MSM4PCoD

Proposed work post-scoping workshop

*Task 2: Select suitable metrics for monitoring populations of deep diving odontocetes*

*and large baleen whales using PCoD models that already exist or are currently in development.*

* Develop existing bioenergetics models for beaked whales and pilot whales to identify metrics to be used in Task 3 and develop suitable scenarios for how these might change as a result of disturbance. These scenarios will take account of uncertainty associated with the parameters and structure (e.g. allowing for variation in length at age as a consequence of energy intake) of the bioenergetics models.
* Explore how the bioenergetics model that has been developed for sperm whales (Farmer et al 2018) and the model that is being developed for humpback whales by UC Santa Cruz can be adapted for the same purpose.
* Explore the use of data from tags deployed on Navy ranges to improve modelling of feeding rates before, during and after exposure to sonar, as in Wisniewska et al. 2018, Goldbogen et al 2019, Pirotta et al in prep.

*Task 3: Conduct power analyses to assess the power of these metrics to inform PCoD*

*analyses when collected within existing MSM projects, and determine the effort required to*

*increase this power.*

* **A) Scenario development**Goal: Develop realistic scenarios of effect size, precision/variability and effort/sample size (using current and realistic future single-modality data collection methods) for populations of interest. These scenarios will form the basis of the power calculations.

Scenarios: Long-term declines in abundance and scenarios of changes in demographic parameters provided by Task 2; sudden declines (relevant to early warning detection).

* **B) Power calculations**

Goal: Calculate power for given scenarios using density, demographic parameters and metrics suggested by Task 2

Methods: Monte Carlo simulations using generalised population models for two populations of interest.

* **C) Methods for improving precision of effect estimates**

Goal: Investigate methods for improving precision of parameter estimates (and hence power to detect declines) without greatly increasing spending (i.e., more “bang for the buck”) by combining multiple data sources (e.g. passive acoustic monitoring, telemetry, photo-ID, photogrammetry).

Methods: 1. Review potential for combining data sources to better estimate single parameters – e.g., combining telemetry and photo-ID data in spatial capture-recapture models to estimate survival. 2. Develop an integrated population model (as in Jacobson et al. 2020) for the Cuvier’s beaked whale population at SOCAL and fit this to multiple data sources (e.g. telemetry, photo-ID, passive acoustics) to better estimate parameters and identify efficient monitoring approaches.