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Control Rules & Uncertainty

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Targets and Limits

"Another common element in the application of the precautionary approach to fisheries management worldwide is the specification of "targets" that are safely below limits. Setting OY at its limit (MSY in the Magnuson-Stevens Act) would not normally be precautionary because there could be a high probability of exceeding the limit year after year. Under the precautionary approach, the target should be set below the limit taking uncertainty and other management objectives into consideration. Development of control rules requires communication between fisheries managers, scientists, industry and the public."

Technical Guidance On the Use of Precautionary Approaches to Implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act. 1998. Restrepo, …Methot, ….Thompson.

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Déjà vu, all over again

"Section 3 presents a recommended default target control rule that could be used in the absence of more specific analyses. The default sets the target fishing mortality rate 25% below the default limit proposed in Section 2. The 25% reduction constitutes a safety margin that may not perform well for all stocks in terms of preventing overfishing. The performance of the default target can only be evaluated on a case-by-case basis and will depend on (a) the accuracy and precision of stock size, B and F estimates, (b) MSY MSY natural variability in population dynamics, and (c) errors in the implementation of management regulations."

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11 Years Later

- Control rules with Catch = *f*(SSB) are not uncommon;
- Target = 75% of limit is not uncommon;
- Management Strategy Evaluation (MSE) has become a common research tool;
- Probabilistic approaches continue to evolve (following presentations);
- Implementation of fully probabilistic approaches is rare.

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Impediments

- Technical complexity
- Setting p* and/or objective function
  - A management decision informed by science
- Communication to fishery public
- Incomplete characterization of uncertainty
  - Goal: better asmt always results in smaller buffer
  - Comparability to extreme data-poor situations

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Bound the Problem

- Rather than just Target = 75%*Limit
- Target = ~95%*Limit for “best” assessments
- Target = ~50%*Limit for least precise assessments
- Use tiers or a smooth function to scale between these extremes
- Current NPFMC tiers do not necessarily have this property

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Deal with Unmeasured Uncertainty

Options if uncertainty is clearly underestimated:

- Decrease p*
- Inflate variance
- Add additional buffer

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Components of Uncertainty

- Model fit to data
- Model structure and mis-specification
  - Fixed and estimated parameters
  - Is a simple model just a complex model with lots of fixed (and hidden) parameters?
  - Retrospective patterns
- Use of proxies for Status Determination Criteria
  - What's role of vulnerability score?
- Unaddressed linkages to climate and ecosystem trends

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Catch Only Scenarios

Historical Catch	Expert Qualitative Judgment	Possible Action
Nil, not targeted	Inconceivable that catch could be affecting stock	Not in fishery; Ecosystem Component; SDC not required
Small	Catch is enough to warrant including stock in the fishery and tracking, but not enough to be of concern	OFL unknown; Set ABC above historical catch; Set ACT at historical catch level. Allow increase in ACT if accompanied by cooperative research and close monitoring.

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Harder Catch Only Scenarios

Historical Catch	Expert Qualitative Judgment	Possible Action
Moderate	Possible that any increase in catch could be overfishing	OFL = unknown ABC = f(catch, vulnerability) So caps current fishery
Moderately high	Overfishing or overfished may already be occurring, but no assessment to quantify	Set provisional OFL = f(catch, vulnerability); Set ABC below OFL to begin stock rebuilding

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Forecasting Skill

- With input (F) controls, fluctuations in future recruitment cause fluctuations in realized SSB and catch
- With output (TAC) controls, future TAC is set, so fluctuations in actual future recruitment will cause fluctuations in realized F and SSB
- What are consequences for prevention of stock depletion and overfishing?
- For now, just look at future stock abundance relative to target stock abundance; can we stay near Bmsy?

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Poor Man's MSE

- Consider multi-year (5 or 10 yr) forecast with output (e.g. ACL/ACT) control, not input (effort) controls
- Assert that random assessment error at onset sets scale for whole forecast
  - Note: even if assessment is updated annually, there is still autocorrelation in structural model errors
- Then annual implementation error adds imprecision
- Need a two-stage forecast
  - Stage 1 calculates TAC_y | E(recruitment)
  - Stage 2 calculates SSB and F | TAC and Recruitment
  - Comparable to approach to be described by Kyle

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Model Structure

M = 0.2

sigmaR = 0.6

target F = F40%

spawner-recruitment relationship is flat (steepness=1.0)

Each scenario is run with 500 realizations.

Each realization starts with a 100 year burn-in with F=F40% and with random recruitment

In year 100, it calculates the 5 or 10 yr forecast according to a specified variance condition

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Model Scenarios

Perfect: Each year with perfect information about status of stock and with perfect implementation, so equivalent to input control

Noerr: No asmt error, do 10 year forecast using assumed equilibrium recruitment, calc TAC for each year, fix these TACs as the future catch quotas, then redo forecast using random recruitment draws and adjust F to obtain the quota

20% or 50% IMPerr: as above, but add random implementation error

Asmt_err: Instead of implementation error, add an error to the initial asmt, so scale the entire 10 yr stream of forecast TAC levels according to this error

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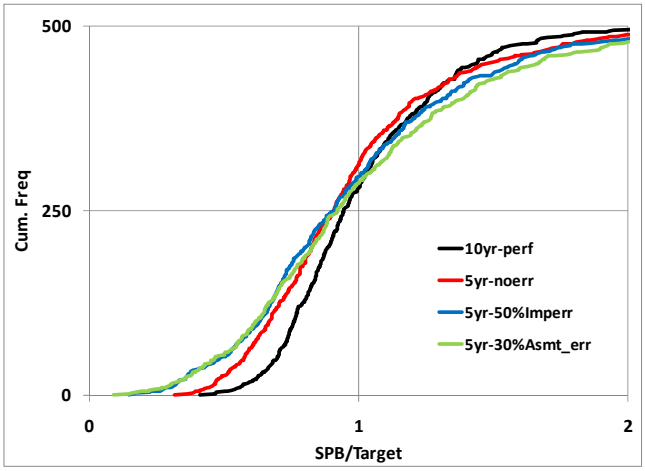
5-Year Forecast Result



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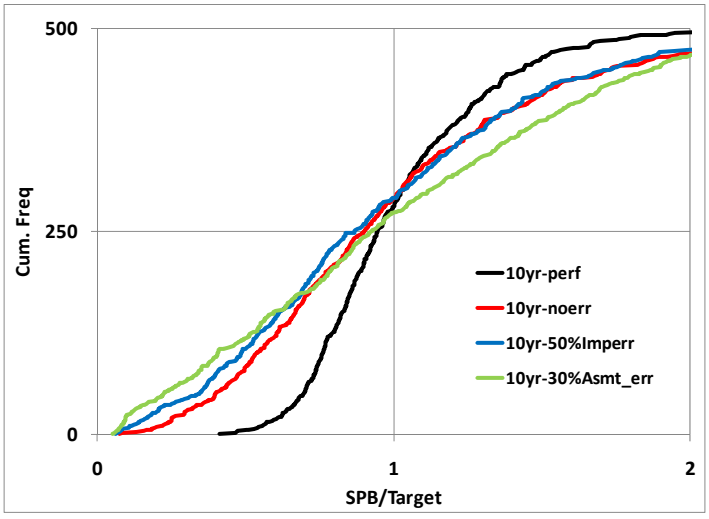
10-Year Forecast Result



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Implementation

Stock Synthesis is close to having this two-stage forecast capability

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Questions?

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