Stock Assessment Overview

- Marine Mammal Protection Act
- Structure of Stock Assessment Reports (SARs)
- PBR (Potential Biological Removal)
- Assessment Research Methods
- Overview of 2009 False Killer Whale SAR
MMPA Amendments of 1994
Taylor et al. 2000, Conservation Biology 14: 1243-1252

- MMPA of 1972 required extensive data that could not be obtained for most stocks.
- 1988: Congress recognized that system not working
- 1994 amendments work with the type of data we can actually get.
- Designed to account for uncertainty in assessment data
- Potential Biological Removal (PBR) approach identifies stocks that may have unsustainable human-caused impacts (=‘strategic’ stocks)
- Allows management to identify potential problems and focus on species & fisheries with greatest likelihood of adverse impacts.
- Marine Mammal Stock Assessment Reports published annually

MMPA, Sec. 117- Stock Assessment Reports

Sec. 117. (a) Each draft stock assessment, based on the best scientific information available, shall—

(1) describe the geographic range...

(2) provide the minimum population estimate, net productivity rates, and current population trend...

(3) estimate the annual human-caused mortality and serious injury of the stock by source and, for a strategic stock, other factors...including effects on marine mammal habitat and prey;

(4) describe commercial fisheries that interact with the stock...

(5) categorize the status of the stock... [Strategic/not strategic]

(6) estimate the potential biological removal level for the stock...
MMPA, Definitions

The term "potential biological removal level" means the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.

The potential biological removal level is the product of the following factors:

(A) The minimum population estimate of the stock.

(B) One-half the maximum theoretical or estimated net productivity rate of the stock at a small population size.

(C) A recovery factor of between 0.1 and 1.0.

\[ PBR = N_{\text{min}} \times \frac{1}{2} R_{\text{max}} \times F_r \]

Working out the details...


- **September 2003: Guidelines for Assessing Marine Mammal Stocks II (GAMMS II) Workshop** ([NMFS 2005, 70 FR 35397 June 20, 2005])

Revisions to Guidelines for Assessing Marine Mammal Stocks (GAMMS II) NMFS 20005

The MMPA... 
... defines the **minimum abundance estimate** as "...an estimate of the number of animals in a stock that—

(A) is based on the best available scientific information on abundance, incorporating the precision and variability associated with such information; and

(B) provides reasonable assurance that the stock size is equal to or greater than the estimate."

The Stock Assessment Guidelines... 
... define the minimum abundance estimate ($N_{\text{min}}$) as either

- a direct count (e.g. seals on land), or

- the lower 20th percentile of a statistical abundance estimate

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**Net Productivity Rate ($R_{\text{max}}$)**

\[ \text{PBR} = N_{\text{min}} \times \frac{1}{2} R_{\text{max}} \times F_r \]

The MMPA... 
... defines the population growth rate, or **net productivity rate** as "...the annual per capita rate of increase in a stock resulting from additions due to reproduction, less losses due to mortality."

The Stock Assessment Guidelines: 

In the absence of stock-specific measured values, use defaults for the net productivity rate ($R_{\text{max}}$):

- 4% for whales, dolphins, porpoises, and manatees
- 12% for seals, sea lions, and sea otters
The MMPA...

... defines the recovery factor as "between 0.1 to 1.0"

The intent of Congress was to ensure the recovery of populations to their optimum levels, and to ensure that the time necessary for populations listed as endangered, threatened, and depleted to recover was not significantly increased.

The Stock Assessment Guidelines:

Set the default recovery factors as follows:

- 0.1-0.3 for endangered species or stocks known to be declining
- 0.4-0.5 for threatened or depleted species, and for stocks of unknown status
- up to 1.0 for stocks known to be at optimum levels, or of unknown status but known to be increasing

Stock Assessment

The MMPA...

... requires comparison of estimated human-caused mortality and serious injury (M&SI) to the PBR.

To reduce variation in annual estimates, guidelines suggest comparing 5-yr average annual M&SI.

| If M&SI > PBR → Strategic stock |
| If M&SI ≤ PBR → Not a strategic stock |

Example: PBR = 5000 * 0.02 * 0.5 = 50 animals per year

Estimated M&SI: 12 animals per year

→ Not strategic
Established Stock Assessment Process

- Designed to achieve MMPA goals using the type and quality of data we can obtain.
- Provides default values for estimates that are difficult or impossible to obtain ($R_{\text{max}}$)
- Takes into account uncertainties in data (e.g. inaccurate or imprecise estimates of abundance, mortality)
- Provides incentive to obtain better data
- Mechanism (TRT) for finding collaborative solutions when takes are unsustainable

Questions?
Assessment Research Methods

- Abundance & Trends
- Stock Structure
- Human-caused mortality and serious injury

Abundance and Trends: Common methods of monitoring marine mammal populations

- Shipboard visual & acoustic line-transect surveys
- Aerial line-transect surveys
- Small boat based photo-identification studies
**Ship-based, Visual Line-transect Survey**

- **Reticles (distance)**
  - 25X "Big Eye" binoculars

- **Data Recorder (7X Binos)**

**Transect Surveys**

- Established survey methods (since 1986).
- Advanced analytical techniques including correction for missed animals.
- Peer-reviewed and published in scientific journals and reports.

**HICEAS 2002**
- 5-month survey
- 19,700 km

**PICEAS 2005**
- 3-month survey
- 11,100 km

Johnston Atoll
Palmyra Atoll
Hawaiian Islands
Howland & Baker Is
Aerial Survey Methods

- Distance sampling (line/strip transect)
- Good to fair weather conditions (BF0-4, mostly clear skies)

Transect Surveys

- **Strip Transect**
  - Seabirds
- **Line Transect**
  - Marine Mammals

\[
D = \frac{n \times s}{L \times 2w}
\]

- D = Density
- n = number of sightings
- s = average group size
- L = length of transect
- w = effective strip width

*Buckland et al. 1993*
Survey 1:  
M = marked

Survey 2:  
C = captured  
R = recaptured

\[ N = \frac{M \cdot C}{R} \]

\[ 45 = \frac{12 \cdot 15}{4} \]

✓ Sampling considerations

Comparison of Methods

- **Ship surveys**
  - Pros:
    - Large scale
    - Two detection modes
    - In situ environmental data
  - Cons:
    - Expensive
    - Poor seasonal coverage

- **Aerial survey**
  - Pros:
    - Broad seasonal coverage
    - Historic data
    - Variety of scales
    - Cost-effective?
  - Cons:
    - Weather-dependent
    - No environmental data

- **Small boat surveys**
  - Pros:
    - Broad seasonal coverage
    - Fine scale
    - Opportunity for other studies
  - Cons:
    - Small study area
    - Limited detection capability
**Stock Identification tools**

- Distribution
- Movements
- Population trends
- Genetic differences
- Morphological differences
- Life history
- Contaminant loads
- Natural isotope ratios
- Parasite differences
- Habitat differences

**Evaluating genetic structure**

Haplotype $A = ATGC\ldots AAAAGC$
Haplotype $B = ATGC\ldots AAAAAAGC$

- 25 samples
- 5 samples

*Hawaii*
*Mexico*
*California*
Stock Identification

• Must be aware of localized impacts

• Even though distribution may appear continuous, localized reductions may eliminate undetected or result in reduction in range

“In particular, where mortality is greater than a PBR calculated from the abundance just within the oceanographic region where the human-caused mortality occurs, serious consideration should be given to identifying an appropriate management unit in this region.”

- NMFS 2005
Case Study:
Harbor Porpoise
*Phocoena phocoena*

*Continuous distribution in coastal temperate waters of northern hemisphere*

- **Puget Sound:** Harbor porpoise were abundant prior to ~1940s. Extensive gillnet fishing activity (unmonitored). In recent decades harbor porpoise are rare. No recolonization from waterways to north.

- **Baltic Sea:** Harbor porpoise have been virtually eliminated by fishery bycatch (documented). No recolonization from adjacent North Sea.

Stocks that Span International Boundaries

- Ideally manage entire range of population through international agreements.
- If have bycatch estimates and abundance estimates throughout range, manage based on PBR for whole stock.
- For false killer whales, we do not have abundance estimates outside of US waters.
  - Estimate PBR based on portion of stock in US waters.
  - Estimate bycatch within US waters.
Assessing human-caused mortalities and serious injuries

MMPA, Sec. 117. (a) (3):
Each draft stock assessment, based on the best scientific information available, shall estimate the annual human-caused mortality and serious injury of the stock by source...

**Human-caused mortality & injury sources:**
- Incidental fishery takes
- Ship strikes
- Power plants
- Illegal shooting
- Research mortalities
- Naval exercises
- Other...
Sources of information

- Self-reports by fishermen (required by MMPA)
- Strandings (rarely observed, biased)
- At-sea reports (ship strikes, sightings)
- On-board observer programs:
  - Document marine mammal takes on sampled trips
  - Trained in species identification
  - Can collect biological samples
  - Record mortalities / injuries
  - Forms designed to collect data to distinguish serious vs. not serious injuries.
  - Collect additional data on the nature of marine mammal interactions with gear

Photo: NOAA-PIRO Observer Program

Estimating annual takes of marine mammals in fisheries

- Based on a sample of all fishing trips, extrapolated to rest of fleet
- Simplified conceptual overview:

  "50 Trips"

  10 Observed (20%):
  1 with a take
  9 with no take

  → 1 take per 10 trips
  (rate = 0.1)

  For all 50 trips:
  50 * 0.1 = 5 estimated takes
  (observed and unobserved)
Assumptions and additional estimation steps

- Simple method assumes sampled trips are representative of unsampled trips.

- Actual calculations are more complex to adjust for potential uneven sampling, season, area, and numbers of marine mammals killed or seriously injured vs. not seriously injured...

- Need to...
  ...Differentiate species and stocks
  ...Differentiate serious from non-serious injuries

Attributing takes by stock

Attribution methods
- Geographic
- Genetics
- Seasonal (e.g. Atlantic bottlenose dolphin)
- Prorating
- Individual identification
Serious Injury Determination
Takes = Mortalities and Serious Injuries

Serious Injury = “Any injury that will likely result in mortality” (NMFS, 50 CFR 229.2)

- **April 1997:** Serious Injury Workshop (Angliss and DeMaster 1998, NOAA Tech Memo NMFS-OPR-13)
- **September 2007:** Serious Injury Technical Workshop (Andersen et al. 2008, NOAA Tech Memo NMFS-OPR-39)

Serious Injury Determination Guidelines

1997 Workshop (Angliss and DeMaster 1998)

- Marine mammal, fishery, and veterinary experts
- Serious injuries: impair feeding or locomotion
- Key recommendations relevant to longline fishery:
  - **Serious:**
    - Hooked internally (mouth, ingested)
    - Released with substantial gear attached
    - Swimming abnormally
  - **Not serious:**
    - Hooked externally (body, fluke)
    - Released with no or minimal gear
Serious injury determination

- Contact interaction
  - Entangled
    - Disentangled
      - No impairment of locomotion/feeding
        - Not serious injury
  - Hooked
    - Gear attached
    - External
    - Internal
      - Impairment of locomotion/feeding
        - Serious injury

Updated Serious Injury Determination Guidelines

2007 Serious Injury Technical Workshop Report
(Andersen et al. 2008)

- Broadly reaffirmed previous determinations
- Clarified 'Substantial gear' = gear wrapped or with potential to wrap around appendages, beak, or head
- Should consider length of 'confinement' (capture myopathy = severe muscle tissue damage)
- Developed table with injury types to guide process
Serious Injury Determination - Examples

False killer whale hooked in fluke, line cut with only 1 ft of line and hook attached. Not in head area, cannot wrap around appendages or head, swimming actively. Therefore, animal is not seriously injured.

False killer whale hooked in mouth. Mouth/head hookings are considered serious for dolphins and small whales because this impairs feeding. Therefore, animal is seriously injured.

Photos: NOAA PIRO Observer Program

False Killer Whale Draft 2009 SAR overview

HI Insular Stock:
- Abundance:
  - Nbest = 123
  - Nmin = 76
  - PBR = 0.8/yr
  - Bycatch = None documented
- Status: Not strategic

HI Pelagic Stock:
- Abundance:
  - Nbest = 484
  - Nmin = 249
  - PBR = 2.5/yr
  - Bycatch = 7.4/yr
- Status: Strategic

Palmyra Stock:
- Abundance:
  - Nbest = 1329
  - Nmin = 806
  - PBR = 6.4/yr
  - Bycatch = 0.3/yr
- Status: Not strategic

High Seas & Johnston Atoll: (no SAR)
- Abundance:
  - Nbest = 906
  - Nmin = 539
  - PBR = 5.2/yr
  - Bycatch = 5.4/yr
- Status: (Strategic)
Questions?

Back Pocket Slides
Transboundary Stocks Example

<table>
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<th>All waters, All fleets</th>
<th>Intl waters, US fleet</th>
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<td>500</td>
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<tr>
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<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>M&amp;S I</td>
<td>3</td>
<td>9</td>
<td>1</td>
</tr>
</tbody>
</table>

PBR = 5; M&S I = 4

U.S. EEZ                Foreign/International waters