Agenda Item G.4.b
Supplemental NMFS PowerPoint 2
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Potential Biological Removal Management Framework under the Marine Mammal Protection Act

Dr. Lisa T. Ballance[1] and Dr. Jeff E. Moore
Marine Mammal and Turtle Research Division,
Southwest Fisheries Science Center, NOAA, La Jolla, California

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[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

The 1994 Marine Mammal Protection Act (MMPA) reauthorization outlines the required management framework for incidental take of marine mammals in commercial fisheries.

- NOAA Fisheries must establish monitoring (observer) programs to estimate stock-specific mortality and serious injury (M&SI) due to commercial fishing operations.
- "Potential Biological Removal" (PBR) must be calculated for each marine mammal stock.
- If estimated human-caused M&SI (from all sources) exceeds PBR, or if the stock/species is Threatened or Endangered (ESA) it is deemed "strategic".
- For strategic stocks, NOAA Fisheries must develop and implement Take Reduction Plans to reduce incidental fisheries M&SI to a level below PBR.

[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

1. What is Potential Biological Removal (PBR)?

- An upper limit to the level of mortality that would allow a stock to achieve abundance ≥ the Maximum Net Productivity Level (MNPL)*

**Conceptually analogous to MSRA management framework for direct take of commercially-fished species*

- A stock whose abundance is at or above MNPL is referred to as being at "Optimum Sustainable Population" (OSP).
  - ➢ A goal of the MMPA
  - ➢ Assessing stock status relative to OSP is challenging because that determination rests on the ability to estimate abundance relative to K.

- Estimating bycatch and keeping it below PBR is analytically more feasible, more precise, and a more direct way of managing marine mammal stocks and ensuring that they reach/are maintained at OSP.**

***Taylor et al. 2000 Conservation Biology*

[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

2. How is PBR calculated?

$$PBR = 0.5\ R_{max}\ N_{min}\ F_R$$

This equation is defined by the MMPA.

Parameters determined, estimated, or calculated according to NMFS *Guidelines for Assessing Marine Mammal Stocks* (GAMMS)

- NMFS currently follows a second revision, referred to as GAMMS II*.

** NMFS 2005. Revisions to the guidelines for assessing marine mammal stocks. 24pp. Available at: http://www.nmfs.noaa.gov/pr/pdfs/sars/gamms2005.pdf*

[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

$$PBR = 0.5\ R_{max}\ N_{min}\ F_R$$

- Assumes that marine mammal population growth follows a logistic model: MNPL occurs at 0.5 K
- MNPL for marine mammals likely 0.6K - 0.8K (0.5 is precautionary)

Taylor & DeMaster 1993

[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

$$PBR = 0.5\ R_{max}\ N_{min}\ F_R$$

Maximum potential population growth rate

- May be estimated for individual stocks
- Default = 0.04 for cetaceans, 0.12 for pinnipeds

Wade 1998

[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

$$PBR = 0.5\ R_{max}\ N_{min}\ F_R$$

Minimum estimate of abundance

- Defined as the value at the 20th percentile of the distribution of estimated abundance*

**Typically obtained from surveys (remember for later)*

Why the 20th percentile?

- Shown through simulations to provide a high level of confidence that management objectives can be achieved in spite of uncertainty in parameters used to estimate abundance**

***Wade 1998*

[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

$$PBR = 0.5\ R_{max}\ N_{min}\ F_R$$

Recovery Factor

- Used as a conservative buffer against various plausible biases or assumption violations
- Range: 0.1 – 1.0
  - o Default = 0.5
  - o = 0.1 – 0.3 for Endangered Species (depending on estimated abundance)

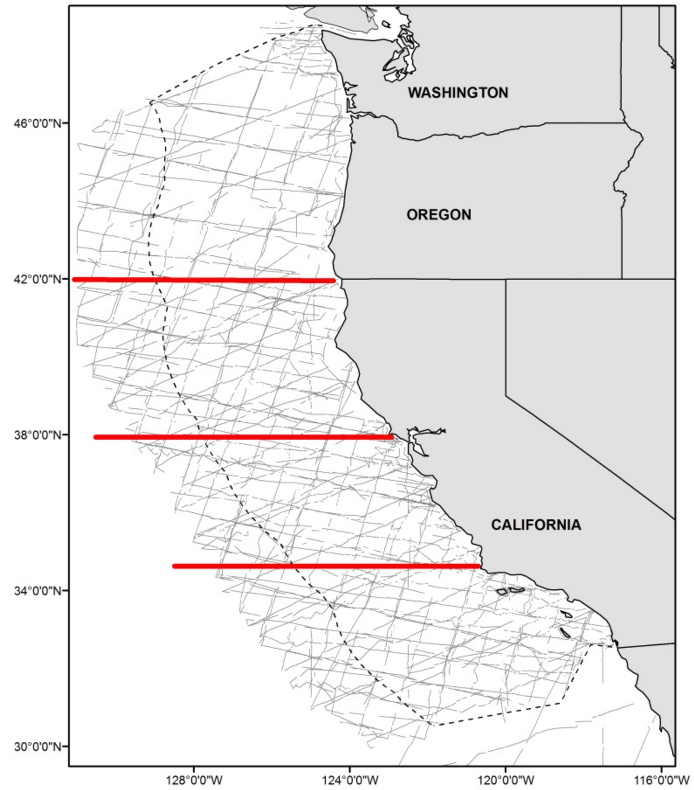
Wade 1998

[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

3. How is abundance (N_{min}) estimated?

- For most cetacean stocks, we conduct periodic line-transect surveys aboard NOAA research vessels and estimate abundance using distance-sampling methods.

- Such surveys have been conducted seven times in the U.S. EEZ portion of the California Current since 1991 (including one occurring right now).



[1]Division Chief, Lisa.Ballance@noaa.gov
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Abundance Estimation:

- Aerial surveys and distance sampling methods (harbor porpoises) or pup counts (pinnipeds)
- Small-boat surveys and mark-recapture methods (coastal bottlenose dolphins, blue whales)
- Shore-based surveys (eastern north Pacific gray whales)

[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

- Traditionally, NOAA Fisheries has used the most recent survey abundance estimate for each stock, or an average estimate from the two most recent surveys.

- We are moving toward using trend-based models that use information from all past abundance surveys to estimate current abundance.

    - These estimates are generally more precise and more consistent through time (less prone to random sampling errors).

    - To date: fin, beaked, sperm whales (US EEZ – CA Current)

[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

4. Example: Sperm whales

$$PBR = 0.5\ R_{max}\ N_{min}\ F_R$$

$$PBR = 0.5\ (0.04)\ N_{min}\ (0.1)$$

Conventional approach: N_{min} based on average estimate of abundance from two most recent surveys

Year	N	N_{min}
2005	3140 (CV = 0.4)	
2008	300 (CV = 0.51)	
Average	971 (CV = 0.31)	751

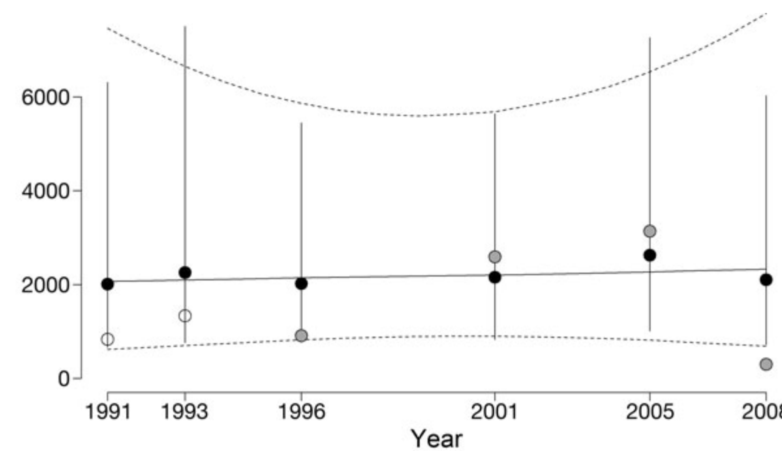
[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

$PBR = 0.5\ R_{max}\ N_{min}\ F_R$

$PBR = 0.5\ (0.04)\ N_{min}\ (0.1)$

Model-based approach: N_{min} based on estimates of abundance from all previous surveys and Bayesian methods

$N_{min}(2008) = 1332$



Moore & Barlow. In Press. Endangered Species Research.

[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

$$PBR = 0.5\ R_{max}\ N_{min}\ F_R$$

Conventional Approach $\quad PBR = 0.5\ (0.04)\ (751)\ (0.1) = 1.5$

Model-based Approach $\quad PBR = 0.5\ (0.04)\ (1332)\ (0.1) = 2.7$

[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

5. Estimating bycatch and comparing to PBR

Conventionally (following GAMMS recommendations) NOAA Fisheries has used running 5-year averages to estimate bycatch. **Why?**

- Annual bycatch estimates are variable (due to variation in true values and estimation uncertainty).
- MMPA management objectives depend on long-term average annual bycatch being below PBR.
- Pooling bycatch estimates across multiple years provides a more precise measure (especially for species caught infrequently).
- This also helps reduce management volatility.

[1]Division Chief, Lisa.Ballance@noaa.gov
jeff.e.moore@noaa.gov

Example: Sperm whales

Estimated bycatch for the drift gillnet fishery

Year	Observer coverage %	Observed M&SI	Estimated M&SI
2006	19%	0	0
2007	16%	0	0
2008	14%	0	0
2009	13%	0	0
2010	12%	2	16
Average			3.8

$PBR = 0.5\ R_{max}\ N_{min}\ F_R$

$= 2.7$

(model-based approach)

[1]Division Chief, Lisa.Ballance@noaa.gov
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For stocks for which bycatch is a rare event (e.g., sperm whales), NOAA Fisheries is moving toward pooling additional years of data or taking a model-based approach to estimate annual average bycatch. **Why?**

- To improve precision and reduce bias in the bycatch estimate

Characteristics of the drift gillnet fishery have been relatively stable since 2001. Therefore, pooling bycatch data since 2001 provides a more precise bycatch estimate.*

- = 1.3 for sperm whales*
- PBR = 2.7
- These changes are reflected in the most recent draft Stock Assessment Report for sperm whales.

**Carretta & Moore. 2014. NOAA Technical Memorandum*.

[1]Division Chief, Lisa.Ballance@noaa.gov
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6. Take Reduction Teams and Plans (TRTs and TRPs)

- Coordinated by Regional Offices (not Science Centers)

- One TRT for cetaceans of the U.S. West Coast: **Pacific Offshore Cetacean TRT**
    - principally bycatch of cetaceans in the CA Large Mesh drift gillnet fishery

- TRTs composed of individuals from fishing industry, management councils, U.S. Marine Mammal Commission, NOAA, coastal states, academia, and environmental organizations

- TRTs develop plans (TRPs) to minimize mortality and serious injury through consensus-based measures (voluntary + regulatory)

- Goal is to immediately reduce fisheries mortality to below PBR and to reduce it to < 10% PBR in the long-term (this is referred to as the Zero Mortality Rate Goal, ZMRG)

[1]Division Chief, Lisa.Ballance@noaa.gov
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GAMMS, Stock Assessment Reports, Publications, Contact Information available at https://swfsc.noaa.gov/mmtd/