UK and Ireland

Regional Student Chapter

of the Society for Marine Mammalogy

# Sea Mammal Research Unit, St Andrews

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**ABSTRACT BOOK**



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 **Oral presentations – 15 minute talks**

**A new approach to estimate inter-birth intervals**

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The inter-birth interval (IBI) is an important measure of female reproductive success in many slow-reproducing mammals. Most cetacean studies report observational data, with very few attempts to model birth-interval probabilities, which require long-term individual data to provide the least biased type of information. We used sighting and reproductive histories from female bottlenose dolphins collected over 25 years off NE Scotland and Generalized Linear Mixed Models (GLMMs) to model the probability of birth as a function of the number of years since a prior birth (YSPB). Individual and temporal variability were accounted for as random effects. A mean IBI was estimated based on the predicted conditional birth-interval probabilities and the confidence interval (CI) was derived by bootstrapping. Data from 78 females which gave birth to 156 calves between 1987 and 2012 were analysed, with observed complete IBIs from 2 to 9 yrs (mean 3.75±1.42). The estimated mean IBI from the most supported model was 4.49 yrs (CI 3.94 - 4.93 yrs). To validate the analytical approach and investigate how incomplete datasets and different sighting probabilities affect the estimation of IBI we analysed simulated datasets comprising sighting and reproductive histories from over 600 hypothetical females. Each simulated dataset was projected 50 years using demographic and sighting parameters estimated for the study population and the conditional birth-interval probabilities from the most supported GLMM model. Mean IBI estimates from simulations were smaller by 2.8% on average, validating the analytical approach. Including incomplete datasets resulted in overestimated mean IBIs by 36% on average. Low sighting probabilities (≤ 0.3) either failed to provide enough data to run the models or resulted in substantially overestimated (10-44%) mean IBIs. The approach presented here can be modified to include other factors affecting birth probabilities and is applicable to other populations with comprehensive data on birth intervals.

**Good vibrations by the beach boys: Seismic magnitude is honest signal of male grey seal size (*Halichoerus grypus*)**

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Many mammals use substrate vibrations to maintain group cohesion, or avoid predators but few studies test if seismic signals are honest indicators of resource holding potential (RHP). Male gray seals at Donna Nook, UK, Body Slap (BS) during male-male conflicts and this behaviour likely generates substrate vibrations. We tested to see if the magnitude of the BS is an honest signal of male RHP by deploying 2 Guralp-6TD seismometers during the breeding season which recorded continuous seismic data over a frequency bandwidth 0.03Hz-500Hz. Locations and times of BS events performed by individual males were recorded and matched with the seismic data. We found the BS generates signatures measurable up to 120m away and there was a positive correlation between the maximum magnitude and male length. Substrate dampness had no effect. This confirms the seismic signal contains honest RHP information and is favourable for communication in a variable environment.

**The use of C-PODs and visual observations to survey bottlenose dolphins *Tursiops truncatus* in Cardigan Bay, Wales**

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Monitoring of cetaceans is commonly carried out through visual and / or acoustic surveying. Semi-resident bottlenose dolphins (*Tursiops truncatus*) in New Quay, Cardigan Bay were detected acoustically using C-PODs to determine whether there were differences in detectability. Dolphins were detected in 15% out of 40319 minutes, with peak echolocation behaviour being in the morning. Detections were regardless of the depth in the water column, with all pairs of C-PODs giving a detection similarity >70%. Visual detections peaked shortly after sunrise, although the Beaufort Sea state had a significant effect on the ability to detect dolphins. The most common observed behaviours were travelling and suspected feeding, which dominated dolphin activity during the morning daylight hours. The presence of a whelk processing plant in New Quay is likely to have had an impact on both acoustic and visual detections, and is likely to have encouraged feeding behaviour. This has implications for the local tourism industry and the importance of Cardigan Bay as a Special Area of Conservation.

**Designing line transect surveys to estimate cetacean abundance in the Gulf of Oman**

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Collecting cetacean abundance data from the Gulf of Oman is essential as very little is known about cetacean abundance and population status in this area and these data are needed for any ecological or conservation study. Therefore, this study aimed at designing line-transect surveys to estimate cetacean abundance in Iranian and Omani waters of the Gulf of Oman, for both coastal and offshore waters. The study area and its eleven strata were defined using Manifold System 8.0; stratification was based on the coastal/offshore boundaries and EEZ. The encounter rate of spinner dolphins *(Stenella longirostris*) was used to define survey parameters (cv and transect line length) for different scenarios.Three different survey scenarios were defined using Distance 6.0; the baseline scenario, the most economic scenario and the most statistically robust scenario. The baseline scenario would take 50 days on-effort and resulted in a relatively even coverage probability in both coastal and offshore areas. The most economic scenario would take 29.4 days of sailing on-effort and did not lead to a very even coverage probability in the offshore area. The most statistically robust scenario would take 133 days of on-effort sailing. It resulted in a very good and even coverage probability in the coastal area and an acceptable and even coverage probability in the offshore region. To account for the responsive movement of species to the survey vessel, and to reduce the biases, surveys should be conducted using a double platform vessel. The first scenario is the most recommended scenario as it combines an even survey coverage and viable economics. Although the third scenario is statistically robust, it is not feasible to conduct because it is very time consuming and expensive. Due to lack of knowledge in the region a pilot study based on the suggested designs is highly recommended.

**Brucella Infection Does Not Explain the Scottish Harbour Seal Declines**

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Since 2000 there has been a major decline in the abundance of Scottish harbour seals (*Phoca vitulina*), particularly along the East coast and in Orkney. While many potential causes of the decline have been suggested, the true reasons remain uncertain. The aim of this study was to establish the extent to which the harbour seals in the regions of greatest decline have been exposed to *Brucella,* a bacterial pathogen which has the potential to cause reproductive failure, and may therefore affect population dynamics. Serum samples collected from live capture-released animals around Scotland were tested for *Brucella* antibodies using the Rose-Bengal plate antigen test (RBT) and both competitive and indirect Enzyme Linked Immunosorbent Assays (ELISAs). Variation in seroprevalence over time between 1997 and 2012, by age class, sex, and region was investigated. The three test types gave significantly different results, so the competitive ELISA results were chosen for analysis as these were more sensitive than the RBT, but more conservative than the indirect ELISA with an overall seroprevalence result of 25.4%. These results suggest that although there are no reports of *Brucella* being associated with lesions in Scottish harbour seals, a high proportion of animals are exposed to the bacteria indicating endemicity in these populations, possibly to a host-adapted strain of the pathogen. No change in seroprevalence was seen over time, between regions or between the sexes, and it was concluded that *Brucella* infection is not a major contributing factor to the Scottish harbour seal declines. However, juveniles appear to have both the highest seroprevelance and the highest circulating levels of antibodies, possibly as a result of recent first exposure. Given the high seroprevalance in these seals, and the close proximity between harbour seals, humans and livestock in many areas of Scotland, there is the potential for cross-species infections.

**Final Call: playback applications to marine mammals conservation**

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Playback experiments are a valuable tool to access animal communication and cognitive abilities, particularly for marine mammal species, which rely primarily on sound for communication and information gathering. We present results of a playback experiment of conspecific calls to resident killer whales (*Orcinus orca*) as a case study for playback applications to marine mammals conservation. Resident killer whales live in stable matrilines from which permanent emigration has never been observed. Matrilines that regularly associate and share part of their stereotyped call repertoire belong to the same acoustic clan. The Northern Resident Killer Whale community is comprised of three such clans: A, G and R. Members of different clans associate frequently. In August 2009 we conducted a playback experiment in British Columbia, Canada. We presented a short unaltered sequence of G-clan calls to an A-clan matriline (A30). Boat based observations combined with deployment of a digital archival tag (Dtag) allowed us to non-invasively and continuously monitor behaviour and response to sound. The tag is capable of recording underwater sound and movement and was deployed on a female (A72) from the matriline, Randomization tests showed significant changes in swimming and vocal behaviour immediately after the playback. The animals increased vocal rate and swimming speed immediately after the playbacks and headed towards playback source. Despite being a single experiment (N=1), these results suggest that playbacks may be a valuable tool to alter movements of marine mammals in dangerous situations such as oil spills or industrial blasting activities, with potential to help preventing accidental deaths or injuries. Further studies and a cautious approach are required though, since playbacks can be very disruptive and indiscriminate application is not recommended.

**Is blood thicker than water? The role of kin and non-kin in non-mother-calf associations of captive bottlenose dolphins (*Tursiops truncatus*)**

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Kinship is an important factor in the relationships of many social animals, including cetaceans. Yet, the occurrence and function of kin (aside from the mother) in delphinid calf associations, alloparenting, and/or calf rearing has hardly been investigated in the literature. As such, this study examined the role of kin and non-kin in non-mother-calf associations of a captive population of bottlenose dolphins (*Tursiops truncatus*) from 2006-2011 via underwater video and audio recordings. Event sampling of calf associations was used to determine if differences existed between kin and non-kin associations, specifically in the frequency and duration of events. Calves (N=13) were observed associating with an average of 6.62±1.25 non-mother conspecifics each, though calves with kin present during the study (N=8) exhibited a higher average of associates (7.38±1.36) than calves without kin present (N=5, 5.40±2.50 associates). GLM results determined that calf identification, calf age, and associate age were significant predictors of the frequency of kin and non-kin associations. As for duration, however, kin and non-kin were not significant predictors of the mean duration of calf associations. Nonetheless, significant differences were observed between the proportion of time calves spent with kin and non-kin while in associations (kin=15.58±6.11%, non-kin=84.42±6.11%) and out of the total time in view (kin=6.13%±3.33%, non-kin=24.76%±4.42%). Still, no obvious differences between the context (such as the categories calf sex, associate sex, calf age, etc.) of the kin and non-kin calf associations were observed. Therefore, though calves with kin may surround themselves with a larger number of associates, calves appear to preferentially socialize with non-kin over kin conspecifics. This suggests that kin (outside of the mother) may not play a significantly important role in the development of calves directly, but may do so indirectly.

**Analysis of humpback whale song from the Eastern Caribbean**

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Male humpback whales produce highly structured and complex songs. These songs are transmitted horizontally and are constantly changing through both evolutionary and revolutionary processes. Populations in the same ocean basin share similarities in their song displays, whereas geographically distinct populations have completely different songs. Songs of humpback whales from the North Atlantic and South Pacific Ocean were analysed using spectrographic representations to divide songs into themes, phrases and units. Different unit parameters such as frequency and duration were then measured in order to test an automated method. Previous studies have shown that automated methods are not able to detect all the subtle variation within the unit types, and that in this kind of analysis a human observer is more reliable. After coding all of the unit, phrase and theme names, a Levenshtein distance method analysis was carried out for comparison of songs. Distances were measured from each unit to all other units, and the same procedure was undertaken for phrases and themes. The results showed that the Australian song significantly differed from North Atlantic songs, and that songs from different parts of the North Atlantic have an approximate 50% similarity in all levels of song structure. This study provides evidence of horizontal cultural transmission of humpback whale songs within the same ocean basin that does not occur with a wider geographical separation.

**The effects of anthropogenic activity on harbour seal (*Phoca vitulina*) haulout behaviour at the weekend**

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Harbour seals in Scotland are protected under European and domestic law at important haulout sites designated as Special Areas of Conservation (SACs). These protection laws aim to prevent disturbance caused by humans that affects natural haulout behaviour either by preventing animals from hauling out or by disturbing them into the water. Since 2000 there has been a rapid decline in the number of harbour seals hauling out in the Firth of Tay and Eden Estuary SAC, in SE Scotland. This study assesses how haulout behaviour in these animals is affected by what day of the week it is, a unit of time that dictates human behaviour depending on whether it is a weekday or the weekend. GPS equipped GSM phone tags were deployed on adult harbour seals (n=9) between 2008 and 2011. Telemetry data that included GPS locations, haulout frequency and haulout duration were collected for an average of 92 days (maximum 149 days) from February to July. Generalized estimating equations (GEEs) were used to compare the proportion of time seals spent hauled out at the weekend to that on weekdays. A GEE modelling approach was chosen due to autocorrelation within individuals. We found that seals hauled out significantly less (p<0.05) on days that fell on the weekend compared to those that fell on weekdays. These results demonstrate a change in the natural haulout behaviour of harbour seals linked to a predictably cyclical change in anthropogenic activity depending on what type of day it is. Understanding how varying levels of anthropogenic activity affect harbour seal haulout behaviour will inform mitigation measures aimed at protecting harbour seal haulout sites within SACs. This is especially true where human related disturbance is expected to increase on certain days, such as at the weekend, or at particular times of the year.

**Assessing the effect of boat traffic on bottlenose dolphin foraging activity using passive acoustic techniques**

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Assessments of anthropogenic impacts on marine wildlife often concentrate on large-scale animal displacement. However, changes in the activity pattern of animals that do not flee could also affect their energy balance. Increasing boat traffic raises concerns for exposed marine mammals, but it is hard to disentangle the effect of noise, boat physical presence, and context. We used passive acoustic techniques to quantify boat disturbance on bottlenose dolphin foraging activity in the Moray Firth (Scotland) and characterise the conditions that influence responses, while accounting for the masking effect of boat noise on foraging vocalisations (buzzes). We developed a novel procedure to estimate a consistent relationship between buzz detection probability and noise level in the appropriate 1/3 octave band. We then used a Bayesian hierarchical modelling framework to test the effect of boat presence on the occurrence of buzzes, as well as its duration and interactions with broadband noise level, location, year, day, hour, dolphin group size, and type and number of boats. Our results indicate that boat presence, rather than noise, was associated with a short-term 49% reduction in buzzing activity. There were differences between sites and between years, suggesting a variable susceptibility depending on foraging conditions. This effect increased for increasing number of boats present. It also depended on the prevailing boat type, but not on school size. While this population is expected to compensate for current levels of boat disturbance, our results will inform robust predictions of the population consequences of increasing boat traffic resulting from future industrial developments.

 **Can seals generalize call type?**

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Past research found grey seals (*Halichoerus grypus*) were capable of classifying vocal signals by call type using a trained set, but were unable to generalize to novel exemplars (Shapiro, Slater & Janik, 2004). Here we trained a juvenile female grey seal to discriminate novel calls into two classes, growls and moans, using her own calls and those of two unknown animals. The seal was accurately able to discriminate both her own (94%) and other seals (87%) calls. A generalized linear model (GLM) examined variables that affected the seal’s accuracy, and found that performance significantly improved across test sessions. Additionally, the seal’s accuracy was higher during the first presentation of a sound, and decreased after multiple exposures, though this varied for her own calls versus other animals. Factor analysis for mixed data (FAMD) was conducted on test signals to identify parameters that varied between call types and could be used as cues for discrimination. Factor loadings and call clustering indicated that the seal potentially discriminated between call types by using differences in energy, noise, frequency, amplitude, and duration. These results show grey seals are capable of generalizing call classes, and suggest acoustic parameters that could be used as cues for discrimination.

**Seals don’t like salt water! Finescale ecological niche modelling provides evidence that grey seals (*Halichoerus grypus*) prefer access to fresh water in order to drink**

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As capital breeders, many phocids meet their energy requirements during the breeding season using stored reserves in a thick blubber layer. Their large body size, high energy expenditure during lactation, and the insulative effects of the blubber layer can lead to thermal stress from overheating, especially in warm and temperate climates. Thermal stress is known to prompt behavioural thermoregulation, which may influence fine-scale site choice on breeding colonies; this is expressed in breeding female grey seals (*Halichoerus grypus*) as a clear preference for proximity to pools of water. However, anecdotal observations suggest that these pools of water are also used as a source of drinking water, perhaps to avoid the water stress brought about by lactation, though water intake is difficult to verify without real-time physiological monitoring. Here, we use an alternative approach to demonstrate that grey seals prefer access to water for drinking. Using Ecological Niche Factor Analysis to examine fine-scale physical determinants of site choice at North Rona, Scotland, we found that lactating mothers showed a clear preference for proximity to pools of water of lower salinity. This effect is apparent throughout the autumn breeding season, though most pronounced early in the season, when ambient temperatures and presumably thermal stress are greatest. Given that the cooling effect of fresh and salt water should be equivalent, the most parsimonious explanation for this preference is that lactating females use these fresh water pools for drinking.

 **Domoic acid exposure in piscivorous marine predators**

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Marine algal toxins are responsible for a number of harmful human health effects, and for fish, seabird and marine mammal mortality events worldwide. One marine algal toxin, domoic acid (DA), is a neurotoxin produced by some diatom species from the genus *Pseudo-nitzschia*. The transfer of toxins, such as DA, to upper trophic levels via the marine food web occurs when herbivores consume the toxic phytoplankton. Toxins are then assimilated into the herbivores’ tissues and transferred to their marine predators. In marine mammals DA exposure has resulted in mass mortality events due to acute toxicity, reduced reproductive success, and chronic health problems as a result of low level exposure. In the last 40 years the frequency, intensity and geographical distribution of reported harmful algal blooms (HABs) has increased. This is partly, but not entirely, a consequence of increased scientific awareness, frequent monitoring and improved detection techniques. However, another explanation for the increasing occurrence of HABs is the impact of anthropogenic activities on coastal environments. Marine mammals, and other top marine predators that forage in coastal environments are therefore increasingly exposed to biotoxins released during these HAB events. As such, foraging habitat preference in coastal and offshore environments may reveal differences in DA exposure in piscivorous marine predators.

**Designing and carrying out a pilot line transect survey for inshore cetaceans in the Falkland Islands**

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Line transect surveys from ships and aircrafts are widely used to estimate density and/or abundance of cetacean populations. Conducting pilot surveys prior to large surveys is useful, because line transect surveys benefit from prior knowledge. The distribution, abundance and population trends of Commerson’s and Peale’s dolphins in the Falkland Islands are not well known. The pilot ship board line transect survey presented here was developed as a masters project with the intention of being implemented as part of a Darwin Initiative Project. The survey was carried out in February/March 2014. The survey area was defined as six strata between 300 m and 10 km from the Falkland coastline. 10 days were available for conducting the survey. A systematic parallel line design was used to generate the survey using the software Distance. Using the available line length for conducting the survey and encounter rates of the target species from previous studies in Chile, the coefficient of variation of density was found to be 0.26 for Commerson’s dolphins and 0.34 for Peale’s dolphins. Closer to the time of the survey being carried the number of strata was changed to eight, this was done in order to add some strata in more sheltered areas and to better fit with the where the vessel could pick up survey crew. We were able to survey all 10 days and managed to get all but one substratum done. The final results from the survey will be ready over the coming months; we now have enough information for encounter rates of the two species. The data gathered in the pilot survey will be used to provide a set of potential survey effort scenarios for the full Falkland survey.

**Use of Bayesian Statistics to estimate grey seal consumption in West of Scotland**

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Seals are well-known predators of fish around the UK. Previous studies have shown that UK fish stocks have decreased in the last fifty years, while the grey seal population (*Halichoerus grypus*) has increased. These observations are responsible for debates between conservationists and fishermen about the role seals would have played in the decrease of fish stocks. Currently, opinions are still divided, and it seems that further studies need to be done to measure the impact of seals on fisheries and to propose future fishery management. Currently, grey seal diet has been estimated following two years of data collection (1985 and 2002) by the Sea Mammal Research Unit. It is then difficult to obtain reasonable estimates of grey seal consumption for a given number of seals and a given fish abundance with only two years of empirical data. Bayesian Statistics have been used to estimate grey seal consumption and its associated uncertainty from 1985 to 2012 on cod, haddock and whiting, the three main demersal fish species in West of Scotland. The results obtained fit reasonably well the observed data and highlight a seal selectivity for fish which seems length-dependant regardless of the species. The seal outputs for whiting differ substantially depending on the assumption taken as regards to the variability in seal catchability. However, it seems difficult to decide whether the outputs are reliable or denote an inconsistency in the survey’s data. Except for cod, the model predicts surprising low values of mortality due to seal compared to the natural and fishing mortalities. Most of all, this study highlights the benefit of using Bayesian analysis to estimate parameters when only few empirical data is available.

 **Oral presentations – 5 minute talks**

**Passive acoustic detection of dive synchronicity in the cryptic Blainville’s beaked whale (*Mesoplodon densirostris*)**

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Beaked whales have recently attracted scientific scrutiny due to mass strandings associated with military sonar exercises. Offshore distributions and deep foraging dives have traditionally precluded research efforts, resulting in data deficiencies for the majority of these species. The US Navy’s Atlantic Undersea Test and Evaluation Center (AUTEC) currently monitors cetaceans in the Tongue of the Ocean trench off of the Bahamas with an array of 93 bottom-mounted hydrophones. Over the last decade, this available infrastructure and the strandings of the early 2000s prompted the first in-depth research into Blainville’s beaked whales (*Mesoplodon densirostris*). However, little research has yet to be done on social interactions, despite informal observations of separate groups diving in synchrony. This study aims to formally test for dive synchrony between Blainville’s beaked whale groups using over a year of acoustic detections on the AUTEC range. The timing of foraging bouts for different groups will be compared to that expected at random to determine whether dive synchrony is occurring. Interactions will also be investigated by testing for changes in vocalization characteristics when more than one group is present on the range. Such behavioural changes may be considered as possible indicators of eavesdropping behaviour. The results of this study will establish the groundwork for social behaviour in Blainville’s beaked whales and provide a basis of comparison for future research with other beaked whales. This work may also help conservation policies go beyond physiological considerations to understand how the acoustic environment also affects social interactions.

**Investigating the physiological underpinnings of coping styles in grey seals (*Halichoerus grypus*)**

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Animals exhibit consistent individual differences (CIDs) in behaviour and physiology that are: (i) independent of age, sex and social and environmental conditions; and (ii) stable through time and across contexts. CIDs associated with stress responses have been referred to as coping styles – the most widely researched of which have been the proactive and reactive coping styles. Previous studies on the stress responses of grey seals (*Halichoerus grypus*) to novel stimuli reveal CIDs indicative of proactive-reactive coping styles – however, evidence thus far has been purely behavioural. Proactive-reactive coping styles are also characterized by CIDs in physiology, specifically autonomic function and neuroendocrinology of the hypothalamic-pituitary-adrenal (HPA) axis. Individuals appear to cope with stressors in a predominantly sympathetic (proactive) way, with low HPA reactivity, or a predominantly parasympathetic (reactive) way, with high HPA activity. These autonomic and neuroendocrinological differences are associated with differences in heart rate (HR) and heart rate variability (HRV). Consequently, HR and HRV can be used as non-invasive proxies to infer the coping styles of individuals. A system for remotely recording HR/HRV using commercially available Polar® heart rate monitors was piloted on female grey seals on the Isle of May colony (Scotland) during the 2013 breeding season. On-going analyses aim to establish the degree of, and consistency in, individual differences in HR/HRV. Future analyses will focus on determining whether such CIDs in HR/HRV in undisturbed (i.e. whilst resting) and disturbed (i.e. whilst subject to “natural” stressors, such as conspecific aggression) situations can be used, alongside known behavioural metrics, to infer proactive-reactive coping styles in female grey seals.

**Potential for the consumption of fisheries discards by grey seals in the North Sea**

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While this project is still in its very early stages, I aim to convey the potential for at sea interactions between fishing vessels and grey seals, and how these may involve scavenging. It is well known that seabirds benefit highly from fisheries discards, and there are concerns that the upcoming fisheries reform may have negative effects on seabird populations because of this. It is relatively simple to prove the existence of this phenomenon in birds by direct observation and diet analysis. Due to the nature of their foraging activities, it is difficult to detect seals feeding near fishing vessels and to determine whether their presence is driven by the possibility of opportunistic feeding upon discards. It is understood that seals are generalist predators, and that their prey preferences, in some cases, match human ones. Pinniped interactions with fisheries have been documented but until recently, none have observed the particular type of interaction studied here. I propose to use several forms of pre-existing data to determine whether seals do indeed scavenge on this widely available food source. I intend to use data obtained from seal scat analysis and data made available by CEFAS to pinpoint parts of seal diet which may have come from scavenging. In addition to this, I hope to quantify the likelihood of seals and fishing vessels meeting at sea using seal telemetry tracking data, and further vessel tracking data provided by CEFAS. It is my hope that within these data, there is the potential to draw some conclusion about the likelihood of seals and fishing vessels meeting at sea, and then that these seals are feeding on the discarded fish.

**Economy vs. Ecology – a social-ecological approach to the study of anthropogenic noise disturbance of cetaceans in the Pelagos Sanctuary**

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The study of underwater anthropogenic noise pollution and its effect on cetaceans has become a topic of considerable interest in the academic literature. However, the majority of these studies focus almost exclusively on quantifiable impacts on the animals, rather than taking into account the wider social-ecological scenario. There is an increasing need to address the social and economic barriers to cetacean conservation, where significant conflict exists between maritime industries and contiguous cetaceans. Socio-economic issues feature heavily in this conflict, given the fragile economic state of many countries at this time. ‘Social-ecological systems (SES) analysis’ is an area of research that has been recently rising in prominence in the field of conservation. SES analysis seeks to assess the complex interactions between humans and the natural environment within a biogeophysical unit. This project utilises a similar social-ecological approach to the issue of noise disturbance of cetaceans in the Pelagos Sanctuary, a Special Protected Area of Mediterranean Importance in the Ligurian Sea. It is interdisciplinary in nature, involving two strands of research: Ecological, involving acoustic analysis to identify sources and potential impacts of anthropogenic noise in the sanctuary; and Anthropological, investigating the socio-economic barriers to marine mammal risk mitigation. In collaboration with the Tethys Research Institute in Italy, the ecological strand involves analysis of acoustic data collected throughout a designated study site within the Pelagos Sanctuary from 2007-13. The anthropological strand involves a series of qualitative semi-structured interviews conducted throughout the study site, of representatives from the various maritime industries contributing to underwater noise pollution in the sanctuary. Industries of interest include fishing, NATO and naval military, eco-tourism, shipping and recreational maritime tourism. Still in its early days, the project has already garnered a great deal of interest, and collaborations have been established with several local organisations to participate in the research.

**Foraging Behaviour Investigation in oceanographic space**

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One way of assessing an animal’s well-being over a migratory period is through looking at changes in body composition that indicate successful foraging. Studying foraging success of far-ranging marine mammals such as elephant seals is extremely difficult, because these animals spend most of their life at sea during which time direct measurements are difficult to obtain. Changes in body composition in marine mammals are reflected by changes in buoyancy, affecting their dive behaviour. By looking at passive drift movements within dives, i.e. drift fragments, a drift rate can be determined which informs about a seal’s buoyancy. To identify drift fragments, a new method was developed to extract vertical speeds from compressed and abstracted dive profiles through choosing dives having characteristics of drift dives. Looking at the changes in drift rate over time highlightes certain phases of a migratory period during which a seal changed its buoyancy. These phases indicate a seal’s foraging success and can inform about where seals forage successfully. Since marine mammals inhabit the oceanographic space, regions in which they feed successfully should be described and characterised in oceanographic sense. A resulting question is how the oceanographic space these animals move in can be defined. It should also be considered how the oceanographic environment influences a seal’s well-being. How do currents influence the migratory movements and which oceanographic features are used to find these successful foraging regions that permit seals to replenish resources at such a fast rate and enable this extraordinary lifestyle?

**Intra and inter-specific interactions in marine habitat use between two sympatric seal species at the periphery of their range**

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Grey seals (*Halichoerus grypus*) and harbor seals (*Phoca vitulina*) are two sympatric seal species occurring at the southern limit of their range along the French coasts of the Channel, with increasing numbers in all colonies. The dynamics of these seals’ metapopulations are contrasted among sites in Europe. Until recently, both species were relatively separated along the French coasts with grey seals in the western Channel (Brittany) and harbor seals in the eastern Channel. These last years however, grey seal numbers have sharply increased in the eastern Channel (+25%/year), using the same haulout sites as harbor seals (in *baie de Somme* especially). In several seal colonies across the north Atlantic, the co occurrence of both species has lead to a decrease of the harbor seal numbers *vs* an increase of grey seal numbers: competition for resources is usually suggested as an explanation for these distinct trends. This PhD project aims at describing the habitat and resources preferences and usage strategies for both species in contrasted cases of intra and inter-specific interactions, at the core or periphery of their range in the North-East Atlantic. It will focus on the analysis of individual strategies of habitat use by seals, modelling habitat preferences from telemetry. This habitat modelling will mainly focus on the French seal colonies, but will also include a comparison with the British and Irish colonies. Study sites will be chosen in order to document contrasted situations of occurrence of one or both species, in the core or periphery of their range..

 **Effects of Capture and Tag Attachment to a Large Marine Vertebrate**

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Bio-logging refers to a branch of research that involves the deployment of autonomous *in situ* recording devices on free-ranging animals. Bio-logging is integral to marine vertebrate research with diving species of marine vertebrates accounting for the majority of published bio-logging studies. A key limitation is that studies operate under the hypothesis that the presence of a device does not cause departure from normal or; negative effects are not important. Yet a range of tags and bio-logging devices have been shown to affect tagged individuals. This, along with a lack of clearly defined quantitative measures to examine an effect has left the topic of tagging impacts complicated and poorly defined. To assess impacts of capture and tag attachments in harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*), effects will be separated into two categories: short- and long-term. Short-term effects will be treated as those that exist as a result of capture, sedation and effects from carrying a device that decay within a short period following attachment. A framework to quantify the duration and magnitude of short-term effects will be developed to assess telemetry time series data for the existence of short-term effects. Subsequently, the framework will be used to compare animal responses to capture and handling in different animal handling protocols. Long-term effects are those that exist, or their mechanisms of causation exist, for the duration that a tag is attached to an animal. Changes in drag and the energetics effects induced by the attachment of a device to the external surface of a seal will be quantified. The behavioural adaptations animals employ to overcome increased drag will also be assessed. Understanding the responses to animals captured and tagged will aid data interpretation and with ethical assessment of animal welfare during capture and tagging.

**Protosociality in colonially breeding seals**

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Many animals, at some point in their life-history, live in groups attributable to the many benefits they experience such as enhanced foraging, dilution of predation, and finding a mate, amongst others. Coloniality is a form of group-living that has no other resource than breeding. Surprisingly, despite several fitness costs, many species exhibit this form of breeding aggregation. It is thought to have evolved from the combination of suitable, high-quality environment coupled with attraction of conspecifics: the commodity selection framework. 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. The majority of grey seals in the UK breed colonially, and exhibit high site fidelity. The females are also individually identifiable from their pelage patterns, making long term, life-histories studies possible. Previous studies on grey seal sociality have tried to investigate fine-scale site fidelity using Monte Carlo models; stability using social stability indices; and relatedness using genetic microsatellites – all drawing different conclusions. By identifying and investigating the associations of breeding females within, in between and outside the breeding season with the aid of photo-identification and Social Network Analysis, together with long-life, high resolution satellite tags, it will be possible to measure any fitness benefits towards the mother/pup and, consequently, the population of these associations.

**The comparative analysis of passive acoustic CPOD detections with seasonal observation effort relating to the temporal occurrence of dolphin species within Broadhaven Bay, County Mayo**

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Analysis for this thesis is in the early stages, however, here is the plan: Utilizing CPOD passive acoustic detections of dolphins spanning three years, we aim to index false detection rates of CPODs within Broadhaven Bay, Ireland to determine the comparative success of detections between visual effort, and passive acoustic means alone. This will then be used to analyse the seasonality shown from both methods to determine confidence in these methods which will be useful for projects that rely on CPODs to analyse occurrence trends.

**Grey Seal Photo ID on Bardsey Island**

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The grey seal population of Bardsey Island were photographed during the 2013 pupping season, with particular emphasis on mothers and pups. The seals were matched by eye alone and mothers were collated to form a catalogue. This catalogue was compared to a catalogue with images from previous years, the most recent being 2010. Some of the mothers have been sighted in previous years, showing site fidelity. I intend to test ExtractCompare (pelage pattern matching software) by inputting a small selection of seal patterns and then seeing how well it matches different grades of photographs i.e. what I would class as ‘good’ or ‘bad’. The software is designed to take into account the orientation of the seal and other factors that make identification more difficult, so I would expect to find that the software is able to match the grades of photos at a similar success rate.

**Using fine scale movement and acoustic data to quantify temporal differences in the foraging strategies of short-finned pilot whales (*Globicephala macrohynchus*) feeding at depth**

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Marine mammals may choose to alter their foraging strategies in order to exploit prey resources that vary in availability. Studies on short-finned pilot whales (*Globicephala macrohynchus*) in the Canary Islands have indicated that their diving and foraging behaviour differ temporally (Aguilar de Soto et al. 2008). Deep dives that occur during the day often involve a vertical sprint of up to 9 meters per second, culminating in rapid echolocation clicks (termed a buzz) that indicate prey capture attempts. There are usually only one or two buzzes per dive in these daytime deep dives. In contrast, night-time dives rarely contain sprints but have many buzzes per dive. It is likely that these distinct foraging strategies represent attempts to capture different prey species, and it is hypothesized that the prey pursued at night are not available during the day, but have moved up in the water column with the deep scattering layer. The goal of this Master’s project is to use fine scale movement and acoustic data associated with the buzzes in each of these dive types in an attempt to quantify the differences between daytime and night-time foraging. High-rate acceleration and acoustic tags (Dtags, Johnson and Tyack 2003) were deployed on short-finned pilot whales between 2003 and 2008 near Tenerife in the Canary Islands. To compare temporal differences in foraging strategies, I will quantify changes in the inter-click interval (ICI) just prior to and during the buzz, and change in acceleration (jerk) during the buzz for dive records containing both daytime and night-time deep dives. In addition, I will attempt to use change in acceleration immediately following the buzz to determine if a prey-handling signature is evident, which would allow us to use acceleration data to determine foraging success. Here I present hypotheses, methodology, and some preliminary results.

**Comparative analysis of movement patterns and social structure of coastal delphinids in southern Chile**

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Identifying reliable home range patterns and core areas of Chilean dolphins (*Cephalorhynchus eutropia*) and Peale’s dolphins (*Lageorhynchus australis*) could give us important information about these species` habitat use and distribution. We could determine key areas that should be protected in order to ensure the survival of these species. This is important due to the growing number of aquacultures within their habitat, since earlier studies show that their high site fidelity and small home ranges make them sensitive to habitat fragmentation by aquacultures. For the above reasons, I will analyse Photo-ID data in my study collected over 12 years (2001-2012) around the Chiloé Archipelago, by examining individuals with high re-sighting numbers and defining their home range and core areas. My goal is to confirm a previously established estimate (that was only supported by a few years of data) for the small home range size and the high site fidelity of Chilean dolphins, and underline their vulnerability for habitat loss. I will try to identify, whether there is shift in their core areas over time and whether any such shifts are correlated to the presence of aquaculture. I plan to identify which conspecifics spend time together in order to define their social associations and get a conclusion on how that might affect their home range. I aim to carry out the same analysis for Peale’s dolphins, since these species are sympatric here, but their behaviour differs significantly. However, due to the low level site fidelity of this species based on previous examinations, I expect larger home ranges, which may exceed the boundaries of the study area. I expect to gain valuable information from my results that will be useful for the protection of these two poorly known species by providing home range and core area usage- based guidance for Marine Protected Areas.

**The direct responses of sperm whales (*Physeter macrocephalus*) to the attachment of DTAGs, and the implications thereof**

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A large proportion of established general history pertaining to marine mammal behaviour has been derived from analyses of tag data: small recording devices attached to animals to monitor their fine-scale activity. It is important to understand whether the data collected are reliable and representative of the animal’s natural behaviour, as opposed to an artefact of their carrying the tag. Since the development of small, streamlined, suction-cup DTAGs in the early 2000’s (Johnson and Tyack, 2003) there has been much use of the tags, but relatively little investigation into the impacts the tags may be having on the animals. This project aims to examine a null hypothesis that the attachment of a DTAG to a sperm whale (*Physeter macrocephalus*) does not affect its natural behaviour in a perceivable way. Using data from a range of DTAG deployments on sperm whales around the world, hypotheses concerning energetic, physiological and social costs will be investigated. It is assumed that during the tag-on period, the animal will transition from a state of disturbance due to the tagging event, to a more natural baseline. The speed, foraging duration and foraging success of the first post-tagging dive will be compared to later dives in order to assess whether the tagging event disturbed the whale such that there was a resultant cost to the animal. The surfacing activity after the first dive will be examined at a fine scale in order to ‘back-calculate’ whether the tagging caused the animal to dive before it had acquired enough oxygen. Furthermore, social implications and grouping costs will be considered acoustically. If the attachment of a tag is perceived to cause a significant adverse impact, conclusions made from DTAG data may need to be reviewed. Findings could influence future tag development

**Studying the distribution of harbour seals (*Phoca vitulina*) in Kyle Rhea**

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The high abundance of marine mammals in tidally energetic sites suggests that these areas may be important marine mammal foraging grounds. The aim of this study is to investigate the distribution and abundance of harbour seals (*Phoca vitulina*) in Kyle Rhea, a tidal channel on the west coast of Scotland. Here, we shall consider how different factors affect the abundance/presence of seals in the channel and we will discuss a new method that has been used for geolocating animals. This method, using landmarks on the shore, can help geolocate animals on the surface from photographs, which provides fine-scale distribution data on the animals. Data was collected using a cliff-top observation site to undertake visual surveys of the channel, with photographs taken of all sightings. The statistical analysis for this study is ongoing and only preliminary results are available as of yet. This study is of particular interest because Kyle Rhea has been proposed as a future site for tidal turbine development and so our findings could be relevant if such a development affects the harbour seal population in the channel.

**Using Passive Acoustics to Determine Seasonal Presence of Delphinids in the Inner Hebrides**

Louise Wilcox 1, Doug Gillespie2

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Many visual surveys have been conducted to study cetaceans on the west coast of Scotland, particularly in response to the growing whale watching industry and continued military activity. The majority of these have been carried out in summer due to the challenging weather conditions that are frequently experienced in winter which prevent accurate visual surveying. Acoustic monitoring is not affected by weather so this study provides a unique opportunity to measure year round occurrence. This project is using the automated detection software Pamguard to analyse recordings from a fixed hydrophone array off the coast of the Isle of Rona. Known recordings from the area will then be used to train a classifier which can be used on the experimental data to identify the clicks and whistles to species level.The results of this will be used to record monthly presence of the common species of delphinid in the area. Data on winter occurrence will be useful to inform any future research in the area.

**Understanding the sequence in humpback whale songs**

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Humpback whale songs are characteristically complex in structure. They are made of units arranged into phrases, which are repeated in themes, and a song is defined as a full cycle of themes. In my undergraduate dissertation project, I want to study the organization of humpback whale songs into sequences of units and themes, for songs recorded off Hawaii in 1977 and 1978. I am trying to model the sequence with a simple Markov chain as well as a more complex hierarchical model. I will generate artificial songs based on those models, and will compare them to the original data via error counts. This project should reveal that hierarchical models are better suited to describe the highly structured songs of humpback whales.

**Poster presentations**

**Acoustic detection ranges for marine mammal monitoring at a tidal turbine site: Grand Passage, NS, Canada**

Chloe Malinka1, Alex Hay2

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High tidal flow environments are the focus of a growing effort to explore the feasibility of energy extraction from tidal flows using in-stream tidal turbines. Among the many questions is the effect these turbines will have on marine mammals. Passive Acoustic Monitoring (PAM) for marine mammals at tidal energy developments requires an understanding of site-specific acoustic detection ranges. Furthermore, the naturally occurring ambient noise in high-flow environments imposes rather severe constraints on detection limits. Since underwater sound is used as a tool for detecting marine mammal presence via their vocalizations, sounds mimicking those of marine mammals were projected to assess the feasibility of a PAM system at a proposed small-scale (<2 MW) tidal energy site in Grand Passage, Nova Scotia, Canada. Consecutive sweeps were transmitted with an Ocean Sonics underwater projector (icTalk MF) from a rigid inflatable boat as it drifted over a moored Ocean Sonics hydrophone (icListen HF) in July 2012. A Nortek Vector acoustic Doppler velocity sensor co-located with the hydrophone measured the flow to determine the hydrophone’s effective detection range over the phase of the tide. The conditions under which the projected sounds were detectable will be presented. False alarm rates as a function of distance from the hydrophone were determined, with a typical detection range of 400 m at a false alarm rate of 50%. Ambient noise levels were also measured with a drifting hydrophone to establish baseline acoustic conditions prior to turbine installation, and were modulated by water speed and location within the channel. Such measurements are relevant to the tidal project’s environmental assessment process. This work will contribute to the future monitoring of marine mammal presence in the vicinity.

**The effects of anthropogenic activity on harbour seal (*Phoca vitulina*) haulout behaviour at the weekend**

William Paterson1, Dominic McCafferty2, John Currie3 and Dave Thompson1

1. *Sea Mammal Research Unit, University of St. Andrews, St. Andrews, Scotland*
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UK harbour seals are legally protected under Annex II of the European Habitats Directive. Scottish Government legislation extends the protection of seals in Scotland under section 117 of the Marine (Scotland) Act 2010 stating it is an offence to harass seals intentionally or recklessly at designated haulout sites. This is particularly important at certain times of the year when seals spend an increased amount of time on land such as during the moult. There is a need to quantify what effect disturbance has on UK harbour seals, both behaviorally and physiologically, to better inform policy aimed at protecting seals from the effects of disturbance. This PhD builds on previous work that predicted an energetic cost of increased body surface temperatures of harbour seals while hauled out during the moult. Surface temperature is increased during the moult by opening anastomoses in the blubber layer to allow blood flow to the skin surface, an adaptation to facilitating proliferation of hair follicles during pelage renewal. Increased levels of anthropogenic activity that adversely affect the physiological requirement of seals to haul out more, perfuse blood through the blubber layer and increase skin surface temperature will have cumulative physiological consequences. By measuring metabolic rate in captive animals as they transition to and from land it will be possible to predict the energetic cost of disturbance seen in wild animals using behavioural data from telemetry studies. Those telemetry data will also allow an assessment of the likelihood of transition between haulout sites when disturbed into the water. Captive physiological experiments that compliment wild behavioural telemetry studies will develop a clearer understanding of the magnitude of the effects of disturbing harbour seals from haulout sites.

**The use of geographical bottlenecks to monitor marine mammal movements - A case study of bottlenose dolphins in the Sound of Mull, Scotland**

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A network of strategically placed passive acoustic monitoring devices has the potential to determine coastal dolphin presence and movements which, in turn, could be used to minimise anthropogenic impacts. The west coast of Scotland is inhabited by a wide ranging, but small bottlenose dolphin community and information on their temporal distribution and mobility is limited. With the marine renewable industry showing development interest in the area, an increased understanding of dolphin movement patterns is required. However, it proves difficult to know where low density dolphins are at any one time, which is further complicated by the complex coast, including numerous islands and an enormous coastline. Nevertheless, the presence of a discrete number of alternative routes, in combination with the known clustering behaviour into few groups, offers the opportunity for a potentially more effective way of tracking movements. Therefore, the primary aim of this study was to test the concept of using geographical bottlenecks (i.e. narrow coastal channels) to monitor dolphin movements. An array of six C-PODs were attached to navigational buoys (to prevent risk of equipment damage/lost by trawlers) in the Sound of Mull (a 37km long gateway) for approximately one year. Simultaneously, visual sightings were collected from the public and compared to the acoustic detections. Results show that, although dolphins were visually and acoustically detected passing through the Sound, acoustic detections were surprisingly rare, and proved of limited usage to infer movement occurrence or directionality. Whilst these results might be related to the deployment design (e.g. chain noise, deployment depth, hydrophone orientation), it could be that the dolphins’ acoustic behaviour wasn’t suitable (e.g. vocalisation abundance, orientation and characteristics). These possibilities were subject to further experiments, which revealed a local lack of echolocation by the dolphins. Our results have implications for monitoring the presence and movements of dolphins in these and similar coastal areas with comparable geographical corridors.**List of attendees**

|  |  |
| --- | --- |
| **Name** | **University** |
| Abigail Goulding | Exeter |
| Alexis LevengoodAlina Loth | St AndrewsSt Andrews |
| Amanda Stansbury | St Andrews |
| Amy Bishop | Durham |
| Amy Johnson | St Andrews |
| Anikó Szegedi | St Andrews |
| Belinda Tonkins | Bangor University  |
| Ben Goss | St Andrews |
| Braulio Leon-Lopez | St Andrews |
| Brigid McKenna | St Andrews |
| Chloe MalinkaDominique Weilermann | St AndrewsSAMS |
| Eileen Hesse | Aberdeen |
| Enrico Pirotta | Aberdeen |
| Gabriela Alongi | St Andrews |
| Hayley McGeoch | Aberdeen |
| Iris Thomsen | St Andrews |
| Isabel Baker | GMIT, Ireland |
| James Robbins | University College Cork |
| James Stewart | Durham |
| Jeanne Shearer | St Andrews |
| Jessica Torode | Aberdeen |
| Joanna Kershaw | St Andrews |
| Joseph Christopher McKnight | St Andrews |
| Kady Marino | St Andrews |
| Kalliopi Gkikopoulou | St Andrews |
| Katherine Whyte | St Andrews |
| Kathryn Holmes | St Andrews |
| Kayleigh Ann Jones  | Bangor University  |
| Lara Fahey | St Andrews |
| Leticiaà Nadine Alves Legat  | Cumbria |
| Lily Burke | St Andrews |
| Lorant Fabiny | Aberdeen |
| Louise Wilcox | St Andrews |
| Lucia Martin Lopez | St Andrews |
| Maria Zicos | St Andrews |
| Mariel ten Doeschate | Aberdeen |
| Marina Costa | St Andrews |
| Mathilde Huon | Université de La Rochelle, France |
| Monica Arso  | St Andrews |
| Naomi Brannan | Durham |
| Nathaniel Stephenson | St Andrews |
| Nienke VanGeel | SAMS |
| Paméla Valadoux | Aberdeen –Strasbourg (France) |
| Paul Dees | Newcastle  |
| Philippa J. Dell | Exeter |
| Rebecca Boys | Bangor  |
| Rebecca Robotham | Bristol |
| River Foers | Newcastle  |
| Rob Patchett | St Andrews |
| Sahar Izadi | St Andrews |
| Sam Fowler | St Andrews |
| Samantha Alex Gordine | St Andrews |
| Sara Niksic | University of Zagreb |
| Siân Tarrant | St Andrews |
| Skylar LobdellTexa Sim | St AndrewsAberdeen |
| Toby Rosas da Costa Oliver | St Andrews |
| Vanessa Trijoulet | Strathclyde |
| Victoria Warren | St Andrews |
| William Patterson | St Andrews |