

Science, management, uncertainty & risk: Experiences from New England

Jake Kritzer, Ph.D.
NEFMC SSC

Fisheries Leadership and Sustainability Forum
Beaufort, NC
May 11-13, 2010



Overview

- Preamble.
- Why have buffers? Underfishing vs. overfishing.
- General comments on management uncertainty.
 - Monitoring.
 - Input vs. output controls.
 - Responsiveness of the fleet.
- Types of scientific uncertainty.
- What's missing?
 - Demographic structure: Atlantic cod
 - Habitat effects: Southern New England winter flounder
- Blurred lines between science and management?
 - Management without science?: Atlantic herring
 - Science doing management?: Sea scallop, part I
 - Single-species science, ecosystem-based management?: Sea scallop, part II
- Closing remarks.

Preamble

- Caveat: For two years, NEFMC has tasked its SSC with a heavy workload comprised of one narrow task: Setting ABCs.
 - No input on management uncertainty.
 - Contrasts Rosenberg and Sandifer's (2005) multi-faceted view on the role of SSCs.
 - SSC has taken initiative on other issues, e.g., EBFM.
- Thoughts beyond ABC advice to date:
 - Need to look more closely at scientific uncertainty?
 - Taking on responsibilities of management (risk).
 - Removed from key science/management issues beyond ABC.

Underfishing vs Overfishing

- If we're catching too few fish, we can fix that problem at any time and immediately, as soon as we learn more about stock dynamics.
 - I.e., the “fix” is in our hands → investment in science and management.

But,

- If we're catching too many fish, we can pay for that problem for years while we wait for biology to unfold.
 - I.e., the “fix” is out of our hands → growth, maturation, spawning, recruitment.

General comments on management uncertainty

- Monitoring reduces uncertainty (also reduces scientific uncertainty in the longer term).
- Input controls are more uncertain than output controls...
- ...and catch shares improve output-based management even further (Essington 2010)...
 - Implications for scientific uncertainty as well?
- Responsiveness of the fleet to stock status and ability to implement adaptive management are underappreciated.



Scientific uncertainty

“True” scientific uncertainty

vs.

Biological/ecological uncertainty

Assessment

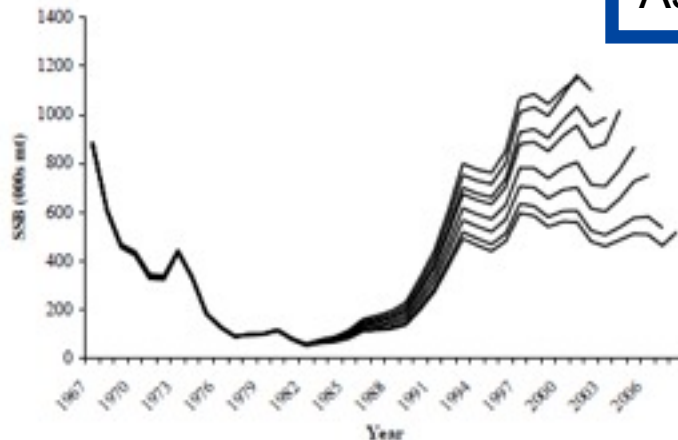
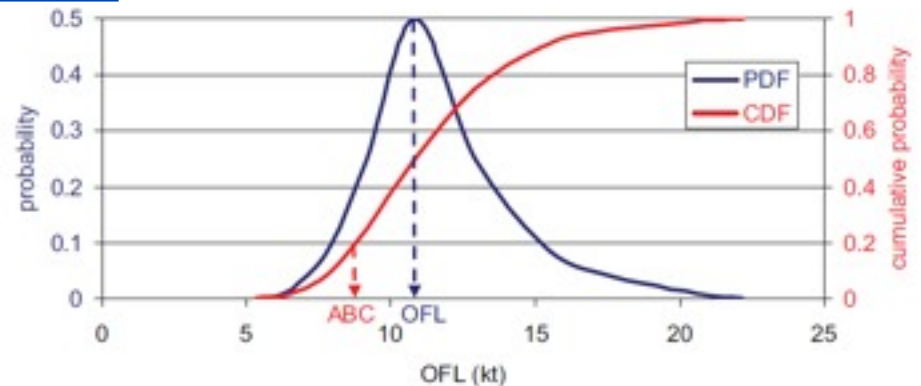


Figure 2. Retrospective pattern of Gulf of Maine/Georges Bank Atlantic herring spawning stock biomass.



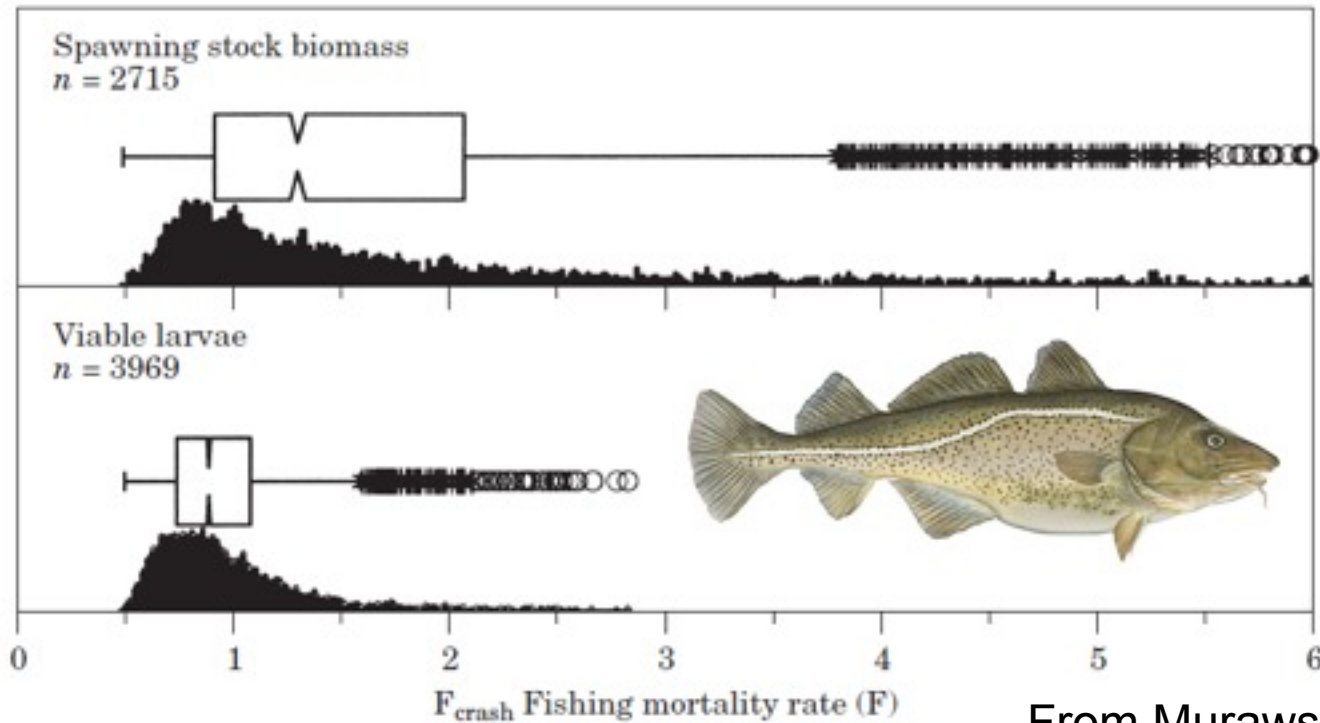
Appendix VI, Figure 1. Distribution of projected catch associated with overfishing (OFL) and an example of Acceptable Biological Catch (ABC) based on a 10% risk of overfishing ($p^*=0.1$).

- Model specification error.
- How well do we understand stock dynamics?
- Dealt with by buffers in the near term + scientific investment in the longer term.
- Probabilistic approach
- What will happen in the future?
 - Stochastic biology/ecology (primarily recruitment)
- Can't control, so dealt with only by buffers (but Essington 2010?).

What's missing?

- Model specification error is evaluated by retrospective analysis and/or sensitivity analysis.
- These only account for errors and imperfections in underlying math, input parameters and data sets.
- Errors in outputs could be due to biology and ecology not considered by the model:
 - Inter-specific interactions.
 - Spatial structure.
 - Demographic structure.
 - Habitat effects.

What's missing?: Atlantic cod

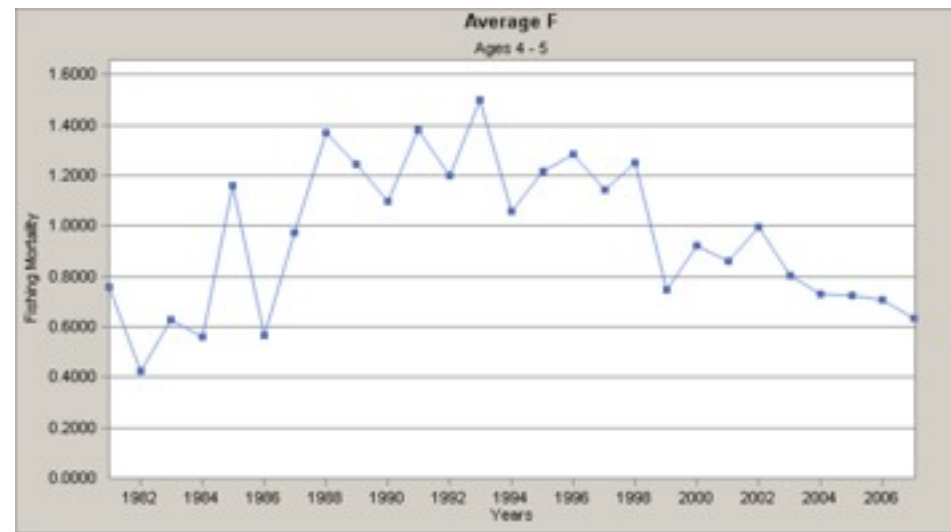
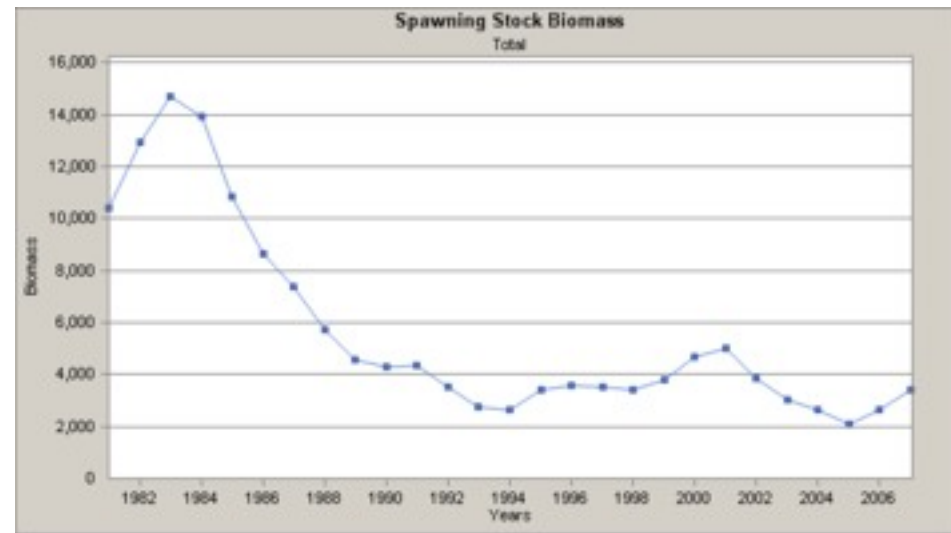
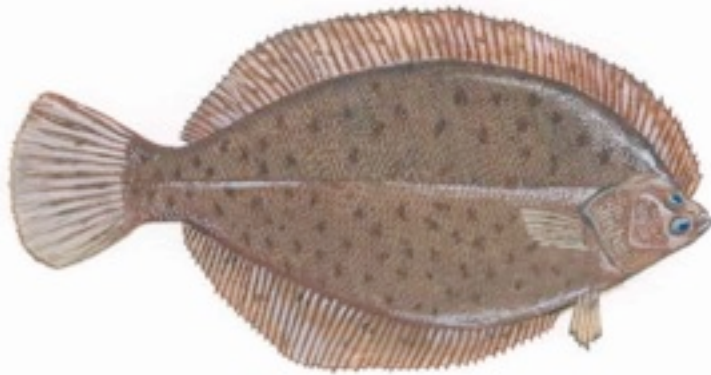


From Murawski et al. 2001

- Cod assessments with and without age-specific reproductive success give very different BRPs.
- Need to assess on the basis of viable eggs and/or larvae.
- Set management targets for age and size structure.
- Potential for fishing-induced evolution? Build into models?

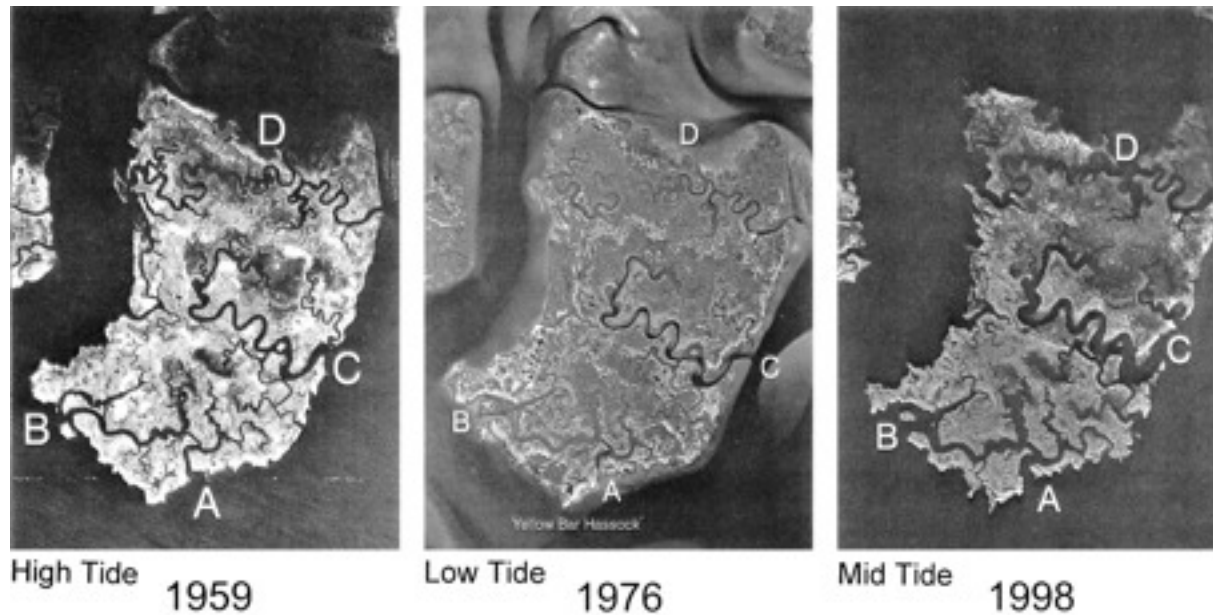
What's missing?: SNE winter flounder

- Drastic decline in biomass since early 1980's.
- No sign of recovery despite large reduction in F.



Terceiro 2008

What's missing?: SNE winter flounder



Hartig et al. 2002

- More dependent upon nearshore and estuarine habitats than any other groundfish species.
- Long-term degradation of these habitats not accounted for (e.g., 37% loss of Jamaica Bay salt marshes since mid-70s).
- Build into models? Track status as basis for adjusting buffers?

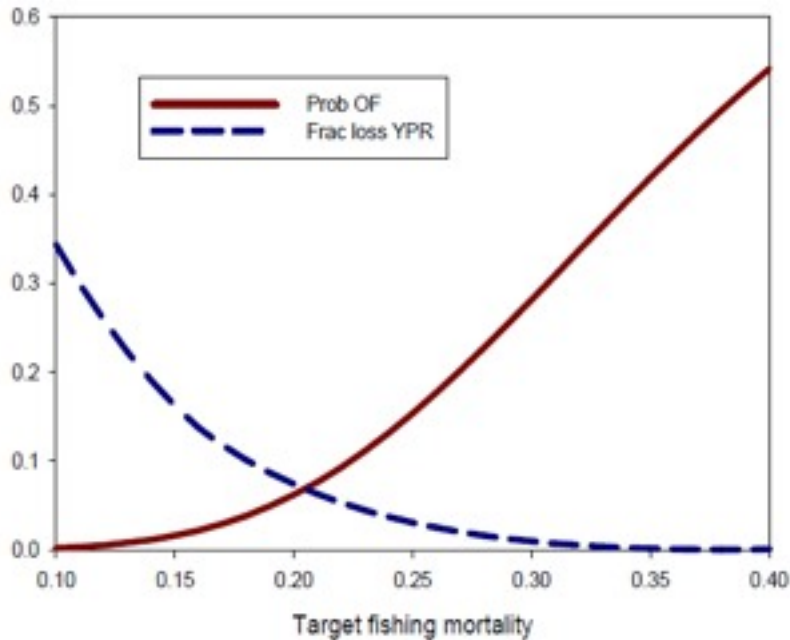
Management without science?: Atlantic herring



Atlantic Herring

- Sept. 2009:
 - Original ABC of 90,00mt based on magnitude of large retrospective pattern.
 - Concerns about spatial structure raised, but not explicitly accounted for in models or buffers.
 - NEFMC asks SSC to reconsider.
 - PDT begins developing specs.
 - Nov. 2009:
 - SSC provides ABC options of 90K, 106K & 108K based on recent average catch over 1, 3 & 5 years.
 - Jan. 2010:
 - Council adopts middle value (106K).
 - Adds all additional ACL to Area 2.
- Spatial management without spatial ecology: Implications for metapopulation dynamics?

Science doing management?: Sea scallop, part I



- Feb. 2009:
 - SSC asks PDT for more quantitative evaluation of uncertainty.
- Aug. 2009:
 - PDT present new analysis and proposes F with 25% prob. overfishing + 1% loss of yield.
- Sept. 2009:
 - SSC provides ABCs to Council with 25% probability of overfishing, plus 20% and 30% for illustration.
 - Council adopts 25% option.



Single-species science, ecosystem-based management?: Sea scallop, part II

- TORs from NEFMC to SSC, July 2009:

“...review updated quantitative analyses of uncertainty of OFL...[and]...identify ABC for the 2010 fishing year.”

- SSC report to NEFMC, Sept. 2009:

“The SSC recommends that Acceptable Biological Catch of scallops in 2010 should be 29,578 mt [$F=0.29$; 57,785,854 lbs] for the overall fishery.”

- MA DMF letter to NMFS, Dec. 2, 2009

“...we conclude that the Council did not defer to PDT/SSC findings; consequently, 2010 DAS are far too restrictive...”

- FW 21 Executive Summary, Dec. 18, 2009:

“...the proposed action also has lower area swept projections, which has implications for expected impacts on bycatch, sea turtles and EFH. Several Council members cited this as another reason they supported $F=0.20$ [41,510,840 lbs] compared to $F=0.24$...”

- NMFS response, Dec. 21, 2009:

“...Framework 21...includes an ABC of 29,578 mt.”

Concluding remarks

- Setting TOR for assessments is key to ensuring needed information is in hand.
- SSCs need to be asked for, or simply offer, advice on key issues beyond TOR to better inform management.
- No clear distinction between scientific and management issues/uncertainty, or just not clearly defined?
- “Socio-ecological systems” (SESs) as the integration of natural and social sciences, and the unification of scientific and management uncertainty?