Marine Mammal Scientific Support Research Programme MMSS/001/11

MR 5.1 Report
At-sea usage and activity

Executive Summary

Within this task there were six subtasks dealing with different aspects of seal at-sea usage and activity:

MR5.1.1 Produce, publish and maintain seal usage maps with confidence intervals.

The seal usage maps, produced by the Sea Mammal Research Unit, University of St Andrews as a deliverable of Scottish Government Marine Mammal Scientific Support Research Programme MMSS/001/11, were updated to incorporate new data. The report also outlined how the maps can be interpreted and the extent of their limitations with a set of caveats. The Appendix describes methodology and software used.

The report and usage maps (GIS files) are available for download from the Marine Scotland Interactive website (http://www.gov.scot/Topics/marine/science/MSInteractive/Themes/usage).

MR5.1.2 Determine data sparse regions.

The deployment of telemetry tags on UK seals is patchy both in space and time. The data-sparse regions around the UK were identified. This will allow future targeted regional deployments of telemetry tags to improve in the synoptic usage maps produced under MR5.1.1.

The criteria for classifying regions as *data sparse* were defined as:

- No telemetry data have been collected; or
- The underlying population of seals are known to have recently increased significantly, and although telemetry data exist, there is a strong possibility that at-sea distribution may have changed.
- Existing telemetry data is over 10 years old and sample size of telemetry data is unrepresentative of the seal population in an area.

Based on these criteria, recommendations were made about where future tagging effort should be directed.

MR5.1.3 Review the extent of how new survey data affect usage estimates.

Currently (in the MR5.1.1 task) survey count data are averaged over the historical duration of data collection within each 5km cell. Thus recent survey counts in regions that have been frequently surveyed will have lesser influence on the usage maps than recent counts in areas where surveys have not been frequent.

This situation could be improved by modelling recent regional trends in counts, such that predicted maps of usage can be produced at all sites for current or recent years.

MR5.1.4 Classify activity between foraging and travelling usage using a state-space model approach.

From telemetry tags deployed on 63 grey seals and 126 harbour seals behavioural and movement data were used within a Bayesian state-space model (SSM), to define population-level activity budgets around Britain. How time spent in four states (resting on land (hauled out), resting at sea, foraging and travelling) was influenced by seasonal, intrinsic and extrinsic covariates was examined. It was found that a substantial proportion of time was spent resting at sea, when underlying habitat may be of little importance or unrelated to foraging, highlighting the potential problem of using all location data to define habitat preference in seals.

There are two key limitations to this approach. First, it was found that for 20% of the harbour seals, only one diving state was defined. This is likely to be because harbour seals exhibit shorter trips than grey seals, and segments of travelling and foraging are likely to last under 6 hours, which was the interval considered here to

allow the lower resolution Argos data to be included. The second issue is that tidal currents may lead to unreliable movement-based classification of foraging and travelling. Due to the potential magnitude of this problem in areas of high tidal energy, all tags on individuals that spent the majority of time in an area of high tidal energy (e.g. Pentland Firth) were excluded. In task MR5.1.5 (in this Report) two improvements to deal with the above defined limitations were implemented.

MR5.1.5 Determine environmental covariates of preference for all activity, and foraging activity.

Traditionally habitat preference analyses consider all available location data (MR5.1.6). However, habitat preference of seals may differ with activity, e.g. foraging versus travelling. This was investigated for harbour and grey seals in the North Sea, by quantifying habitat preference using (1) all at-sea locations and (2) only foraging locations (defined in task MR5.1.4 in this Report). The following covariates were considered: geodesic distance from haul-out site, depth, winter/spring sea surface temperature (SST) and sediment (percentage gravel, mud and sand); their influence was allowed to vary depending on the sex of the seal.

For grey seals, the covariates retained differed between the models including all locations (overall model) and only foraging locations (foraging model). In addition to geodesic distance, percentage gravel and SST, it was found that depth and percentage mud was also retained in the overall and foraging models, respectively. For harbour seals, all covariates (except percentage sand) were retained in both models. In general, for both species, the shape of the relationship between covariates and usage was similar in the overall and foraging models. Although the spatial predictions of overall and foraging usage were broadly similar in grey seals, there appeared to be more fine resolution variation in the predictions from the foraging model.

For harbour seals, the predictions from the foraging model showed a more restricted range of high coastal usage than from the overall model, especially in the Thames. When modelling habitat preference, considering all locations rather than only foraging locations, appears to be a trade-off because including all locations results in a higher sample size but may result in the masking of some relationships and the retention of covariates which may not actually drive species' distributions. For grey seals, there are some key differences between overall and foraging preference, probably as a result of their relatively long trips and thus spatially distinct travelling and foraging areas. Therefore, the most accurate quantification of foraging preference would result from using only foraging locations. In harbour seals which have much shorter trips and may switch more frequently between foraging and travelling, using overall preference may be more sensible as the higher sample size results in tighter confidence intervals.

MR5.1.6 Determine environmental covariates for usage preference around the UK.

Habitat modelling for UK grey and harbour seals permitted construction of realistic distributions for areas where telemetry data were available, and to predict distributions for areas where direct observations were sparse or absent. Maps were produced for each species, showing habitat preference scaled to population size.

Both grey and harbour seals show a preference for shallower water (consistent with a central-place forager spending much of their time close to the coast). Grey seals prefer tidally stratified areas where the water column remains vertically well-mixed all year. They show preference for the potential between the surface and bottom temperature to be 3.6°C (with a near-bottom year-average temperature of 9.7°C, and show slight preference for substrate with increasing levels of sand (and subsequently decreasing levels of gravel). Harbour seals prefer areas with a near bottom salinity of 33.7 psu and increasing sea-floor slope. Harbour seals spend much of their time close to the coast, where mixing of the water column (that may influence prey distributions) is known to be primarily driven by salinity. Water column mixing, near bottom temperature and salinity, and sediment may all be associated with the distribution and concentration of prey that are utilised by grey or harbour seals.

The methodology will allow predictions based on the current models, e.g. for future scenarios including local seal population change, or changes in environmental variables such as sea temperature. The resulting maps can also be updated when new data become available, including seal telemetry or new environmental data.