MSM4PCoD – incorporating other data sources

Photo-ID for demographic information

While the primary objective of Capture-Recapture is not usually to establish demographic parameters, photo-identification has previously been combined with biopsy data to extract information on population structure from various marine mammal species, including Cuvier’s beaked whale (Curtis et al. 2020). Obtaining information about the age structure and sex ratio of a population provides extra detail which may be used to inform a population model, and potentially reduce uncertainty in estimates of population size. Exploration of the relevance of demographic information for PCOD indicates that there are multiple variables that can be considered within these models. Booth et al. (2020) used a population simulation model to identify how calf ratio and especially the proportion of immature animals in the population, can be used as early indications of population decline. One of the earliest examples of incorporating demographic information into a population model was on Stellar sea lions (Holmes and York 2003). Photographs were used to estimate the number of juveniles within the samples from animal size. An age-structured population model was then fit using pup, non-pup and juvenile fraction data. It was found that using juvenile fraction data for the detection of change in vital rates to be detected with 1 year, versus the 7 years required for population and new-born counts alone. While there are only a few marine mammal-specific examples of this type of integrated population model, simulated datasets also show support for the merging of multiple datastreams (including demographic information) to accurately detect trends within a population (Boyd and Punt 2021).

Telemetry and Capture-Recapture

Currently, few other studies have combined telemetry with capture recapture methods for marine mammals, with the exception of polar bears (Regehr et al. 2018). Despite this, an integrated approach of Capture-Recapture and telemetry is becoming more frequent in terrestrial mammals and bird literature. Murphy et al. (2019) incorporated telemetry information into a capture-recapture model, to inform the model of cryptic activity related to home range. Modelling sex as a partially identifying categorical covariate further improved the precision of population estimates. Recently, tagging of Cuvier’s beaked whale in the Cape Hatteras region revealed that individuals occupy small core use areas, and are infrequently displaced from the region (Foley et al. 2021). Therefore, including home range could help inform a population model for this species, if a capture-recapture model were to be implemented. If sex and age can be estimated from a combination of photo-id and biopsy, perhaps this information could be incorporated as partially identifying categorical covariates. Mark-recapture studies in the terrestrial environment have recently supported the combined efforts of telemetry and photo-id, and it has been hypothesised that will method might be beneficial to localise the activity centre for mobile species (Whittington et al. 2018). This method has been shown to improve the precision of density estimates in other terrestrial mammals, for example in Florida Panthers (Sollmann et al. 2013).

Biopsy and population models with age/sex structure

Biopsy sampling can be used to obtain a wide range of information about an individual, but also about its population and genetic background. Within the navy reports, biopsy samples have been used to better understand population structure (age and sex ratios), as well as in some cases, looking at the genetic components of the individual to determine ecotypes. While the intention for this analysis is expressed, much of the results are not provided within annual reports. This could be the result of the time required to analyse samples, but also perhaps the results from analysis are held until a full report is ready to be published. Booth et al 2020 summarises the potential for remote sampling in its application to MSM4PCoD, whereby biopsy can be used for sex and age ratios, and to better understand reproductive hormone levels. This information can be used to inform a population model where these parameters might otherwise be more generally estimated.

PAM and other time series data

The existence of multiple long-term datasets provides an opportunity to explore an integration of data sources. In the case of PAM, one option is to overlay acoustic information with visual survey data to confirm species detections (Thompson et al. 2015). As you know (Jacobson et al. 2017), combining PAM with aerial visual surveys has also been used to define the detection area of PAM devices, in order to then estimate abundance in harbour porpoise. This information might be relevant for the Hawaii Odontocete Project case study, as acoustic data was collected, although to use real data, we would require more information to establish the number of detections that are available.

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