



# Gulf of Maine Research Institute

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Dealing with uncertainty in stock  
assessments:  
Impacts of climate change

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9 November 2012

# What we've observed

- Water temps in GoM increased by 5 F in 2012
- Reductions in key plankton species – Calanus by 80% - herring, right whales, cod, haddock
- Shifts in spatial and temporal distribution of fish species, e.g. red hake, cod
- Changes in biology? – growth, reproduction, etc.?
- Regime shift?

# Impacts on stock assessments

- How do we account for the (largely unknown) impacts of climate change on stock assessments?
- What are the impacts on:
  - biological reference points, both B and F? – based on current and past data –will they need to change?
  - Stock status?– One thing we do know is that climate change impacts are likely to add additional uncertainty to projections of future stock status

# Dealing with uncertainty

Management Strategy Evaluation (MSE) aka Management Procedures (MPs)

- Provide a way to make decisions that are based on objectives and can be evaluated against possible futures
- Take advantage of different perceptions of stock status – catches will increase when the stock goes up and conversely decrease when the stock goes down

# Advantages of MSE/MPs

- Provides a better chance of achieving management objectives (pre-testing to identify robust strategies) with pre-agreed data.
- Designed to achieve an agreed balance between competing management objectives.
- Designed to be robust to current scientific uncertainty.
- Demonstrates to the community that you are managing responsibly.

# Challenges with Implementation

- There are technical challenges in actually developing and testing an Operating Model and Decision Rule.
- Scientists and managers are required to make a number of decisions and choices related to:
  - The management objective
  - Choice of Decision Rules
  - Adjustment of Decision Rule re catch and rebuilding priorities
- Each decision involves trade-offs between catch and risk to the stock.

# Elements of an MSE/MP

1. Clearly defined set of management objectives
2. Measurable performance indicators related to each management objective
3. Harvest strategy, e.g. a set of rules for making decisions about management measures given certain data
4. A process for evaluating the likely performance of a harvest strategy

# Indicators and reference points

## Conservation of the stock, e.g.

- Recent trends in biomass
- Projections of future biomass
- Recruitment trends
- Fishing mortality rates

## Utilization objectives

- Catch trends over time
- Frequency of changes in ACLs
- Extent of change in ACLs

# Decision Rules

## Desirable characteristics

- Robust to uncertainties in the stock assessment
- Understandable
- Based on readily measured values from available data
- Readily identifies 'good' or 'bad' stock conditions

# Decision Rules

## Desirable characteristics (2)

- Relates directly or indirectly to some value over which management has some control
- Provides for reliable performance relative to specified management objectives
- Has a high likelihood of achieving the management objective
- Example: Rebuild stock to target B by year xxxx with a yy% probability (additional complexity can be added)

Plots of the spawning biomass and catch for the re-tuned CMP\_2 procedure. The “4” tuning level ensures that there is a 10% probability that  $B_{2022} < B_{2004}$ . The “7” tuning level is the 20% probability that  $B_{2022} < B_{2004}$ . The “e” catch schedule is based on a catch reduction in 2007 that produces an equivalent effect on  $B_{2014:2004}$  to a 5000t catch reduction in 2006.

