HPA) axis and the activity of the autonomic nervous system. One way in which autonomic activity can be measured is through heart rate variability (HRV). Consequently, HRV can be used as a proxy to infer coping styles. The objective of this study was to pilot and evaluate the performance of a non-invasive (i.e. externally-mounted) telemetry system capable of recording HRV in wild breeding grey seals. Commercially available Polar<sup>®</sup> devices were modified and deployed on female grey seals ( $N = 15$ ) on the Isle of May, Scotland, during the 2013 breeding season. The devices were capable of recording accurate HRV data with minimal artefacts under stationary conditions, when individuals were supine and resting. However, the occurrence of artefacts increased with the proportion of non-rest behaviours and days since device application, suggesting the Polar<sup>®</sup> devices were particularly vulnerable to noise from muscle action potentials and/or poor electrode conductance.



## Blubber as an endocrine organ in marine mammals.

Jo Kershaw – University of St Andrews

(Supervisors: Dr. Ailsa Hall and Dr. Patrick Miller)

Mammalian adipose tissue acts as an important endocrine organ. Numerous receptors are expressed which allow it to respond to signals from a variety of hormone systems, including those from the central nervous system. Adipose tissue is also known to express and secrete a variety of peptides including glucocorticoids that are involved in fat metabolism at both a local and systemic level. Thus, if marine mammal blubber functions in the same way as other mammalian adipose tissues, it could be of vital importance in energy metabolism not only by storing dietary fats, but also by responding to hormonal signals and secreting hormones that control feeding and energy expenditure. This project focuses on the presence and functions of the glucocorticoids, specifically cortisol and its precursor cortisone, in the blubber of two model marine mammal species, the harbour seal (*Phoca vitulina*) and the harbour porpoise (*Phocoena phocoena*). Cortisol was extracted and quantified from live adult harbour seal blubber biopsies (n = 85) and stranded harbour porpoise blubber samples (n = 20). Blubber cortisol concentration showed strong individual variation and was negatively correlated with the body condition of the harbour seals calculated using a scaled mass index. Blubber cortisol concentrations were also affected by sex and season in harbour seals. The small number of harbour porpoise samples prevented robust statistical analyses, but preliminary tests suggest that cortisol concentrations are affected by body condition and age class. Cortisone extraction and quantification work is still ongoing. Determining the changes in the concentrations of these two hormones in the blubber of marine mammals would be a key step towards understanding the extreme feeding – fasting physiology of these animals.



## **Eustress and distress in marine mammals: understanding the causes of cellular stress and consequences for tissue function and whole animal health.**

**Holly Armstrong – Plymouth University**

**(Supervisor: Dr. Kimberley Bennett)**

As part of their natural life history grey seals (*Halichoerus grypus*) experience a number of stressful physiological conditions, all without any apparent detrimental effects. These include: periods of fasting, a high fat diet, high blood glucose, insulin resistance and periods of hypoxia/reperfusion. Resilience to these lifestyle stressors is not well understood, however it may be that this exhibited resilience protects the seals against additional stressors that they encounter, such as exposure to disease or contaminants in the marine environment. My current work has involved using molecular techniques to investigate the expression of heat shock proteins (HSPs; up-regulated in animal cells in response to cellular stress) in blubber tissue, in response to the following 'natural' stressors: adult female fasting during lactation, and the post weaning fast experienced by the pup after the lactation period. The majority of progress so far has been the optimisation of suitable methodologies; this has involved developing a protocol for RNA extraction from blubber tissue, designing specific primers and ensuring adequate qPCR conditions. As blubber is a tissue that can exhibit varying levels of stratification, I have initially focussed on gene expression in the inner and outer blubber core. Using the optimised methods, preliminary results suggest that there is no difference in the expression of a suite of HSPs (HSP 70, HSC 70, HSP 90, HSP 40, HSP 27) in the inner and outer blubber core. Additionally, I have started to culture primary leukocytes (white blood cells) and initially intend to examine their function with in vitro assays (e.g. respiratory burst and phagocytosis). I will also use my time during this talk to briefly discuss future work related to the studies mentioned above and ideas dictated by the current structure of my PhD thesis.



## **A comparison of fossil and recent cetacean brain morphologies in the genera *Globicephala* and *Lagenorhynchus*.**

**Amber Coste – University of Southampton**

**(Supervisor: Dr. Gareth Dyke)**

The evolution of cetaceans has long attracted much curiosity but little is known about the senses of these extinct whales and dolphins. The study of an animal's brain can often answer large parts of this question and is being undertaken for a selection of fossil cetaceans. In this study the primary aim is to try and understand the changes in the brain morphology of cetaceans of two specific genera, *Lagenorhynchus* and *Globicephala*, through parts of their evolutionary history. For this a thorough understanding of extant cetacean brain morphology is developed before uncovering the morphology of the endocasts of fossil cetaceans and detailing their morphology. All of these aim to prove the hypothesis that there have been changes in the morphology of the brain of cetaceans throughout their evolution. The fossil endocast morphologies can then be related to brain morphology and this derived brain morphology of the fossil can be compared to that of recent cetaceans. It can be hypothesised that some of these parts of the brain's morphology can be related to sensory adaptations. This can be done using computed tomography (CT) scans to obtain 3D computerised images of the skulls and their interior which will then be compared.



## **Quantification of vitamin D3 as a potential measure of cetacean body condition.**

**Meredith Sherrill – University of St Andrews**

**(Supervisor: Dr. Ailsa Hall)**

In both terrestrial and marine mammals, body condition has been associated with reproductive success and survivorship. Assessing the body condition of free-ranging cetaceans is particularly difficult due to species' large distribution ranges and the limited visibility of the animals. Current methods of estimating cetacean body condition include photogrammetry and measurements of blubber thickness, both of which can be difficult to perform on a free-ranging animal. The purpose of this project is to determine if the quantification of vitamin D3 from biopsy samples collected from live cetaceans can be used to approximate body condition. Previous studies have shown that vitamin D3, a lipophilic secosteroid, is present in increased quantities in the adipose tissue of obese mice and humans. If the quantity of vitamin D3 in cetacean blubber samples correlates with overall body condition, analysis of vitamin D3 could prove to be a useful method for approximating the body condition of free-ranging animals.



## POPULATION BIOLOGY

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### **The reproductive histories and inter-birth calving intervals of female bottlenose dolphins in northeast Scotland.**

**Texa Sim – Bangor University and University of Aberdeen**

**(Supervisors: Dr. Graham Pierce and Dr. Kevin Robinson)**

Where coastal bottlenose dolphin populations range over great distances, establishing robust estimates for individual birth rates can be inherently difficult. Nevertheless, ascertaining reproductive histories is particularly significant for management, as between-female variation in reproductive output provides a strong measure of individual fitness. Accordingly, the intervals between births are one of the most important determinants for reproductive success in these animals. In the Moray Firth in NE Scotland, studies have been carried-out since the 1980s, and integrated datasets provide a current estimate of 195 animals for this region. The southern coastline of the outer Moray Firth is an known calving area for the population, and dedicated studies in this region between 1997 and 2013 have documented 135 calves by 61 mothers during this period. In the present investigation, the reproductive rate and inter-birth period (IBIs) for established females were examined from this dataset. IBIs ranging from 2 to 8 years with an average of  $3.72 \pm 1.29$  ( $n=74$ ) were determined. However, the IBI between first and second-born calves was significantly higher than for all subsequent IBIs, suggesting that female bottlenose invested greater effort in raising their first offspring. The rate of calf production appeared to decrease with age however, such that females with IBIs of six or more years were likely approaching menopause or were unhealthy. An average calf mortality of 10.37% was determined, with first year calves accounting for 89% of all calf losses in animals aged from 0 and 4 years. Whilst congenital deformities, late weaning and maternal inexperience could account for a significant proportion of the calf mortalities recorded in this population, poor body condition of females, related to limited resource access and subsequently resulting in poor calf condition, is likely to be the primary cause of calf mortality and between-female variation in reproductive output and success.



## **Group composition and kinship of southern right whales (*Eubalaena australis*) at the sub-Antarctic Auckland Islands, New Zealand.**

**Helena Voet – University of St Andrews**

**(Supervisors: Dr. Emma Carrol and Dr. Sascha Hooker)**

After over a century-long demographic bottleneck caused by whaling, recent genotype-based mark-recapture work suggests the southern right whale (*Eubalaena australis*) is making a recovery in the sub-Antarctic Auckland Islands, New Zealand. This key wintering ground appears demographically isolated and genetically distinct from its neighbouring populations, based on population structure and mating system analyses. The current project has two key aims (1) to quantify group size and demographic composition at this key wintering ground and (2) investigate kinship and relatedness of groups of whales, particularly those comprising different demographic classes (e.g. males and females) identified in (1). This will be accomplished by analysing field data collected in the 2006-2009 Auckland Island field seasons and linked DNA profile data, comprising genetically-identified sex, maternally-inherited mtDNA haplotype and bi-parentally inherited microsatellite genotype.



## Population structure and behaviour of Moray Firth bottlenose dolphins.

Alexandra Wakefield – University of St Andrews

(Supervisor: Dr. Sonja Heinrich)

The Moray Firth is a designated Special Area of Conservation (SAC) for the population of bottlenose dolphins of eastern Scotland, a population of approximately 200 animals. To aid the conservation of the dolphins in this region, their distribution and population structure needs to be better understood. Previous studies have indicated the presence of two subunits of bottlenose dolphin; those that primarily inhabit the inner Moray Firth, and those of the outer Moray Firth and further beyond the SAC as far down as the Firth of Forth. My aim is to better understand the drivers of this segregation. Lusseau et al (2006) hypothesise two possible reasons- differing prey specialisations or social exclusion by the two groups to avoid competition. I want to explore which of these, if any, is causing a split in the population. Dietary studies can be used to elucidate this. The bottlenose dolphins off eastern Scotland exhibit low mitochondrial genetic diversity. The role of cultural hitchhiking in maintaining the distinct genetic makeup of a population has been studied in the Shark Bay sponging dolphins and it would be of interest to see if the same is happening in this dolphin population, if prey specialisations are found. The next step is to decide on the approach to take in order to answer why there is this sub-structure in the bottlenose dolphin community in eastern Scotland.



## The role of phenology on the reproduction and survival of grey seal pups.

Roma Banga – Swansea University

(Supervisors: Dr. James Bull and Dr. Luca Börger)

The UK grey seals (*Halichoerus grypus*) comprise up to 95% of the European population and 40% of the world population. In the UK, Marine Protection Area management and the EU Habitats Directive protect them and their breeding sites. Several important breeding colonies are found in Wales, in particular the Skomer Marine Nature Reserve (SMNR), which is a key haul-out site for breeding. At this site, Natural Resources Wales (NRW) and its precursors have carried out in-depth, spatially explicit monitoring of grey seal pup production and of the key pup life stages since 1993. Even though they are a well-known part of British marine life, the dynamics of the key pup stages for grey seals on the Welsh coast have not yet been well studied. Here, using the SMNR data we first quantify the trends and seasonality in pup production over the last 20 years, showing that there has been a distinct increase in both the number of observed Class I pups born and the length of the pupping season at the Marloes Peninsula. Second, a series of hypotheses based on the drivers of population dynamics and phenology in west Wales grey seal pups are tested using the SMNR Marloes data. Third, a life history-based model of seal pup population dynamics in western Wales will be developed in order to inform seal management policy in collaboration with NRW. In addition, data collected from other grey seal haul-out sites in Wales such as Ramsay Island and Anglesey, provided by the RSPB and NRW, respectively may be used further on in the project.