Evaluating options for calculating limits to human-caused mortality of marine mammals

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Why a Tier PBR Approach?

To conserve and promote recovery of marine mammal (MM) stocks in U.S. waters, the Marine Mammal Protection Act (MMPA) established a procedure for limiting annual human-caused mortality, known as the Potential Biological Removal (PBR). PBR is calculated for each stock using a formula that includes estimation of minimum abundance (Nmin). Typically, Nmin is derived from a single estimate following a standard approach (Wade 1998); however, data availability varies from a single estimate of abundance (data-poor) to multiple estimates (data-rich), and more data often leads to better (i.e. more precise) estimates. Reduced uncertainty and variability gives management more credibility and makes it more effective. Therefore, it is important to evaluate alternative approaches to calculating PBR, particularly when more than a single abundance estimate is available. Here we propose to do this using Management Strategy Evaluation (MSE).

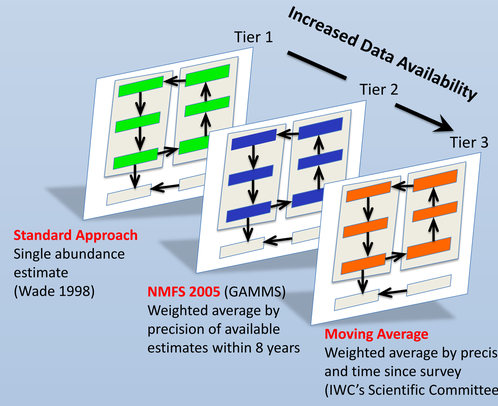
Objectives

- Evaluate the performance of a tier PBR framework relative to the MMPA management objective of recovered populations at or above their optimum sustainable levels
- Investigate whether uncertainty and variability are reduced if PBR calculations incorporate multiple estimates of abundance

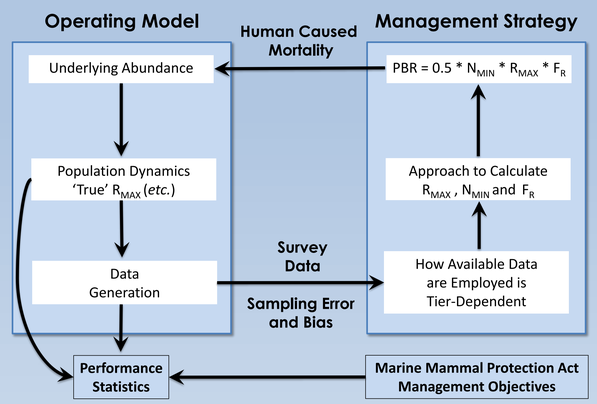
Method

- Each tier represents a given scenario of data availability (e.g., single vs. multiple abundance estimates) and approach to estimate Nmin
- Performance of alternative approaches for calculating PBR is tested against MMPA management objectives through computer simulation (e.g., depletion level after 100 years compared to 50% of carrying capacity)
- Annual variability in PBR for alternative approaches is compared using the average inter-survey variation statistic, which measures the average absolute difference in PBR

Tiered approach

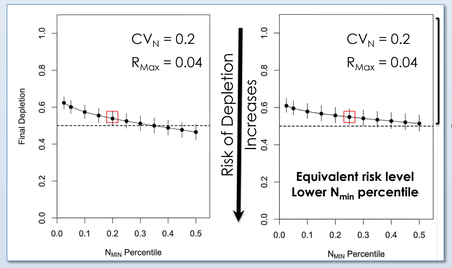


MSE Structure



Tier 1
Single Abundance Estimate (N)

Tier 2
Averaged Abundance Estimates (N)

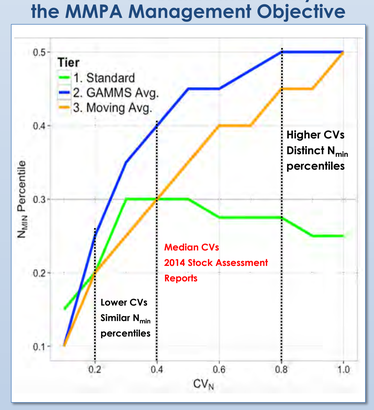


Management Objective:
Population level ≥ 0.5 K

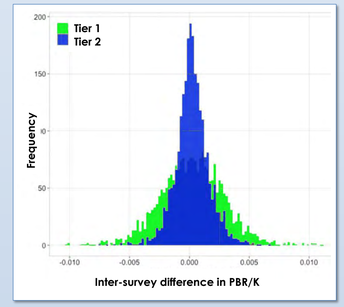
0.5 Carrying Capacity (K)

- **If estimates are imprecise and averaging is used, an N_{min} percentile of 0.2 is conservative (risk-averse)**

Nmin Percentiles that Satisfy the MMPA Management Objective



Temporal Variation in PBR



- **Incorporating additional abundance estimates decreases variability in PBR**
- **Both averaging approaches (Tiers 2 and 3) result in 50-70% reduction in variability, compared to the standard approach (Tier 1)**

Implications

- When abundance estimates are imprecise, both averaging approaches allow a higher Nmin percentile for an equivalent risk of depletion (all else being equal, higher percentile, yields higher PBR)
- The greater stability (i.e. less variability) in PBR over time achieved by both averaging approaches reduces the probability of triggering management measures (e.g. Take Reduction Plans) unnecessarily, especially for near-depleted populations
- This MSE will inform management on the performance of two averaging approaches when multiple estimates of abundance are available for a MM population, thus promoting standardized approaches across U.S. waters

Acknowledgements: