New England Fishery Management Council

# Evaluation of ABC Control Rules in New England

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Scientific & Statistical Committee

# Terms of Reference

1. Review ABC control rules or methods for deriving ABC in each FMP with respect to their expected performance for avoiding overfishing (i.e., conformance with the Act)
2. Identify the information needed to develop ABC control rules that account for scientific uncertainty in OFL and the Council's desired risk tolerance (i.e., conformance with guidelines).

# ABC Control Rules in New England

- General Approaches (2007 MSA and 2009 guidelines)
  - Probablistic approach (NS1 guidelines)
  - Rebuilding ABCs (NS1 guidelines)
  - Ad hoc ABC methods
  - Data-Poor interim ABCs
- ABCs for New England Fisheries (SSC Reports)
- ABC control rules in other regions (National SSC and Duke reports)
- SSC Discussion

# The Act

- The 2007 reauthorization of the Magnuson Act :
  - "*Each Council shall, in accordance with the provisions of this Act… develop* ***annual catch limits*** *for each of its managed fisheries that may not exceed the fishing level* ***recommendations of its scientific and statistical committee*** *or the peer review process*" and
  - "*Any fishery management plan which is prepared by any Council, or by the Secretary, with respect to any fishery, shall … establish a mechanism for* ***specifying annual catch limits*** *in the plan (including a multiyear plan), implementing regulations, or annual specifications, at a level* ***such that overfishing does not occur*** *in the fishery, including measures to ensure accountability*"

# Guidelines (2009)

- **Acceptable Biological Catch (ABC) should be based on an ABC control rule**, which is a "*specified approach to setting the ABC for a stock or stock complex as a function of the scientific uncertainty in the estimate of OFL* (Overfishing Limit) *and any other scientific uncertainty*"; and
- "*Councils must build into the reference points and control rules* ***appropriate consideration of risk****, taking into account uncertainties in estimating harvest, stock conditions, life history parameters, or the effects of environmental factors*."

# ‘ABC Methods’ in New England

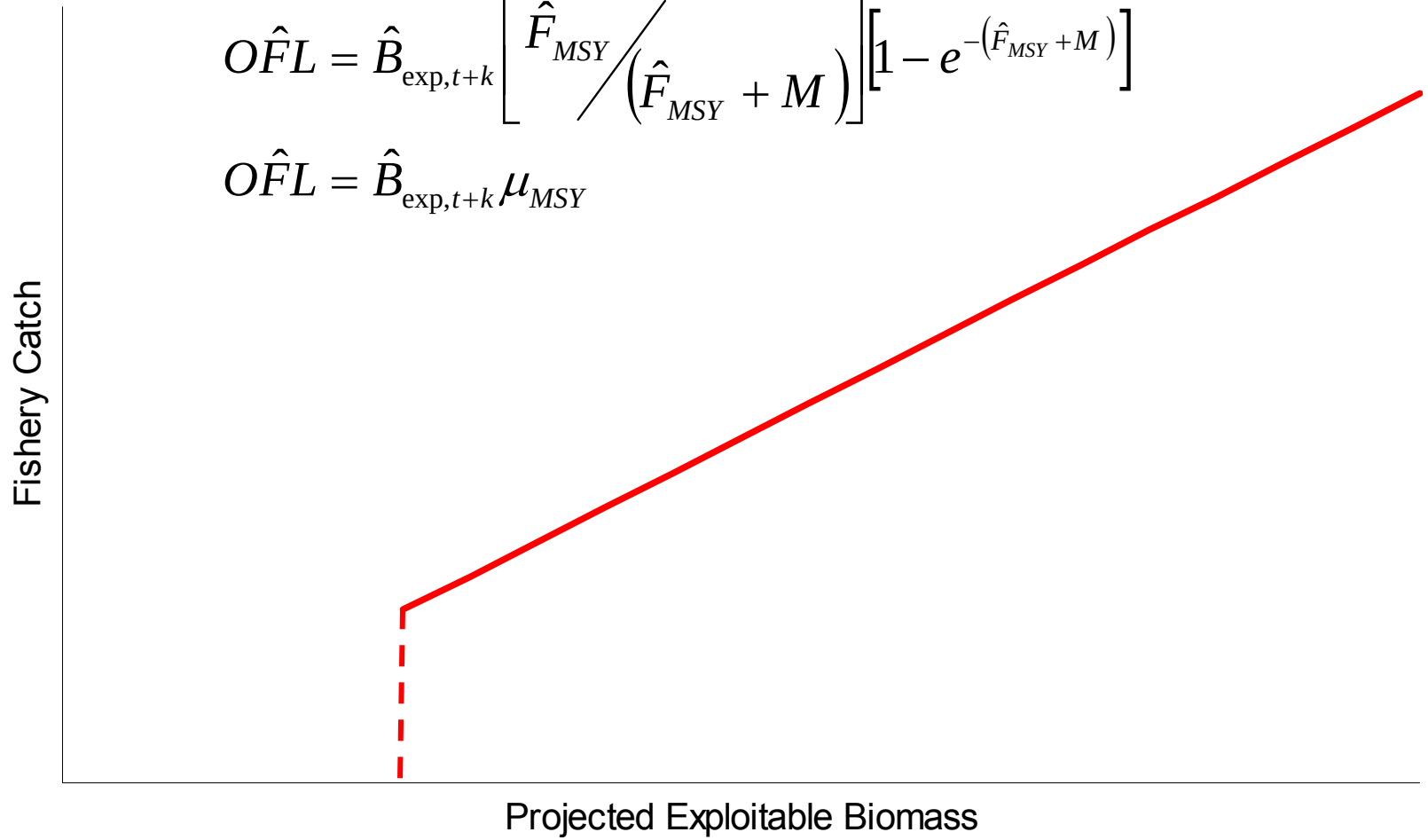
- The SSC developed ABC recommendations to meet the 2010-2011 deadlines for Annual Catch Limits.
- The basis of ABC recommendations and conformance to NS1 guidelines vary among FMPs, and formal ABC control rules have not been developed for all stocks.
- Eventually, all FMPs should include ABC control rules that account scientific uncertainty in OFL and the Council’s desired risk tolerance.

# Overfishing Limit (OFL)

- In addition to classifying stock status, $F_{MSY}$ will be used to determine a limit to future catch (OFL: catch associated with overfishing):

$$\hat{OFL} = \hat{B}_{\exp,t+k}\left[\hat{F}_{MSY} \Big/ \left(\hat{F}_{MSY} + M\right)\right]\left[1 - e^{-\left(\hat{F}_{MSY}+M\right)}\right]$$

$$\hat{OFL} = \hat{B}_{\exp,t+k}\,\mu_{MSY}$$



# Probablistic ABC

- OFL is a composite estimate which is a function of projected biomass and $F_{MSY}$, both of which are estimated with uncertainty.
- ABC is derived as a function of the projected OFL estimate and its distribution:

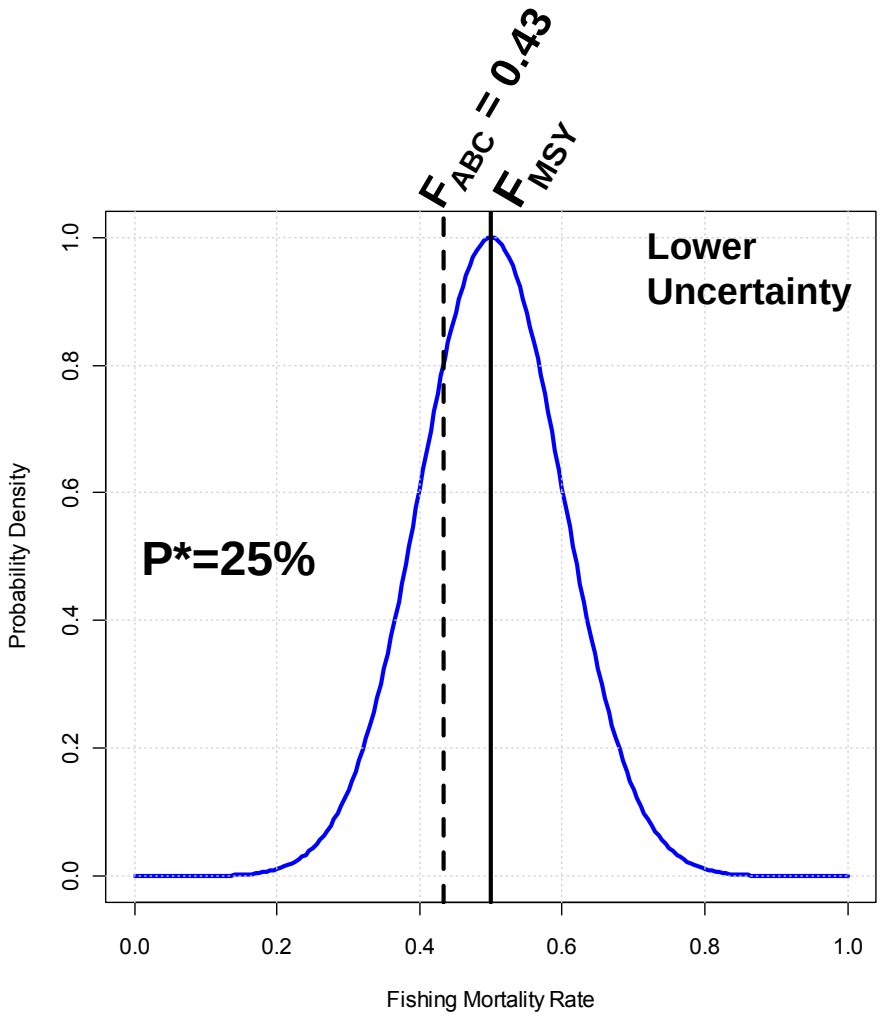
$$ABC = \hat{OFL} - \sigma_{OFL} z_p$$

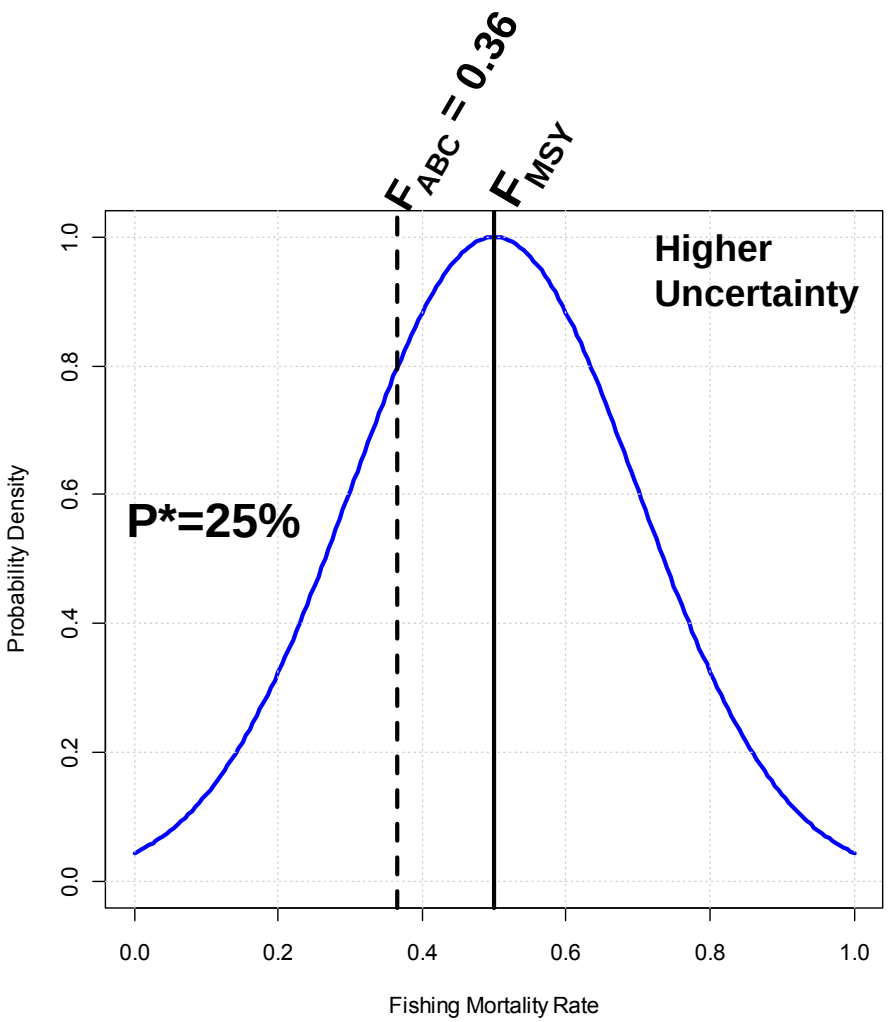
*or*

$$ABC = P_p\left(\hat{OFL}\right)$$

- $\sigma_{OFL}$ is the standard error of the *OFL* estimate
- $z$ is a function of the desired probability ($p$) of exceeding *OFL* (e.g., for $p$=0.1, $z_p$=1.96)
- $P_p$ is the $p$ percentile of the distribution of *OFL*.

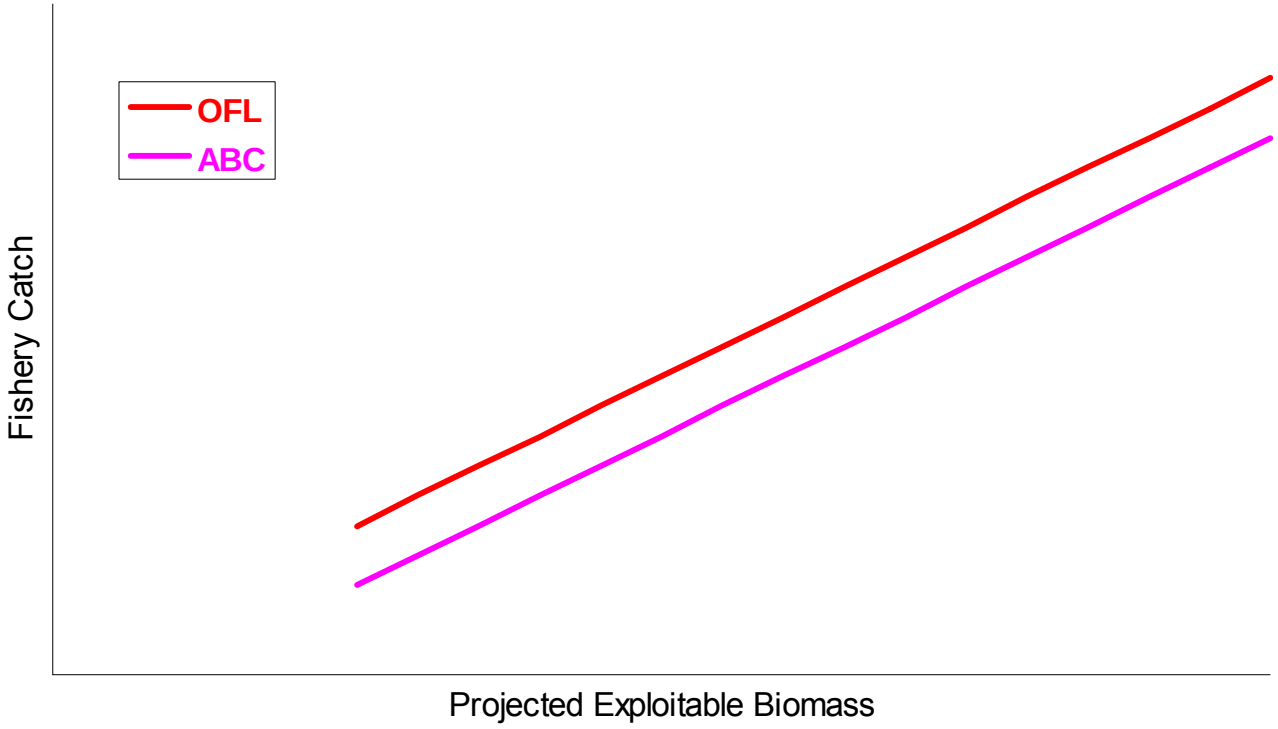
# Probability of overfishing (P*) set to 25%



# Acceptable Biological Catch (ABC)

- National Standard guidelines suggest that *ABC* should account for scientific uncertainty in OFL




$$\hat{OFL} = \hat{B}_{\exp} \cdot \mu_{MSY}$$

$$ABC = \hat{OFL} - \sigma_{OFL} z_p$$

# Rebuilding ABCs

- According to NS1 guidelines, "*For overfished stocks and stock complexes, a rebuilding ABC must be set to reflect the annual catch that is consistent with the schedule of fishing mortality rates in the rebuilding plan*."
- If the ABCs based on OFL are not expected to meet rebuilding goals, ABC should be based on $F_{rebuild}$:

$$ABC = \hat{B}_{\exp,t+k}\left[\hat{F}_{rebuild}\Big/\left(\hat{F}_{rebuild}+M\right)\right]\left[1-e^{-\left(\hat{F}_{rebuild}+M\right)}\right]$$

# Ad hoc ABC Methods

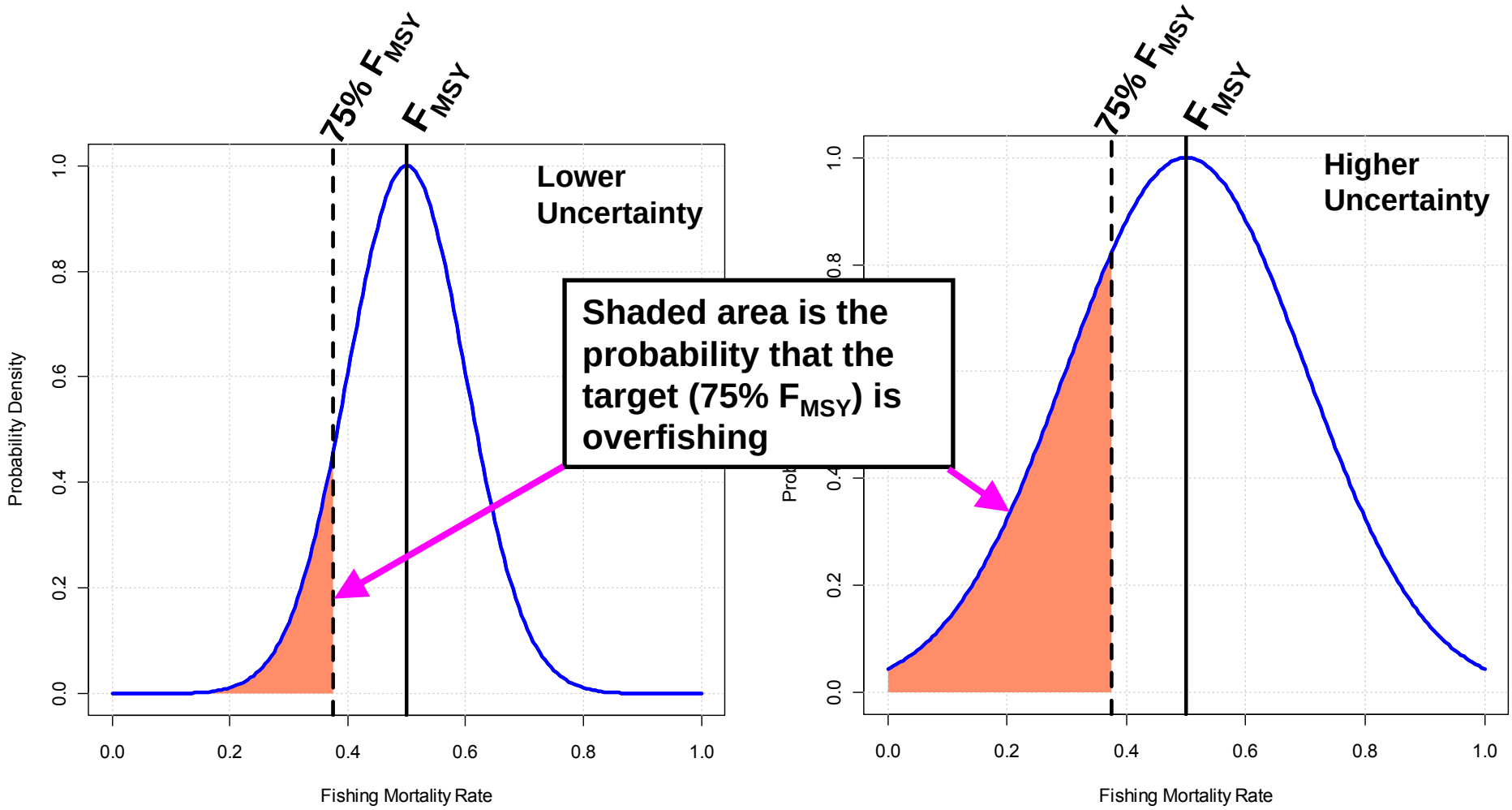
- Ad hoc approaches to determining ABC can also conform to the guideline to determine ABC based on the probability that it would result in overfishing – if that probability is evaluated.

$$ABC = x\%\hat{OFL} = \hat{B}_{\exp,t+k}\, x\%\, \mu_{MSY}$$

$$\neq$$

$$ABC = \hat{B}_{\exp,t+k}\left[ x\%\hat{F}_{MSY} \Big/ \left( x\%\hat{F}_{MSY} + M \right) \right]\left[ 1 - e^{-\left( x\%\hat{F}_{MSY} + M \right)} \right]$$

# Scientific Uncertainty in OFL
# Given target F = 75% $F_{MSY}$

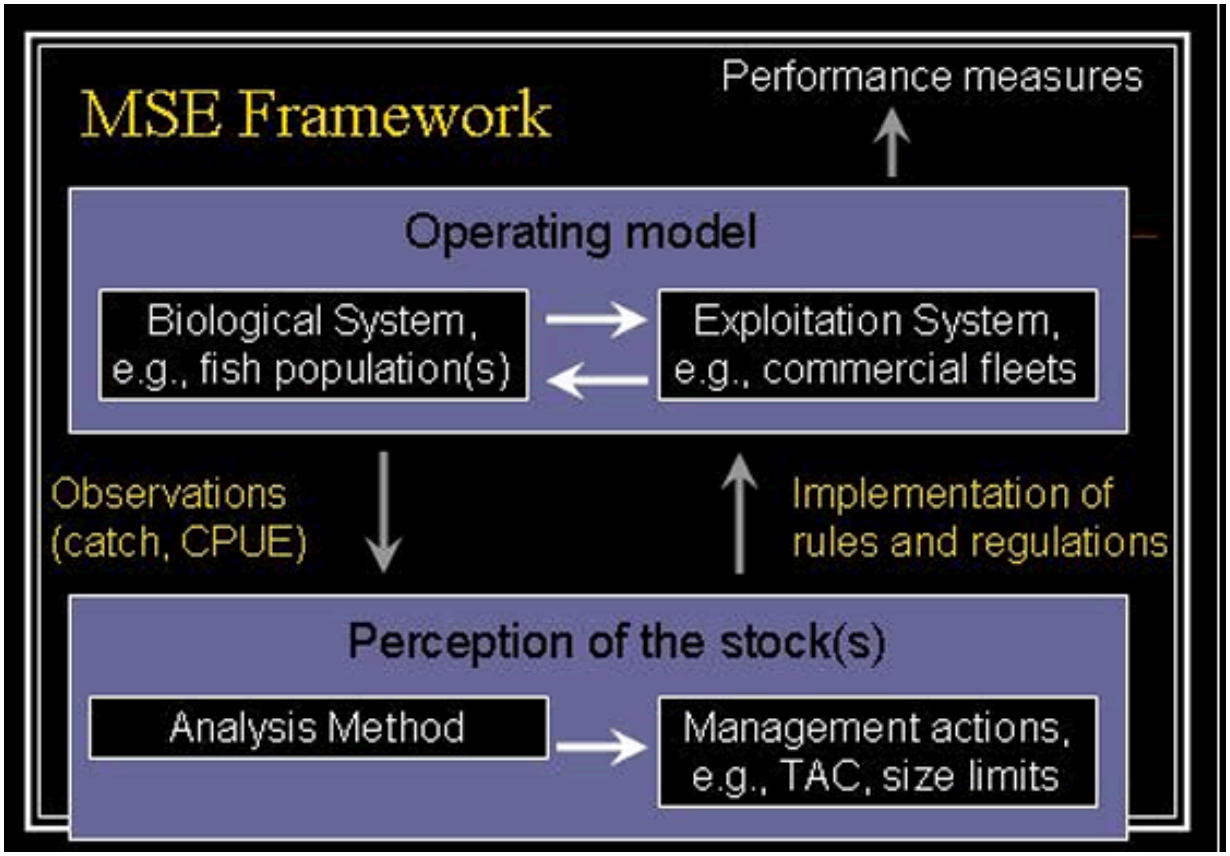



**P* = 10.5%**

**P* = 26.6%**

# Ad hoc *ABC* Methods

- The conventional approach to determining the probability of overfishing is Management Strategy Evaluation (MSE; jisao.washington.edu)



# Data-Poor Interim ABCs

- Many stock assessments don't support the estimation of quantities needed to derive ABC as specified in national standard guidelines, … but catch advice is mandated for all fisheries, with few exceptions.
- Interim ABC methods are needed until more analytical approaches to ABC can be developed.
- Data-Poor interim ABCs should account for major sources of uncertainty for catch advice.
- In data-poor situations, interim ABCs can be based on the magnitude of catch or exploitation index during periods of stability (or periods of stock increase for rebuilding plans).

# ABC Control Rules in New England

- General Approaches (2007 MSA and 2009 guidelines)
  - Probablistic approach (NS1 guidelines)
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  - Ad hoc ABC methods
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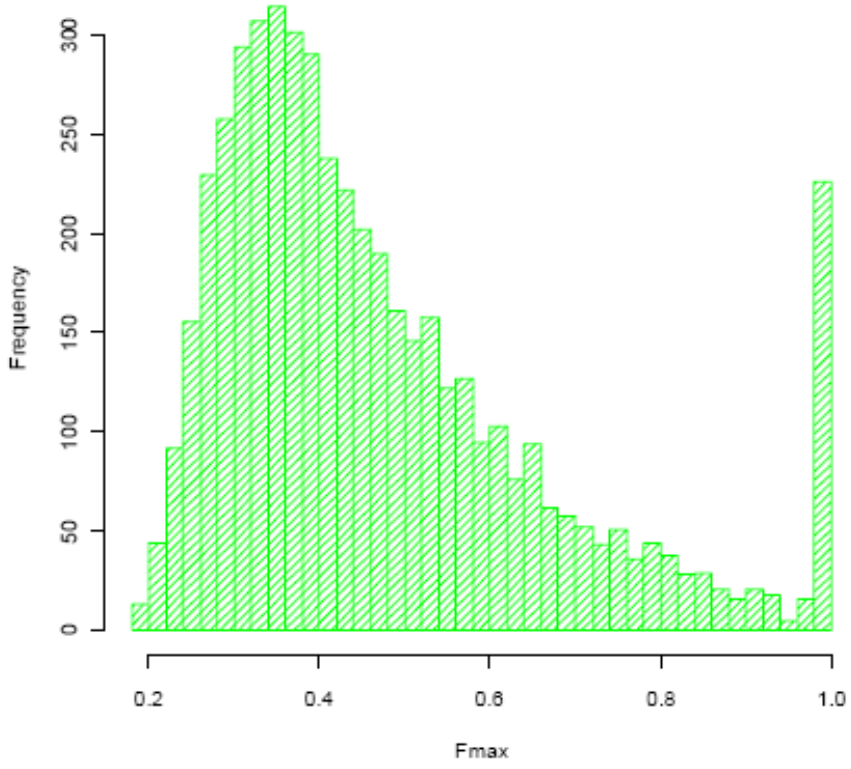
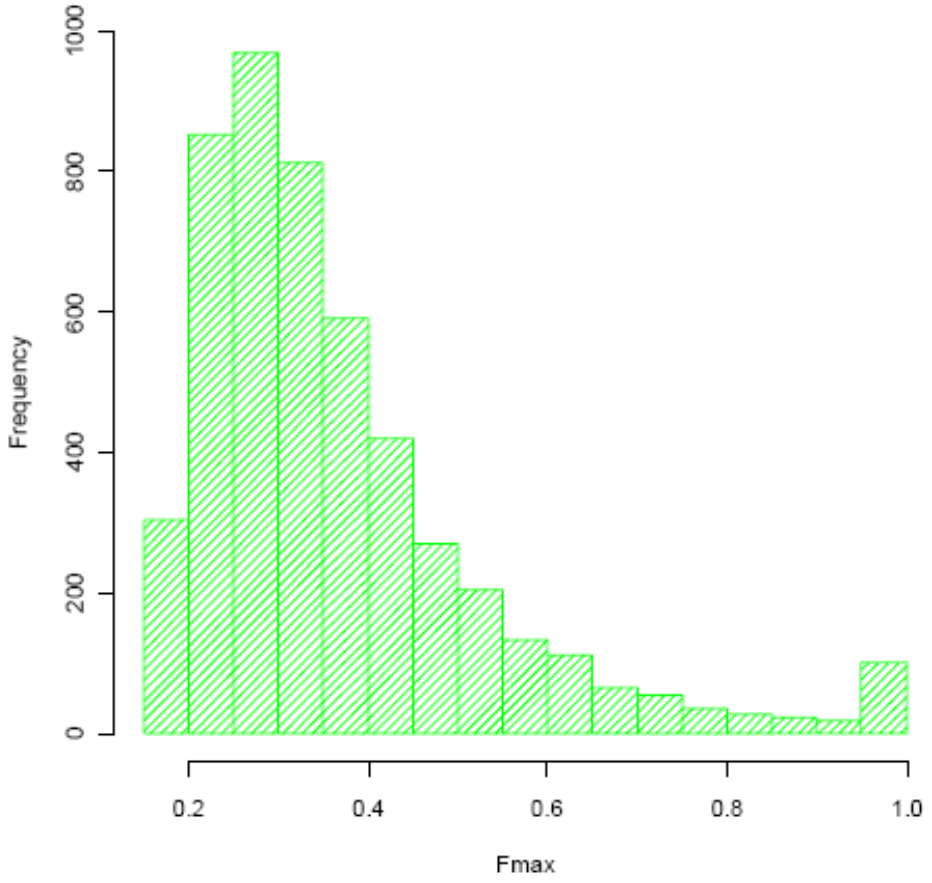
# Scallop *ABC* (Sept 2009)

- The stochastic estimate of $F_{max}$ is 0.37.



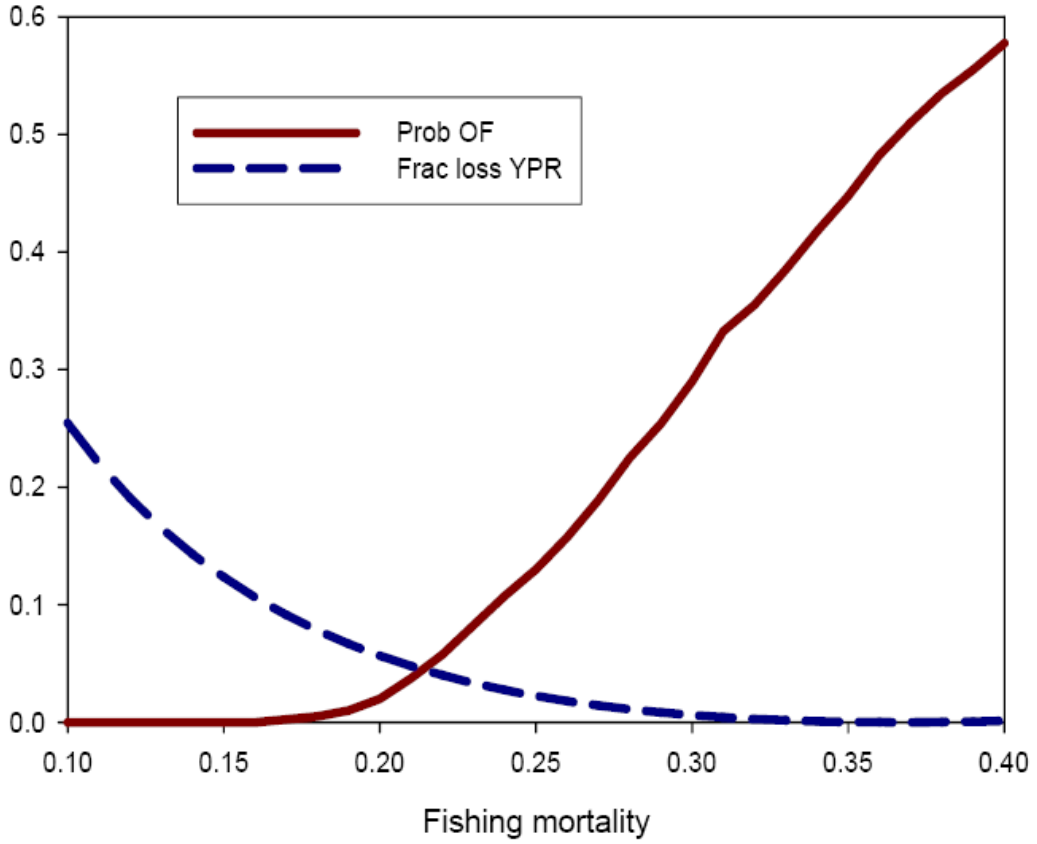

Mid-Atlantic




Georges Bank

# Scallop *ABC* (Sept 2009)

- Based on the probability of overfishing and the projected loss in yield relative to $F_{max}$, the SSC endorsed the proposal by the Scallop Plan Team and other conventions of risk-based harvest rules that ABC be based on 25% probability of overfishing.



# Scallop *ABC* (Sept 2009)

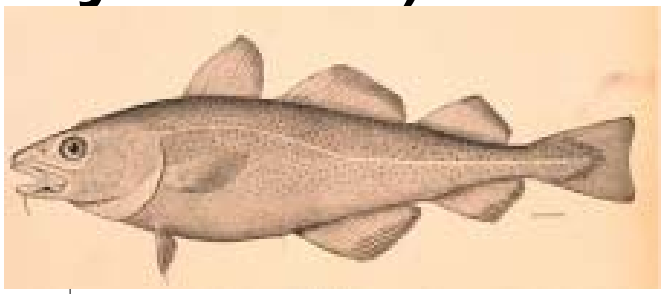
- The optimal combination of risk and probability of overfishing is a management option to be determined by the Council, with input from the Scallop Plan Team and the SSC on scientific consequences of alternative degrees of risk.
- For illustration purposes, alternative projections of fishing mortality and yield at alternative probabilities of overfishing were provided.

| Probability of Overfishing | 2010 Fishing Mortality | 2010 Yield |
|---|---|---|
| 20% | 0.27 | 28,473 |
| 25% | 0.29 | 29,578 |
| 30% | 0.30 | 30,504 |

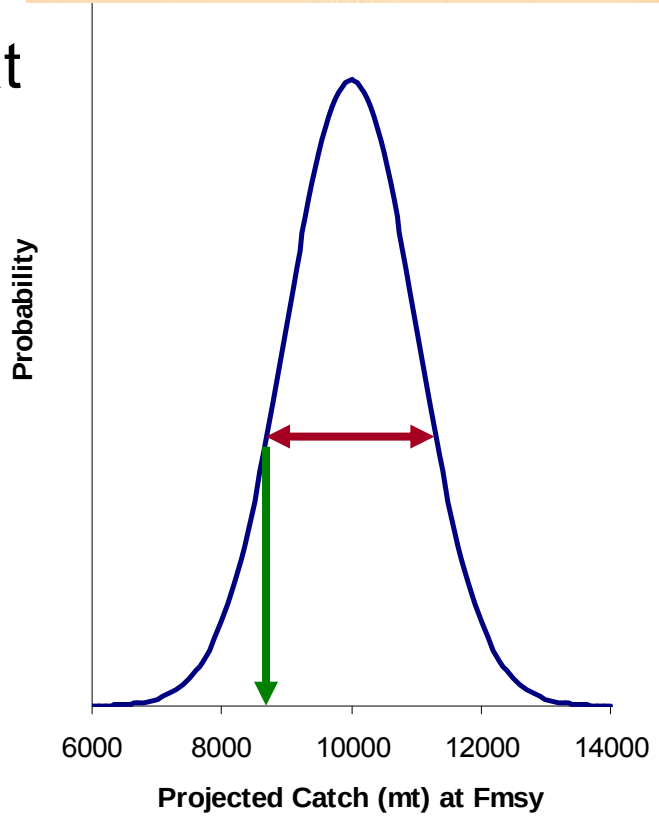
# Scallop ABC for 2011?

- Oct 2008 SSC Report: "Although $F_{max}$ may be a reasonable proxy for $F_{MSY}$, the SSC recommends more explicit consideration of long-term sustainable yield, rather than maximizing yield-per-recruit."
- June 2010 SAW50 estimate of $F_{MSY}$=0.38
- ToR1: Expected performance for avoiding overfishing.
  - ABC can be based on a nominal probability of overfishing
- ToR 2: Information needed to develop ABC control rules that account scientific uncertainty in OFL and the Council's desired risk tolerance.
  - Decision on risk tolerance needed from Council
  - Management strategy evaluation could include model error

# Groundfish ABCs (July 2008)

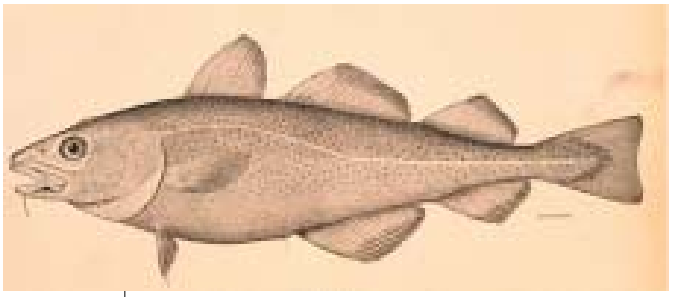


- The SSC reviewed the PDT's proposed ABC approach.
- ABC should be derived as a function of scientific uncertainty in projected catch at $F_{rebuild}$ (for rebuilding stocks) or $F_{MSY}$ (for rebuilt stocks).
- Considering precision of the most recent estimates of stock size and subsequent recruitment, there is a distribution of projected catch.
- A percentile of the lower tail should be selected as the ABC, with the percentile being determined by productivity and uncertainty factors.

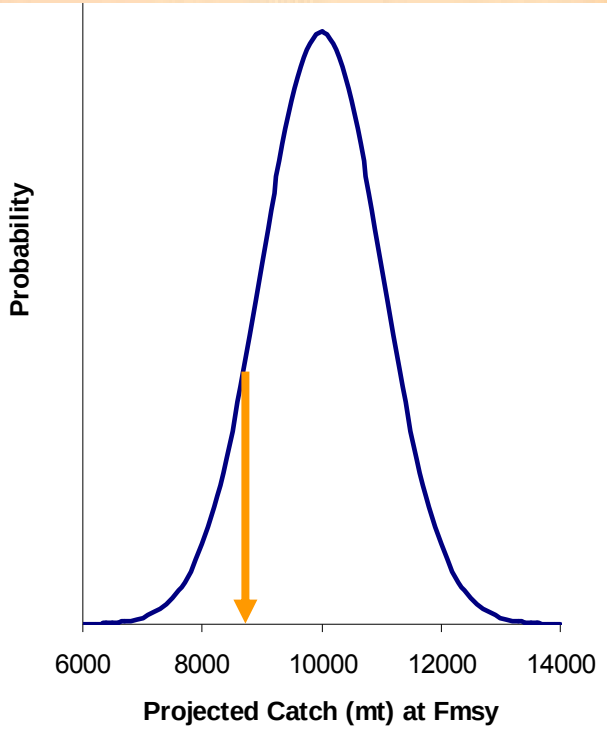


# Groundfish *ABC*s (July 2008)

- Productivity and Uncertainty Factors were initially used to determine the percentile of catch used to determine *ABC*.
- % buffers were not final decisions.

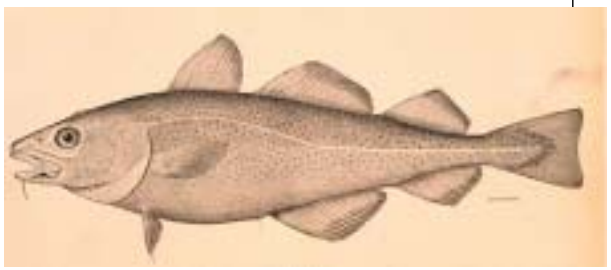


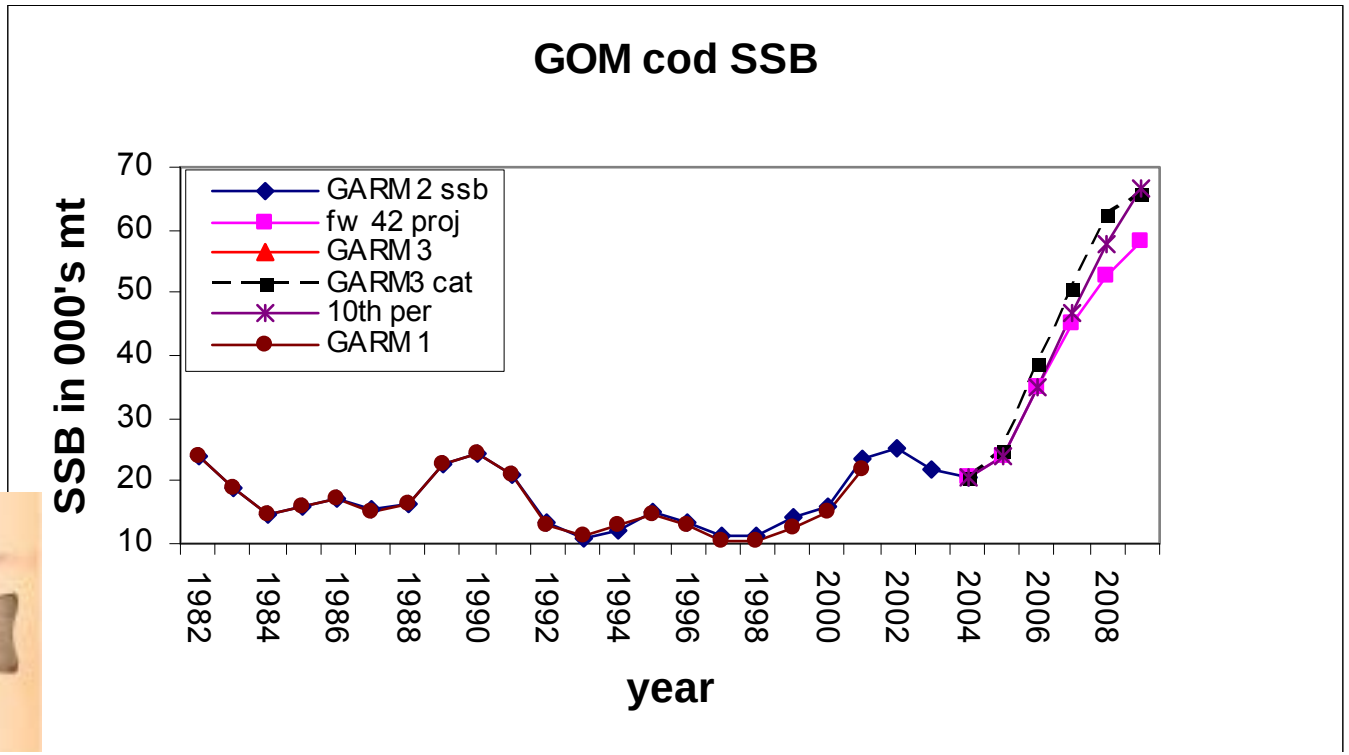
| Stock Productivity | | | | |
|---|---|---|---|---|
| | 3 | ABC = 10%ile Fcontrol rule 10%ile Freb | ABC=25%ile of Fcontrol rule Or 25%ile of Freb | ABC= Fcontrol rule Or ABC=50%ile catch at Freb |
| | 2 | ABC = 10%ile Fcontrol rule or 10%ile Freb | ABC=25%ile of Fcontrol rule Or 25%ile of Freb | ABC=25%ile of Fcontrol rule Or 25%ile of Freb |
| | 1 | ABC = 1%ile Fcontrol rule or 1%ile Freb | ABC = 10%ile Fcontrol rule or 10%ile Freb | ABC = 10%ile Fcontrol rule or 10%ile Freb |
| | | **1** | **2** | **3** |
| | | **Assessment Uncertainty** | | |



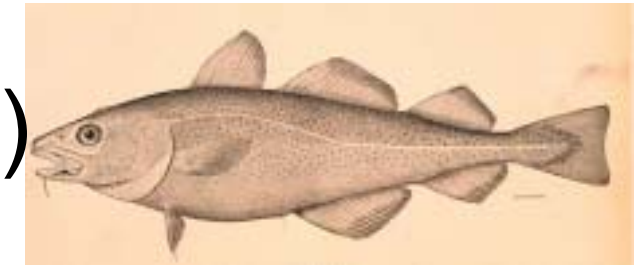
# Groundfish *ABC*s (April 2009)

- The PDT presented its performance evaluation of the proposed approach for 3 principal groundfish stocks: Gulf of Maine cod, Georges Bank cod and Cape Cod-Gulf of Maine yellowtail flounder.
- The Plan Team's approach produced fishing mortalities that exceeded $F_{MSY}$ (because of retrospective patterns), therefore not preventing overfishing nor achieving rebuilding objectives.



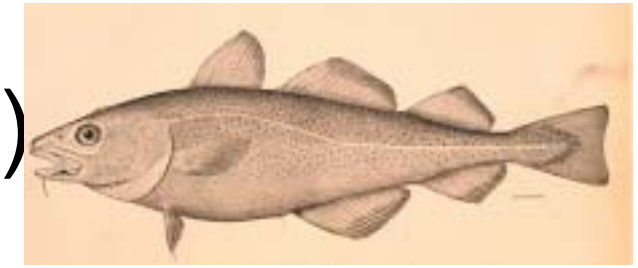


# Groundfish *ABC*s (May 2009)



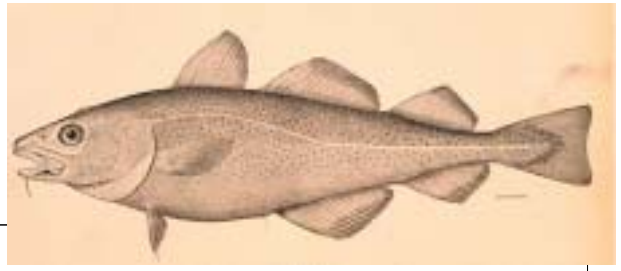
- In the absence of better information on what an appropriate buffer should be between *OFL* and the *ABC*, a relatively simple *ABC* was applied to all groundfish stocks.
- Given the guidance for specifying *ABC* as the lesser of $75\%F_{MSY}$ or $F_{rebuild}$, and the definition of optimum yield in the current Multispecies Fishery Management Plan as that associated with $75\%F_{MSY}$, the SSC recommended that the Council consider this *ABC* specification be applied to all groundfish stocks.

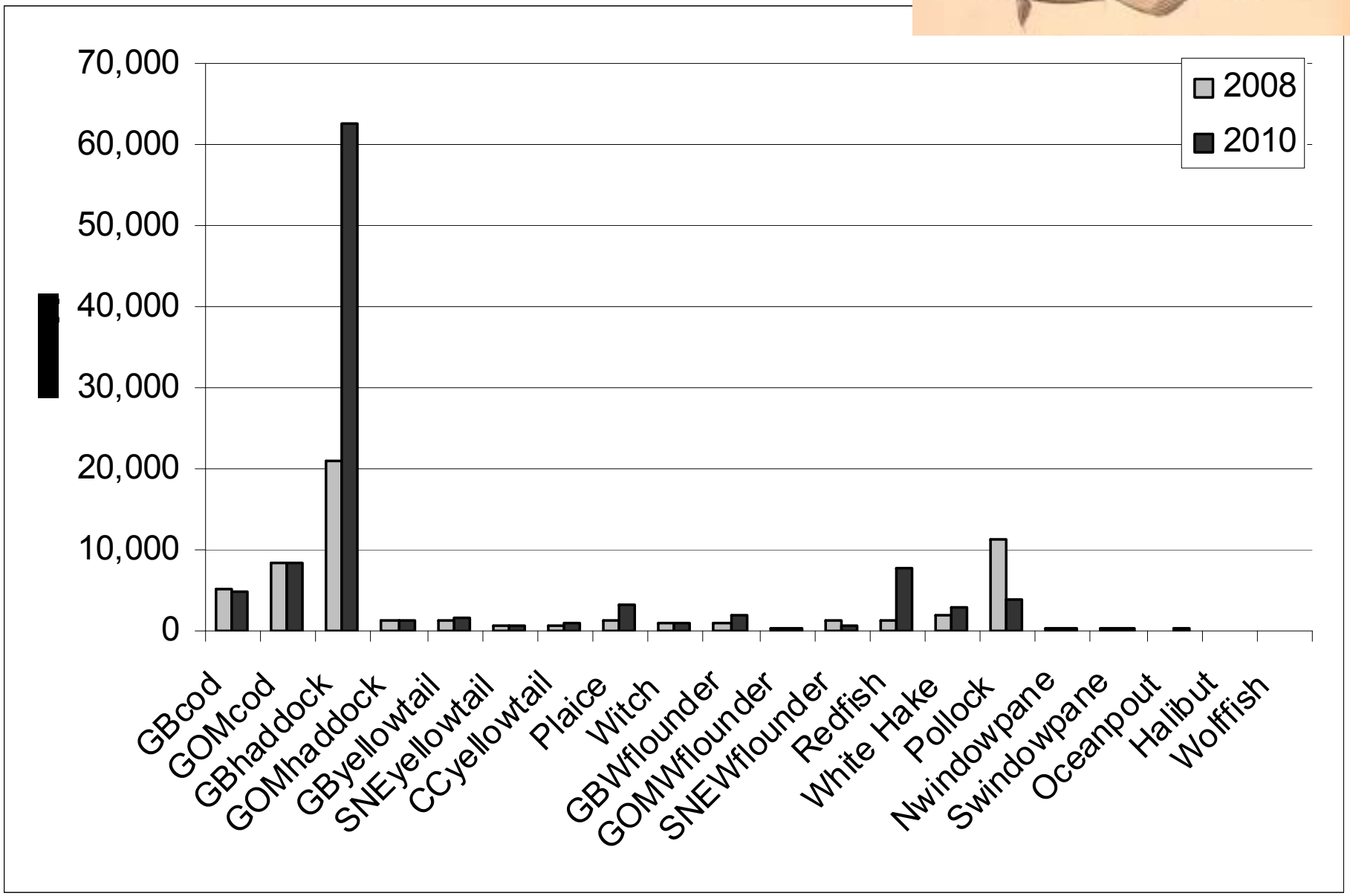
# Groundfish ABCs (Sep 2009)



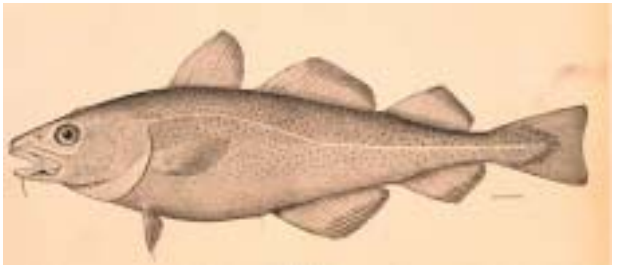
- *Method 1: ABC based on 75%$F_{MSY}$:*
  - 3 groundfish stocks are rebuilt (GB haddock, GoM haddock & redfish).
  - 6 stocks are expected to rebuild within the required period if fishing mortality is limited to 75%$F_{MSY}$ (GB cod, GoM cod, CC yellowtail, plaice, witch & GB winter flounder).
  - 6 stocks do not have accepted projection methods (pollock, N. windowpane, S. windowpane, ocean pout, halibut & wolfish).
- *Method 2: ABC based on $F_{rebuild}$:*
  - 3 stocks are not expected to rebuild within the required period at 75%$F_{MSY}$ (GB yellowtail, SNE yellowtail and hake).
- *Method 3: ABC based on reduction in incidental bycatch:*
  - SNE winter flounder is not expected to rebuild within the required period, and the ABC recommendations are based on estimates of discards that result from recent management measures.
- *Method 4: Interim ABC based on data-poor proxies*
  - GoM winter flounder has unknown stock status, and the ABC recommendation is based on 75% of recent catches.

# Groundfish *ABC*s (Sep 2009)





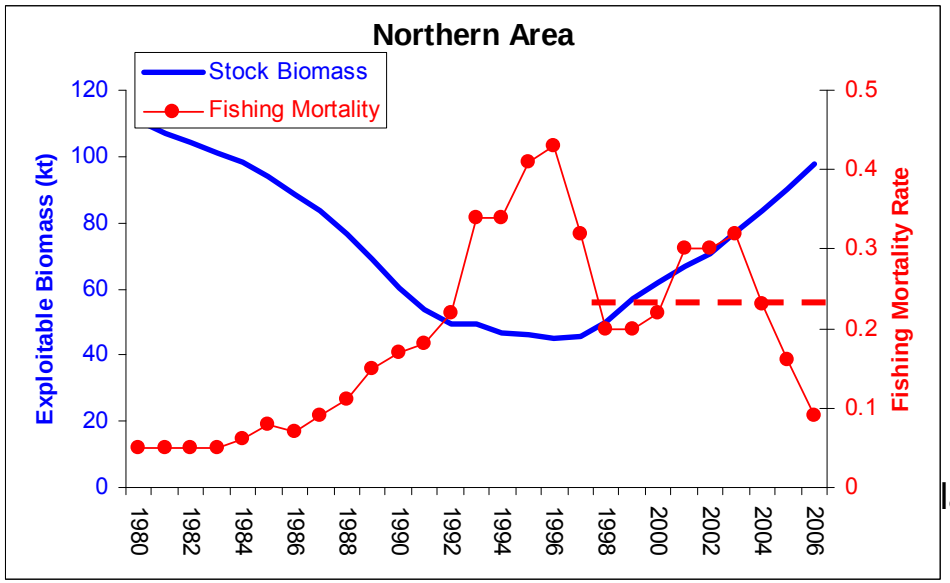
# Groundfish ABCs for 2013?

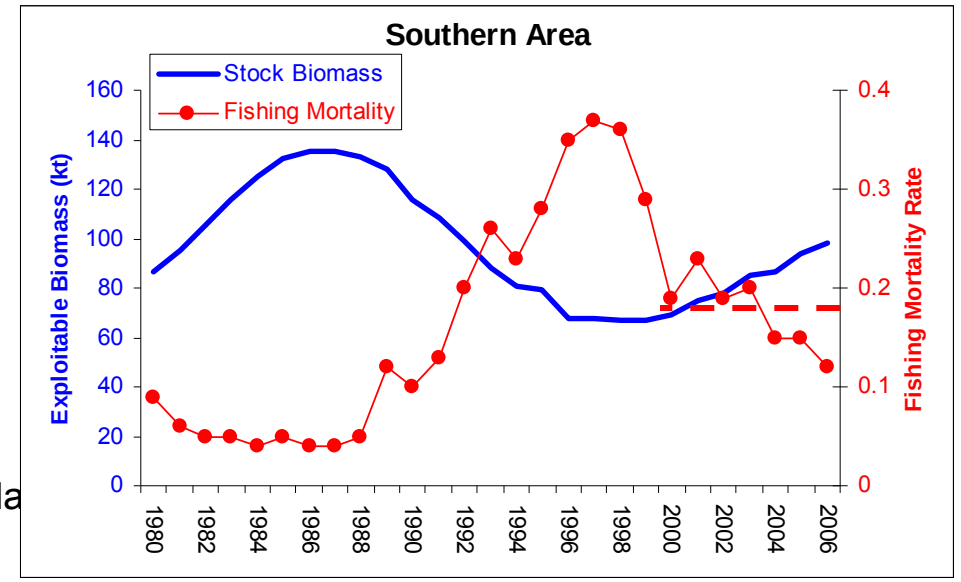


- ToR1 - expected performance for avoiding overfishing.
  - Performance of 75%$F_{MSY}$ only evaluated generically and for other stocks and situations (e.g., principal groundfish in the late 1990s).
- ToR 2 - information needed to develop ABC control rules that account for scientific uncertainty in OFL and the Council's desired risk tolerance.
  - Most stocks need reliable stochastic projections (or MSEs)
  - Decision on risk tolerance needed from Council

# Monkfish Interim ABC (March 2009)

- Considerable uncertainties in the monkfish assessment model preclude its use to determine probability of exceeding the projected OFL.
- The SSC recommended an interim method for determining Acceptable Biological Catch based on average exploitation rate during the recent period of increase in both management units and the most recent estimate or index of exploitable biomass.



# Monkfish Interim ABC (March 2009)

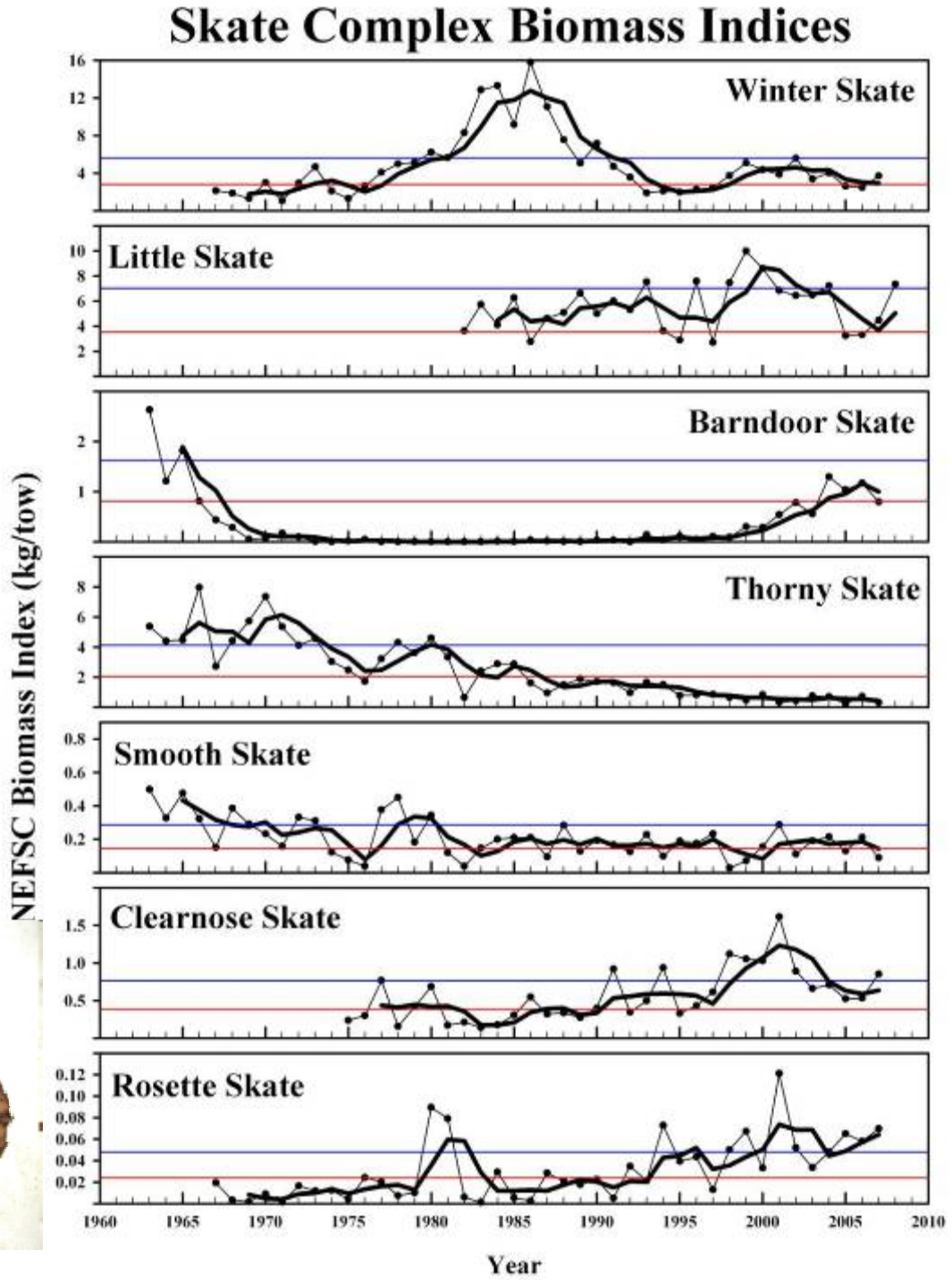
- The data-poor default method for determining interim ABC produces catch advice that is substantially less than the nominal OFL, but is not directly associated with overfishing.
  - OFL is 22,729mt for the north and 28,263mt for the south.
  - ABC is 17,485mt for the north (77% of OFL) and 13,326mt for the south (47% of OFL).
- Although the interim ABCs are not derived as a function of scientific uncertainty, the reductions from OFL are consistent with data-poor situations.

# Monkfish ABC 2011?

- June 2010 - SAW50 benchmark assessment
- ToR1 - expected performance for avoiding overfishing.
  - Recent exploitation rate appeared to be sustainable
  - SAW50 projections of updated assessment indicate low probability of overfishing in the southern area, but high probability of overfishing in the northern area if catch=ABC.
- ToR 2 - information needed to develop ABC control rules that account for scientific uncertainty in OFL and the Council's desired risk tolerance.
  - Stochastic projections or MSEs needed
  - Decision on risk tolerance needed from Council

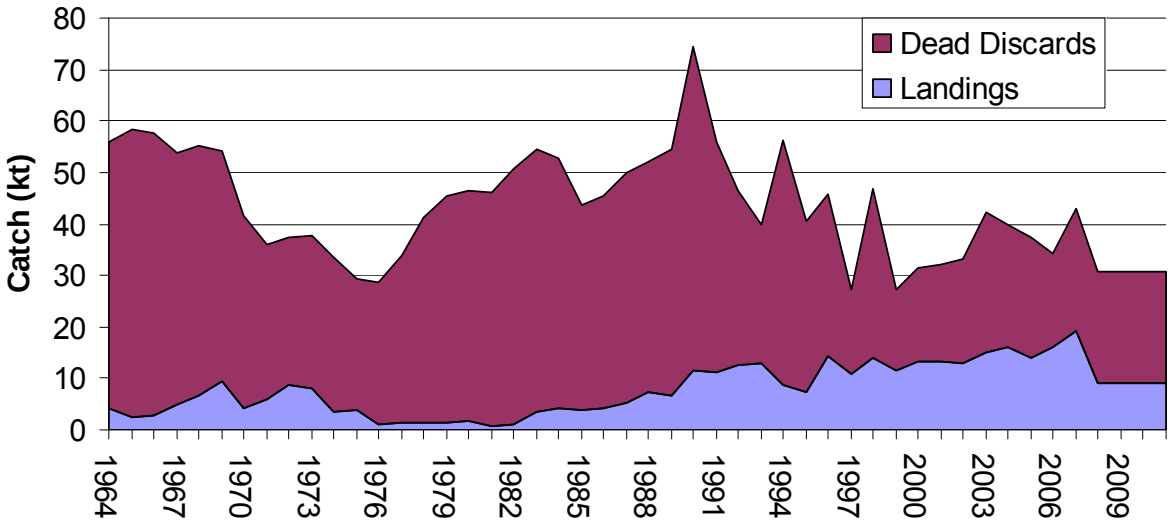
# Skate Interim ABC (Feb 2009)

- OFL cannot be determined, because overfishing reference points are survey proxies, and estimates of F or $F_{MSY}$ reference points are not available.



# Skate Interim ABC (March 2010)

- Status of each skate species will continue to be monitored, but the fishery will be managed using a multispecies catch limit, supplemented with additional management actions.
- The interim ABC is derived as the multispecies skate catch associated with the median of the observed series of a catch/biomass exploitation index and the most recent 3-year average of the multispecies skate survey index.
- The multispecies ABC is be supplemented with a prohibition on possessing thorny skate.




# Skate ABC 2012?

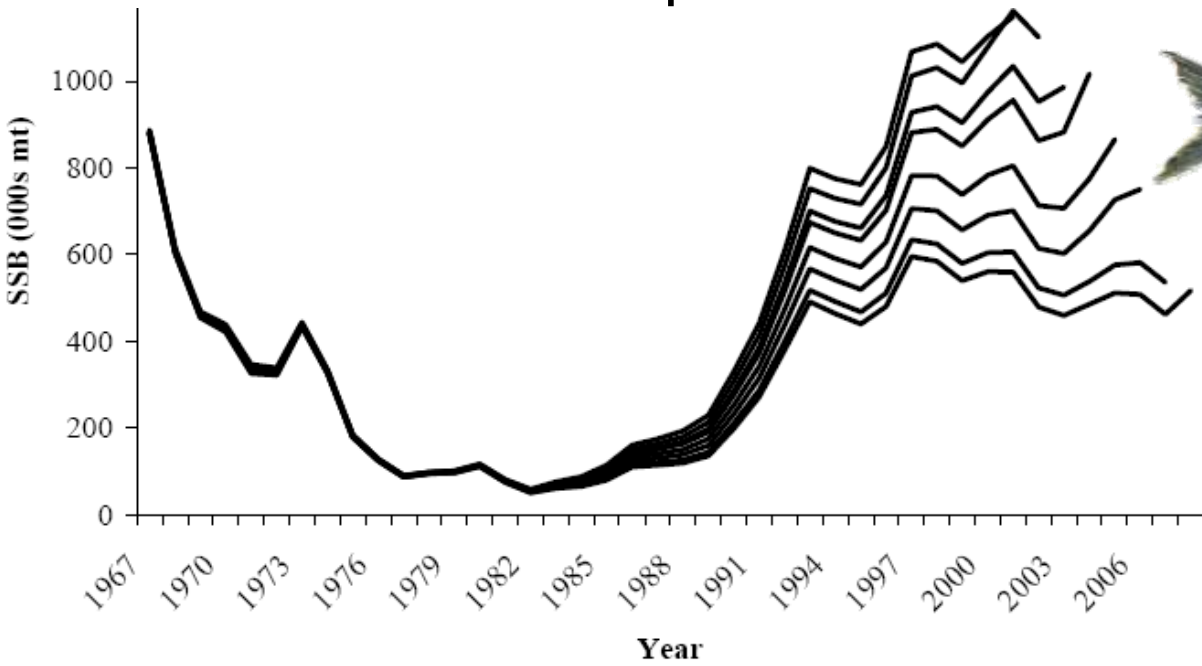
- Several new challenges concerning skate management are expected to arise in the future.
  - Old and new survey systems need calibration.
  - Discarding of skates may increase.
  - Life histories and geographic ranges vary among species:
    - Northern species (thorny and smooth) are overfished;
    - Southern species (rosette and clearnose) are not overfished;
    - Target species (winter and little), as well as barndoor are rebuilding and are most likely transboundary resources.
- Future management of skate fisheries should include consideration of treating species separately or as geographic groups of species.

# Skate ABC 2012?

- ToR1 - expected performance for avoiding overfishing.
  - Unknown, but recent exploitation rate appears to be sustainable for most skate species
- ToR 2 - information needed to develop ABC control rules that account for scientific uncertainty in OFL and the Council's desired risk tolerance.
  - Reliable assessment and stochastic projections needed (or MSE of simpler ABC control rule)
  - Decision on risk tolerance needed from Council

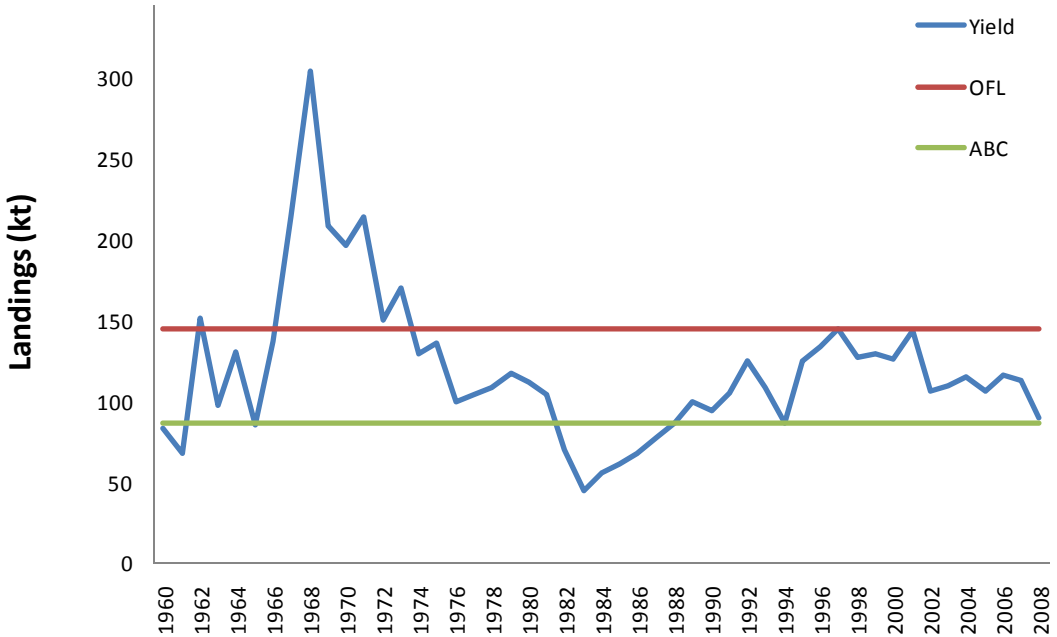
# Herring ABC (Sept 2009)

- Retrospective inconsistency in biomass estimates is greater than confidence limits.
- ABC recommendation was initially based on magnitude of inconsistency in exploitable biomass (40% buffer between *OFL* and ABC).
- Council requested that the SSC consider a smaller buffer (17%) based on recent retrospective inconsistency.




# Herring Interim ABC (Nov 2009)

- The stock complex does not appear to be overfished and overfishing does not appear to be occurring.
- In the context of uncertainties, it would not be appropriate to allow catches to increase.
- Recent catch should be used as an interim ABC.
- The choice of recent time period to use for ABC depends on the Council's tolerance to risk.



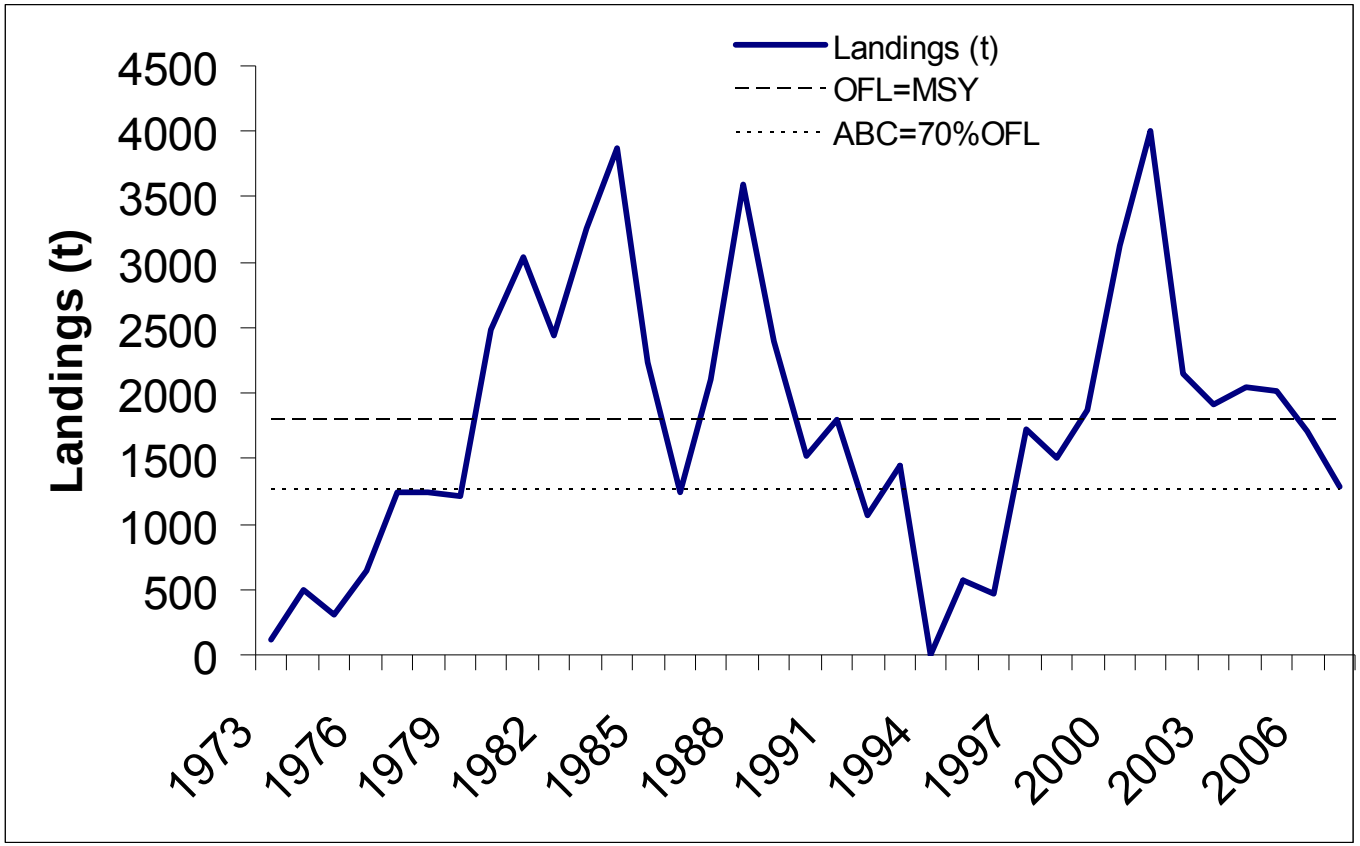
# Herring ABC 2013?

- Benchmark SAW assessment scheduled for 2012 including management strategy evaluation.
- ToR1 - expected performance for avoiding overfishing.
  - Unknown, but recent catches appear to be sustainable
- ToR 2 - information needed to develop ABC control rules that account for scientific uncertainty in OFL and the Council's desired risk tolerance.
  - Reliable assessment and stochastic projections needed (or MSE of simpler ABC control rule)
  - Decision on risk tolerance needed from Council

# Deep-Sea Red Crab (Sep 2009)

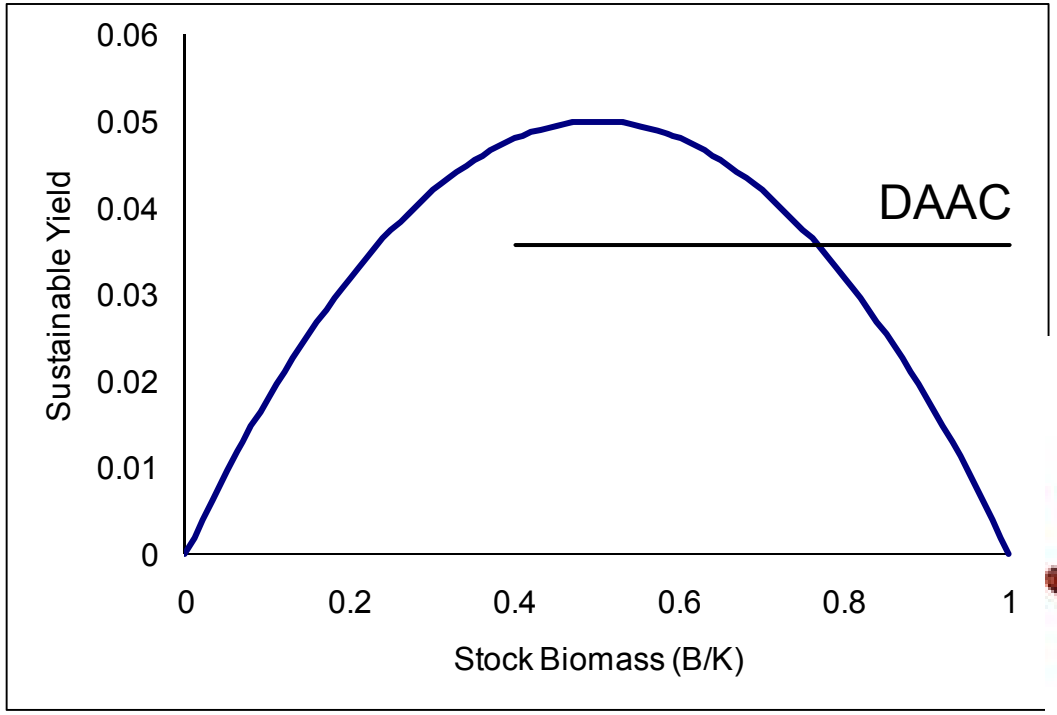
- MSY was initially approximated from depletion-adjusted average catch model
- OFL=MSY proxy
- ABC=recent catch=70%OFL

$$MSY = \frac{\sum_{t=1}^{t=n} C_t}{\left\{\left[n + \left(B_0 - B_t\right)\right] / \left(0.2 B_0 M\right)\right\}}$$



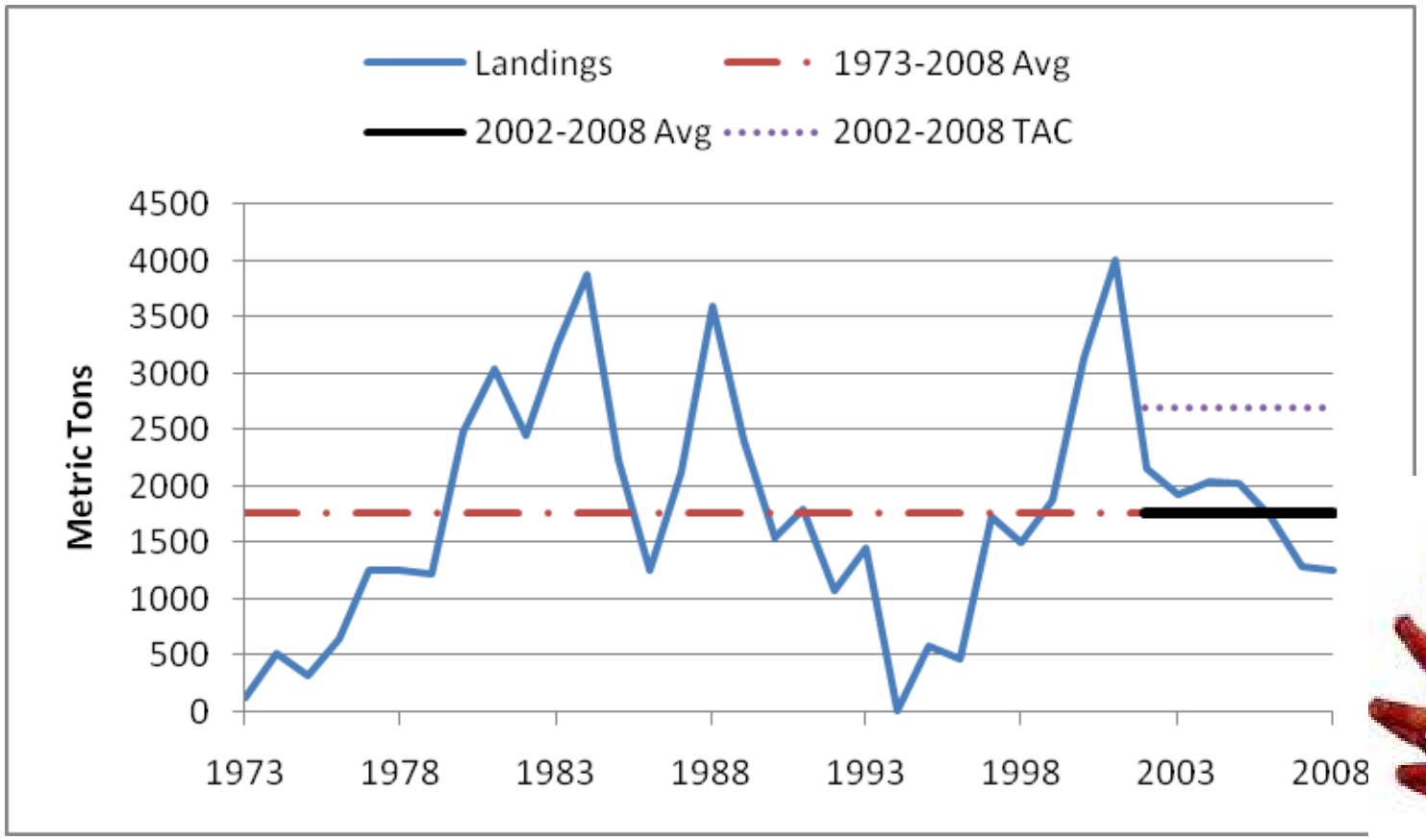

# Deep-Sea Red Crab (March 2010)

- The PDT demonstrated that the Depletion-Adjusted Average Catch model developed by the Data Poor Stocks Working Group provides an estimate of sustainable yield that underestimates maximum sustainable yield (MSY).
- Therefore, the information available for red crab is insufficient to estimate MSY or OFL.



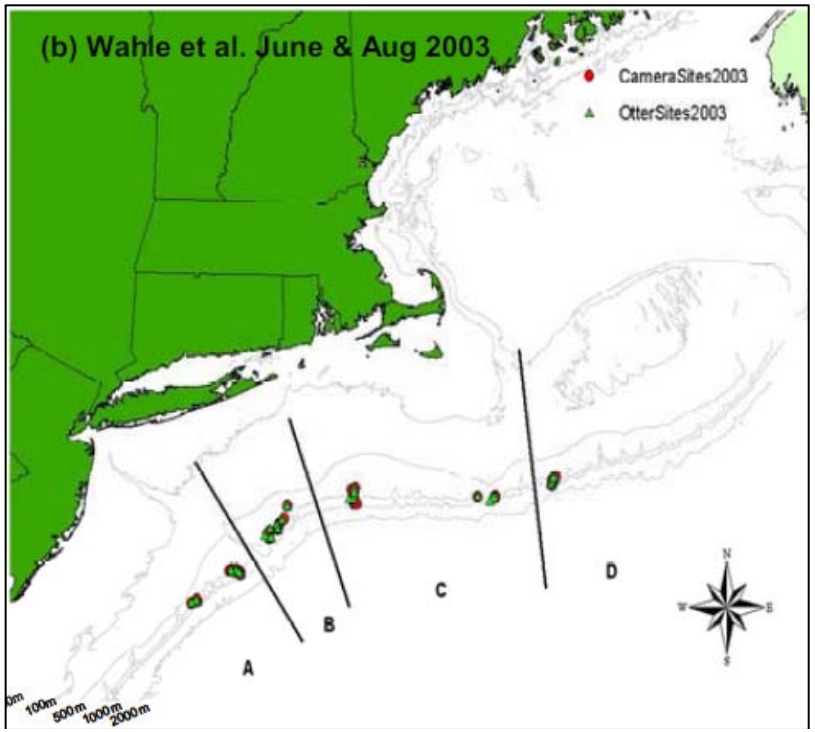

# Red Crab Interim ABC (March 2010)

- In lieu of an estimate of OFL, the SSC recommendation for an interim ABC is based on the long-term average landings of males, which is the same result as provided by Depletion Adjusted Average Catch model that assumes no depletion.




# Depletion-Adjusted Average Catch

- The two survey estimates of abundance and their variance do not provide evidence of significant depletion from 1974 to 2003-2005.
- The SSC concludes that an interim ABC based on long-term average landings is safely below an overfishing threshold and adequately accounts for scientific uncertainty.




# Deep-Sea Red Crab ABC 2011?

- ToR1 - expected performance for avoiding overfishing.
  - Unknown, but average catch appears to be sustainable
- ToR 2 - information needed to develop ABC control rules that account for scientific uncertainty in OFL and the Council's desired risk tolerance.
  - Reliable assessment and stochastic projections needed (or MSE of simpler ABC control rule)
  - Decision on risk tolerance needed from Council

# Strategic Options for *ABC*s

1. Continue to provide ABC recommendations for each management action.
   - Responsive to Council's needs, fishery and resource conditions
   - May lead to inconsistencies among FMPs and management actions
2. Work with PDTs and Council to develop ABC control rules that account for scientific uncertainty in OFL and the Council's desired risk tolerance for each FMP separately.
   - More explicit risk and conformance to guidelines
   - Requires scientific and policy development
3. Develop a common approach to ABC control rules for all New England stocks
   - Consistent approach among FMPs and management actions
   - Less tailored to strengths and weaknesses of science and management situations

# ABC Control Rules in New England

- General Approaches (2007 MSA and 2009 guidelines)
  - Probablistic approach (NS1 guidelines)
  - Rebuilding ABCs (NS1 guidelines)
  - Ad hoc ABC methods
  - Data-Poor interim ABCs
- ABCs for New England Fisheries (SSC Reports)
- ABC control rules in other regions (National SSC and Duke reports)
- SSC Discussion

# North Pacific Control Rules for OFL and ABC based on data available

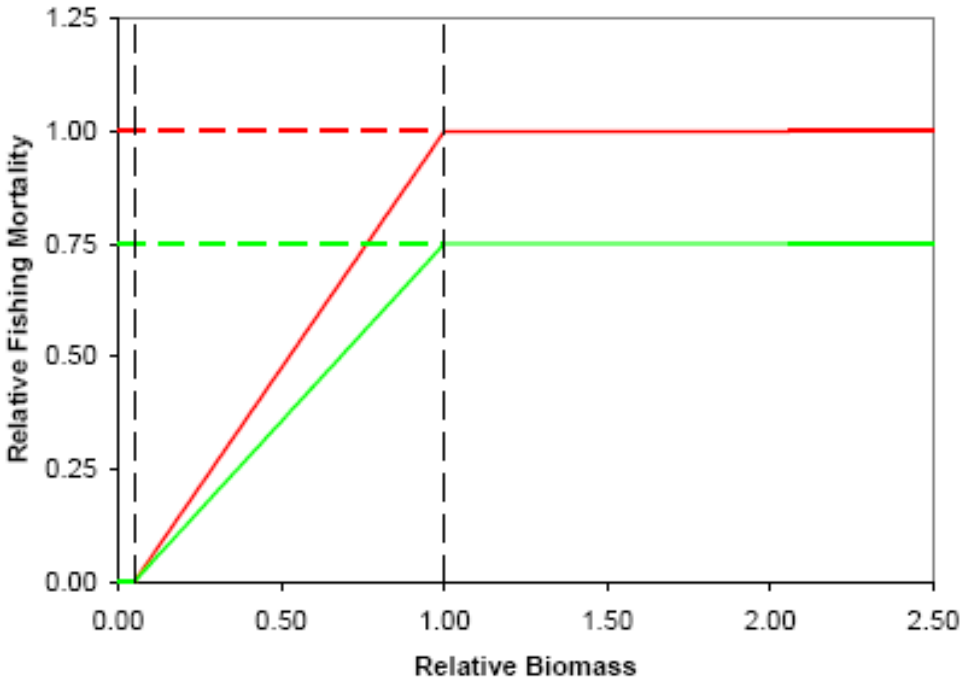
- Tier 1 -- Reliable B, $B_{msy}$, pdf of $F_{msy}$
- Tier 2 -- Reliable B, $B_{msy}$, $F_{msy}$, $F_{35\%}$, $F_{40\%}$
- Tier 3 – Reliable B, $B_{40}$, $F_{35\%}$, $F_{40\%}$
- Tier 4 – Reliable B, $F_{35\%}$, $F_{40\%}$
- Tier 5 – Reliable B and M
- Tier 6 – Reliable Catch History Data

Note: “pdf” = probability density function.

# North Pacific Control Rules for OFL and ABC based on data available

- Tier 1 - Reliable point estimates of B, $B_{MSY}$, and reliable pdf of $F_{MSY}$.
- Stock status: $B/B_{MSY} > 1$
  - $F_{OFL}$ = mA, arithmetic mean of pdf
  - $F_{ABC} \equiv$ mH, harmonic mean of pdf
- Stock status: $a < B/B_{MSY} \leq 1$
  - $F_{OFL} = mA \times (B/B_{MSY} - a)/(1 - a)$
  - $F_{ABC} \leq mH \times (B/B_{MSY} - a)/(1 - a)$
- Stock status: $B/B_{MSY} \leq a$
  - $F_{OFL} = 0$
  - $F_{ABC} = 0$

Note:
a=default value of 0.05.



# North Pacific Control Rules for OFL and ABC based on data available

Tier 2 - Reliable point estimates of B, $B_{MSY}$ , $F_{MSY}$ , $F_{30\%}$ , and $F_{40\%}$ .

- Stock status: $B/B_{MSY} > 1$
  - $F_{OFL} = F_{MSY}$
  - $F_{ABC} \leq F_{MSY} \times (F_{40\%} / F_{35\%})$
- Stock status: $a < B/B_{MSY} \leq 1$
  - $F_{OFL} = F_{MSY} \times (B/B_{MSY} - a)/(1 - a)$
  - $F_{ABC} \leq F_{MSY} \times (F_{40\%} / F_{35\%}) \times (B/B_{MSY} - a)/(1 - a)$
- Stock status: $B/B_{MSY} \leq a$
  - $F_{OFL} = 0$
  - $F_{ABC} = 0$

Tier 3 - Reliable point estimates of B, $B_{40\%}$, $F_{35\%}$, $F_{40\%}$.

- Stock status: $B/B_{40\%} > 1$
  - $F_{OFL} = F_{35\%}$
  - $F_{ABC} \leq F_{40\%}$
- Stock status: $a < B/B_{40\%} \leq 1$
  - $F_{OFL} = F_{35\%} \times (B/B_{40\%} - a)/(1 - a)$
  - $F_{ABC} \leq F_{40\%} \times (B/B_{40\%} - a)/(1 - a)$
- Stock status: $B/B_{40\%} \leq a$
  - $F_{OFL} = 0$
  - $F_{ABC} = 0$

# North Pacific Control Rules for OFL and ABC based on data available

Tier 4 - Reliable point estimates of B, F35%, and F40%.

- $F_{OFL} = F_{35\%}$
- $F_{ABC} < F_{40\%}$

Tier 5 - Reliable point estimates of B and M.

- $F_{OFL} = M$
- $F_{ABC} < 0.75 \times M$

Tier 6 - Reliable catch history from 1978 through 1995.

- OFL= the average catch from 1978-1995, unless an alternative value is established by the SSC based on best available scientific information
- ABC < 0.75 × OFL

# North Pacific Control Rules for OFL and ABC based on data available

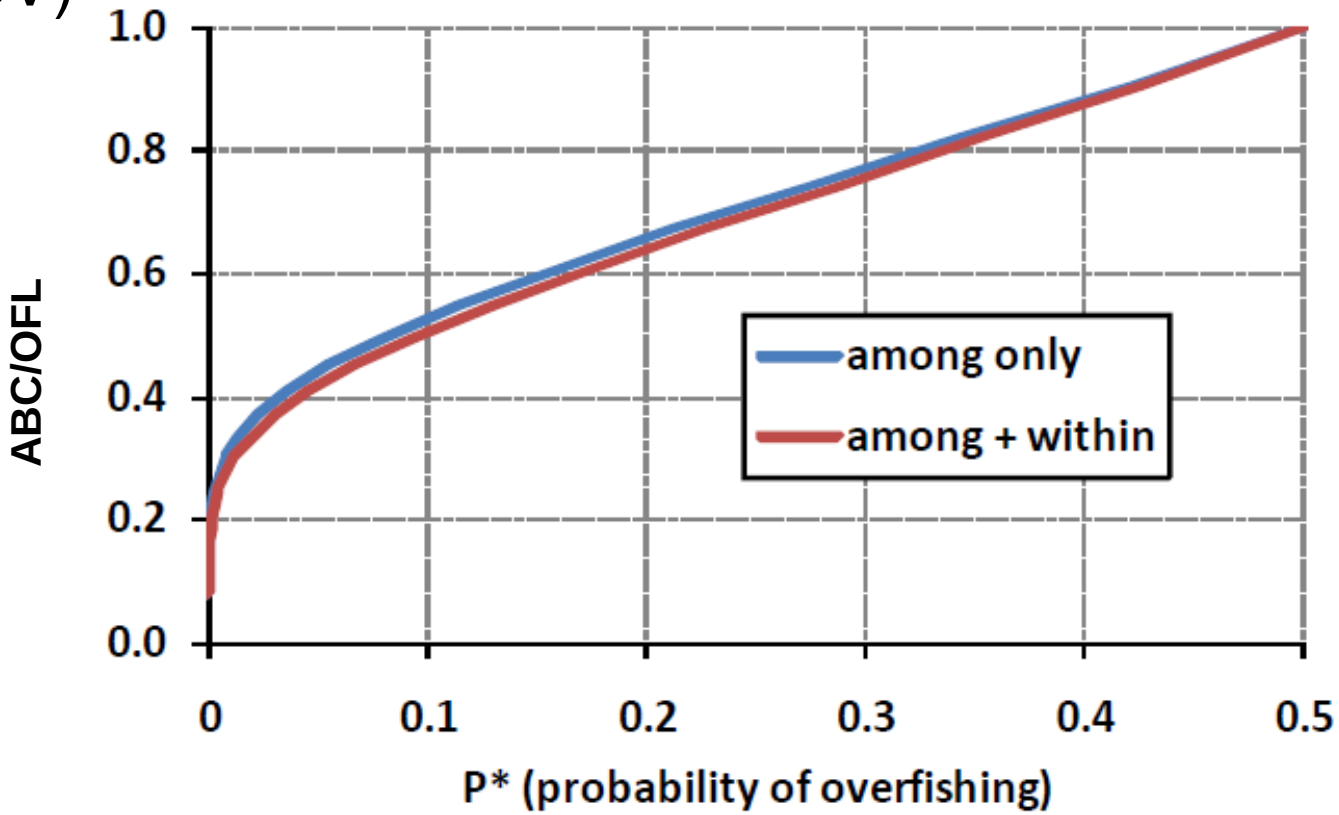
- Tier-1 ABCs are based on uncertainty (harmonic mean of OFL), but not explicitly on risk.
- Tiers 2-6 are ad hoc.
- An analysis of some groundfish indicated that existing ABCs would have a low probability of exceeding OFL (12% or 40%, depending on approach)

# Pacific Council ABCs

- Overfishing definitions
  - Rockfish $F_{50\%}$
  - Roundfish $F_{45\%}$
  - Flatfish $F_{30\%}$ (just changed)
  - Coastal Pelagics 0.15% (exploitation rate)
- Majority of managed species are data-poor

# Pacific Council ABCs

- Proposed ABCs based on uncertainty
  - ‘within assessments’ (statistical uncertainty in OFL; average 19%CV),
  - ‘among assessments’ (retrospective inconsistency; average 51%CV)

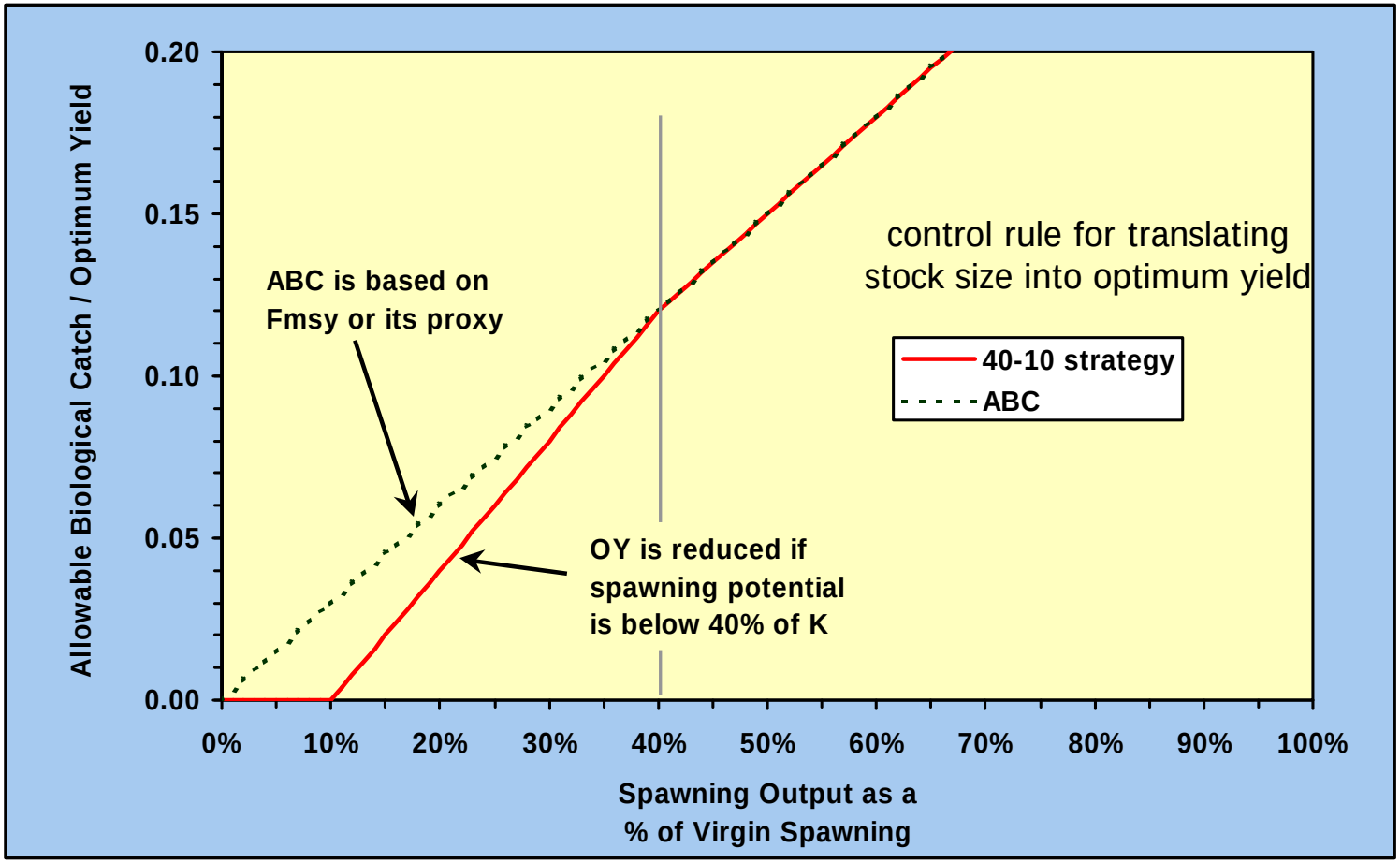


# Pacific Council ABCs

- Council decided to use the P* approach, with risk based on tiers of information, and uncertainties estimated or approximated by the SSC:
  - P*=0.45 for data-rich stocks
    - CV=0.36
    - ABC=46%OFL
  - P*=0.4 for data-moderate stocks
    - CV~0.72
    - ABC=83%OFL
  - P*=0.4 for data-poor stocks
  - CV~1.44
  - ABC=69%OFL

# Pacific Council ABC Control Rules

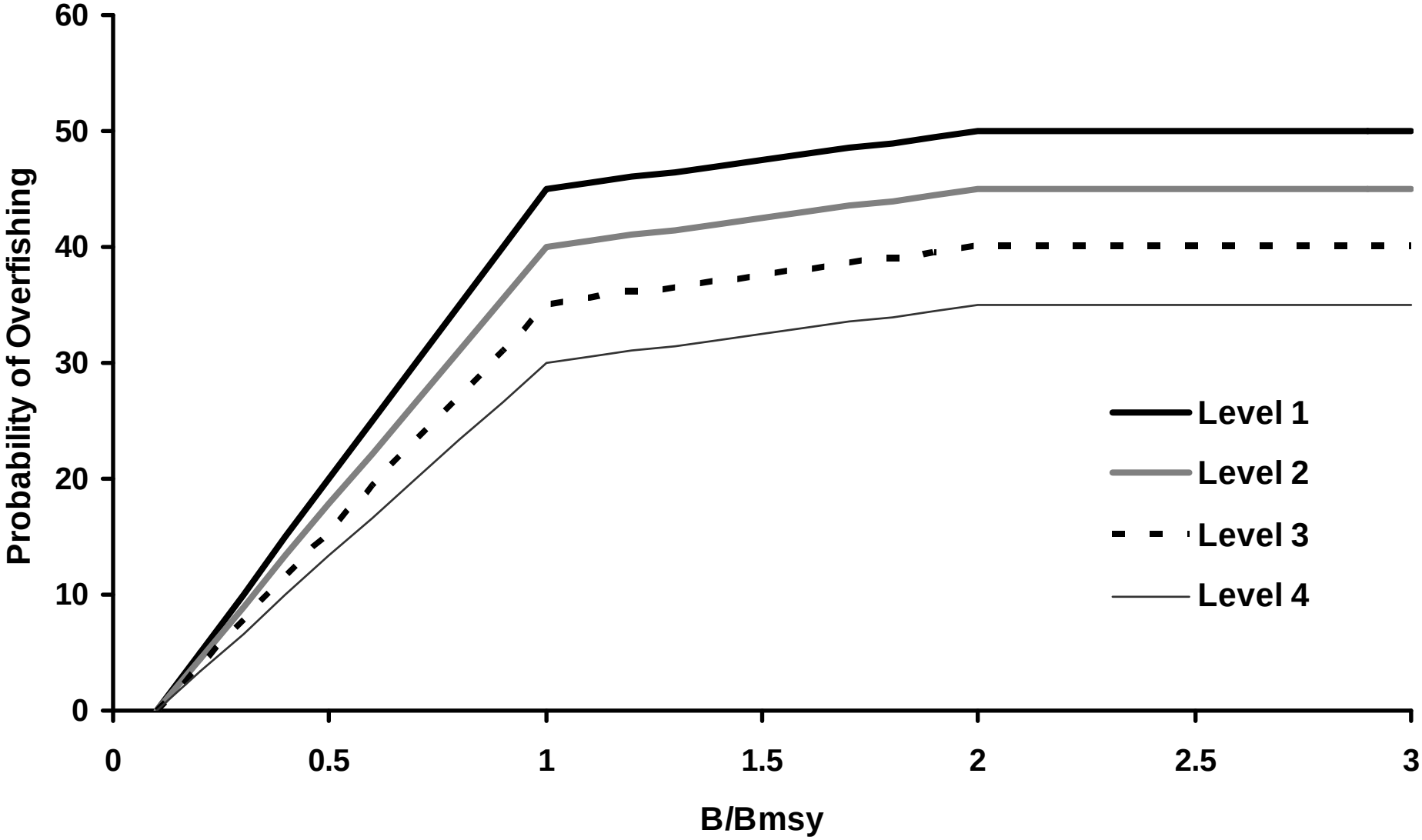
- OFL-ABC reductions being applied to the previous '40-10' control rule



# Mid Atlantic ABC Control Rule Framework

- Four Stock Assessment Levels and ABC approaches:
  1. ‘Ideal’ assessment - OFL distribution provides an adequate description of uncertainty.
  – ABC is determined by OFL distribution and an acceptable probability of overfishing (P*)
  2. ‘Preferable’ assessment - OFL distribution does not include some important sources of uncertainty
  – ABC is determined by expert judgment on the distribution of OFL and an acceptable probability of overfishing
  3. ‘Acceptable’ assessment - No OFL distribution
  – ABC is determined by expert judgment on an OFL-ABC buffer
  4. ‘Data-Poor approach’ - No OFL
  – ABC is based on catch history

# Mid Atlantic ABC Control Rule Framework



# South Atlantic ABC Control Rule

- Proposed probability of overfishing for ABC (P*) is based on four equally weighted sets of 'penalties':
  - Assessment information
  - Characterization of uncertainty
  - Stock Status
  - Productivity and Susceptibility
- Penalties within each category are scored 0 to 10
- P*=0.5-[sum(penalties)/100], ranging from 0.1 to 0.5
- Problems:
  - P* and uncertainty are not independent
  - Aspects of productivity and susceptibility are accounted for in OFL ($F_{MSY}$) and ABC
  - Stock status is accounted for in OFL (B) and ABC
  - Can only be applied to data-rich situations

# Gulf Council ABC Control Rule

- Proposed probability of overfishing for ABC (P*) is based on four equally weighted sets of 'penalties':
  - Assessment information
  - Characterization of uncertainty
  - Stock Status
  - Productivity and Susceptibility
- P* ranges from 0.15 to 0.45
- Currently in the process of making control rule adjustments based on Council's input on "acceptable levels of risk"

# West Pacific Council

- SSC proposed a default ABC control rule:
- ABC=70% $F_{MSY}$ (yield ~ 91% MSY, Walters et al 2005)
- Proposed data-poor control rule:

| **Stock Status** | **Potential ACL Control Rule** |
|---|---|
| Above $B_{MSY}$ | 1.00 x (Recent Catch) |
| Above Minimum Stock Size Threshold (MSST) but below MSY | 0.67 x (Recent Catch) |
| Below MSST (i.e. overfished) | 0.33 x (Recent Catch) |

# Caribbean Council ABCs

- Need to improve catch monitoring and data-poor ABCs.

# ABC Control Rules in New England

- General Approaches (2007 MSA and 2009 guidelines)
  - Probablistic approach (NS1 guidelines)
  - Rebuilding ABCs (NS1 guidelines)
  - Ad hoc ABC methods
  - Data-Poor interim ABCs
- ABCs for New England Fisheries (SSC Reports)
- ABC control rules in other regions (Nat SSC and Duke reviews)
- SSC Discussion

# Terms of Reference

1. Review ABC control rules or methods for deriving ABC in each FMP with respect to their expected performance for avoiding overfishing (i.e., conformance with the Act)
2. Identify the information needed to develop ABC control rules that account for scientific uncertainty in OFL and the Council's desired risk tolerance (i.e., conformance with guidelines).

# Questions for the SSC?

- Should risk tolerance (or pre-set tiers) be consistent among FMPs?
  - i.e., can different sets of stakeholders have different desired risks?
- Is greater desired risk for less certain situations a viable option (or less risk for more certain situations)?
  - i.e., are the two components to the OFL-ABC buffer (risk-tolerance and scientific uncertainty) independent?
- How can risks be evaluated without evaluations of consequences (e.g., cost-benefit analyses)
  - e.g., cost of overfishing, cost of initiating a rebuilding plan, cost of 'underfishing' (foregone short-term yield)