MSM4PCOD Task 3C Outline

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2/8/2022

Metapopulations of marine mammals where disturbance and sampling are not uniformly distributed.

How should we collect data to maximize the ability to detect declines?

We propose to investigate this question using a simulation tool (an R package and/or Shiny app). Users could specify study area size and current density (or density surface). We could include options for a mechanistic (i.e., using life-history parameters to run population models) or empirical (i.e., fixed % change over time) The tool could include default settings for different life history types (as in mmrefpoints) The tool would then allow simulation of data collection using different types of surveys (line-transect, mark-recapture, possibly passive acoustic monitoring) with different intensities. Within these eight months, we could simulate a hypothetical population similar to Zc in SoCal as a case study, with the goal of building a framework that can be adapted for any species/region/scenario.

Phase 1: Population model via empirical growth, data generation based on representative CVs, joint trend analysis via linear regression

- Parameters include number of regions with respective carrying capacities, growth rates, and initial population sizes

- Population model is run forward one year at a time according to the number of animals present in each region plus the growth rate for that region
- After growth, animals are redistributed either evenly across all regions OR according to some measure of underlying habitat suitability/attractiveness
- After true population sizes have been simulated in all regions, surveys are simulated
- Could include any number of survey modalities, each with a frequency/inter-survey-interval and CV associated with resulting estimates of abundance
- TO DISCUSS: how to simulate e.g., increasing survey effort (e.g., vary CV according to published CVs for survey and species type?)
- TO DISCUSS: how to handle surveys that happen only in certain regions
- Once data collection is simulated, and trend analysis can be conducted with a linear regression, where all datasets share a trend parameter (note could include option to weight different datasets)
- TO DISCUSS: Power is defined as the proportion of simulated populations/datasets/trend analyses that result in detecting a trend of the same direction (e.g., positive or negative?) or should it be more strict?
- Histogram/density plot of estimated trends would be more informative (where power would just be the proportion of those trends that are on the right side of zero)

Phase 2: Data generation via stage-specific population model, data generation via simulated surveys, trend analysis via integrated population model

- Parameters include the above minus growth rate plus life-history parameters, which may be the same or different across regions
- After growth, juveniles are redistributed across regions
- Surveys are simulated more mechanistically, with animals in fixed points that may or may not be detected by different methods

- Integrated population model utilizes however many data types are collected, with underlying population dynamics model of the same format as used for simulation
- TO DISCUSS: how to incorporate information about age classes in integrated population model, i.e., assume that sampled ratio of juveniles to adults is representative? Something about number of new animals entering the catalog?