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Management Strategy Evaluation** for North Pacific Albacore Tuna

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(MOW4) Harvest Strategy Workshop

30 November – 1 December 2015
Kuta, Bali, Indonesia

** Much of this material was swiped from work on Sablefish by Sean Cox & Ashleen Benson (Simon Fraser University) & Rob Kronlund (DFO, Canada)

Canada

Overview

- Background
- Management strategy evaluation
  - Purpose
  - Process
  - Roles
- Management Objectives
  - Things That Matter
  - Qualities of Good Management Objectives
  - Operational Objectives
- Simulation Testing
- North Pacific Albacore

Background

* NC10 management framework for NPALB; policy goals for management & LRP
* Request for ISC-ALBWG to conduct analysis to evaluate the range of options for TRP; using a Management Strategy Evaluation (MSE) approach, if appropriate.
* NC supportive of a MSE, if appropriate, to yield new information that would enhance the robustness of the management framework.
* ISC-ALBWG concludes that MSE is the only viable approach to assessing candidate TRPs and that there are scientific issues that can be explored through this process
* ISC and JFA sponsor MSE workshop for managers; Yokohama, April 2015
* Plans for MSE process at NC11 and begins process to identify management objectives (HSW-IP-02 NC11-IP-12)

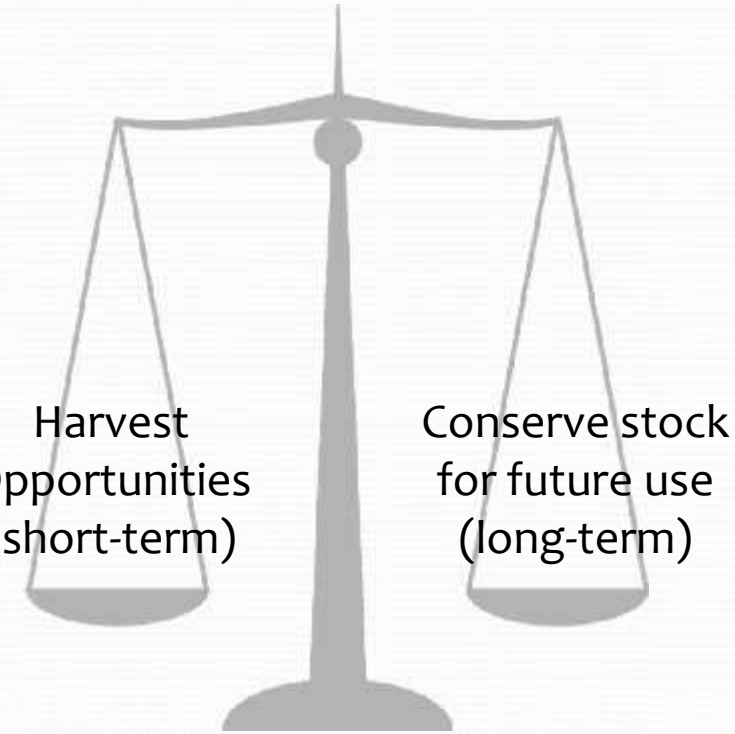
Introduction

* MSE is new to many (including scientists) so lots of education is needed; one reason many of us find it hard to understand is because it has its own jargon/terminology (also because it is highly technical)
* HSW-IP-02 NC11-IP-12 briefly explains some MSE terms to help NC members formulate ideas for input on management objectives for NPALB
* Explanation and visual cues to enhance understanding of key terms

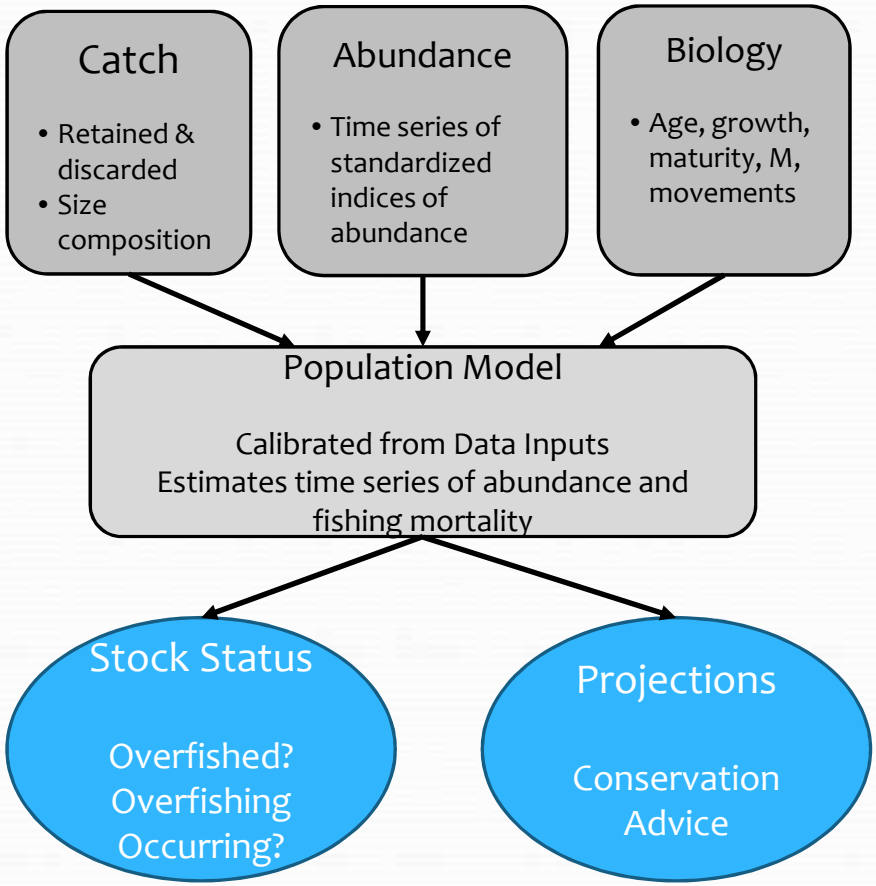
Main Points

- Scientists can play a role in developing a harvest strategy approach for tuna stocks (as per CMM2014-06) using management strategy evaluation (MSE) as identified in the NC NPALB management framework
- Scientists could make all the necessary choices for MSE … if the sole objective is to maximize annual yield
- Otherwise, a structured approach is needed to:
  - Define objectives, harvest control rules, and acceptable risk from stakeholders;
  - Define working hypotheses for ecological and fishery dynamics; and
  - Evaluate consequences of alternative management procedures (relative to the objectives).

Dilemma of Fisheries Management



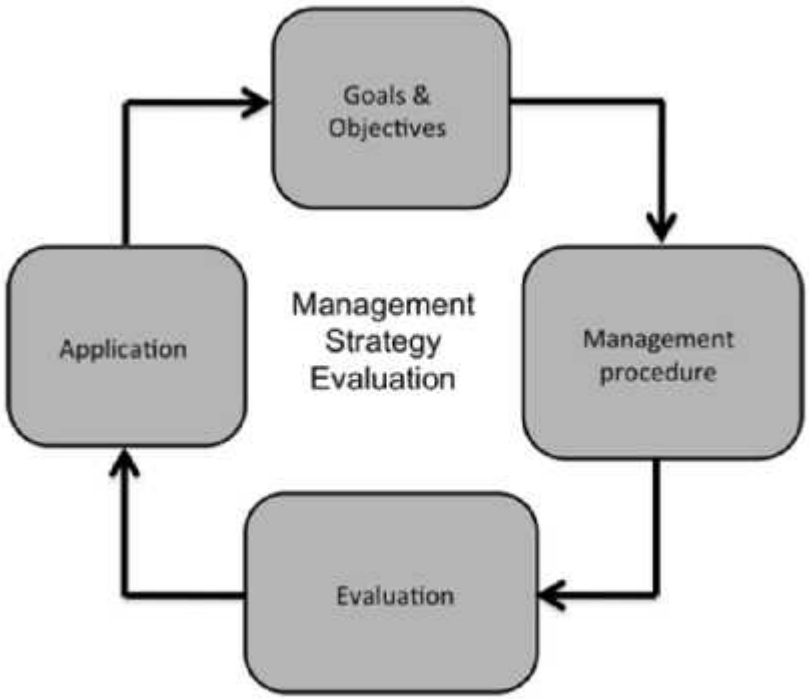
Best Assessment Approach**



- Current assessment approach, leads to most plausible model
- Characterizes risk due to measurement and process uncertainties
- Results may change between assessments due to changes in assumptions, estimation methods, or weights put on data sources.
- Low engagement with managers/stakeholders
- Confusion among managers/stakeholders

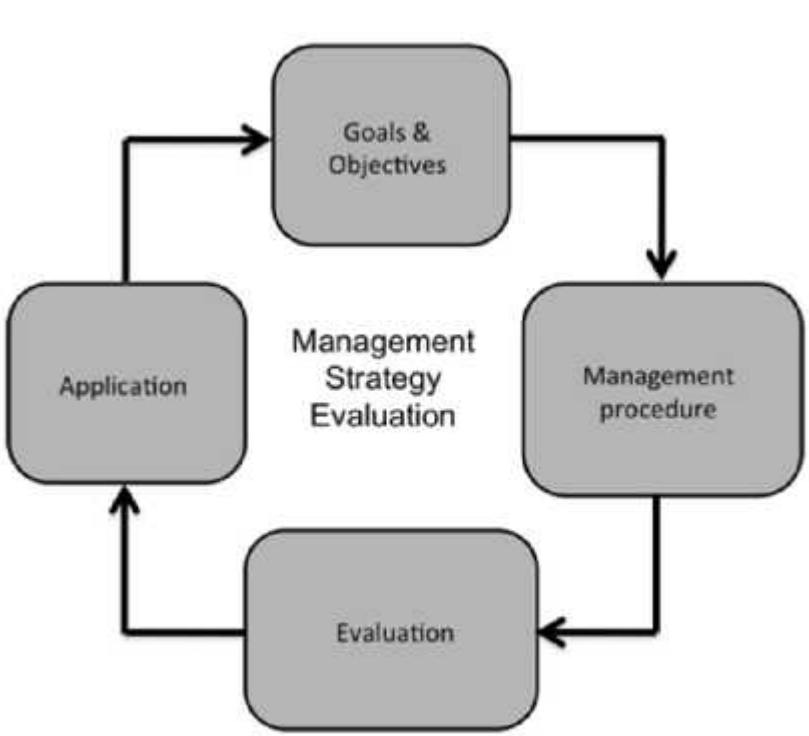
** http://www.st.nmfs.noaa.gov/stock-assessment/stock-assessment-prioritization

Management Strategy Evaluation



- Structured approach to designing fishery management systems that meet stakeholder and manager objectives
- Accounts for scientific and management-related uncertainties
- Simulated world in which management and scientific issues ("*what if*" questions) can be evaluated before being considered for the "wild"
- Results highlight trade-offs among objectives in more transparent way

Management Strategy Evaluation



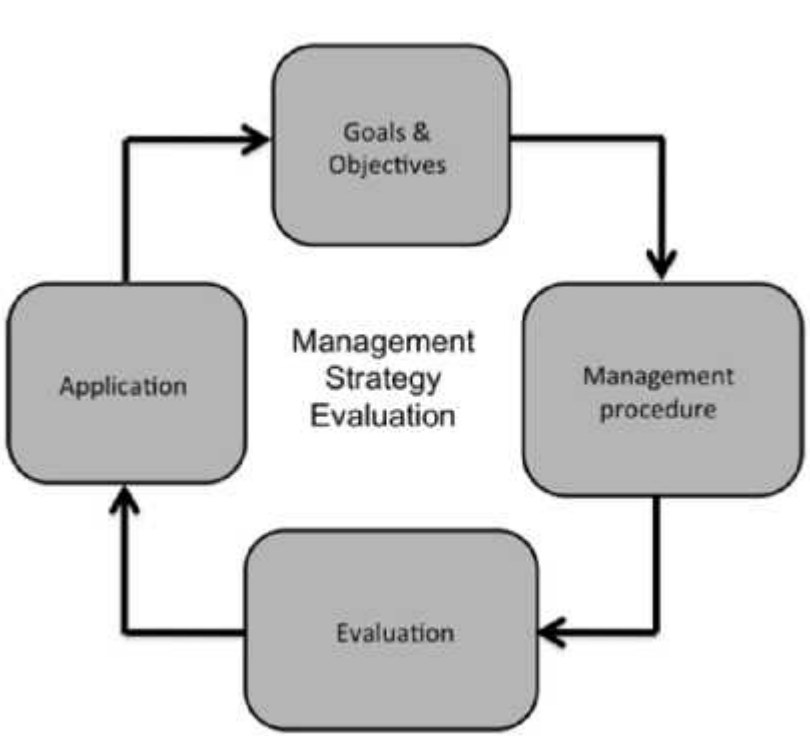
Positives

* Multiple working hypotheses
* Focus on robustness
* High stakeholder engagement
* Management-oriented

Negatives

* Slow, laborious, open-ended
* Technical
* Expensive
* Management-stakeholder confusion

Management Strategy Evaluation - Process



* Identify Management Objectives
* Define alternative Management Procedures (MPs) – pathway from data to management action
  * Fishery monitoring data
  * Assessment (evaluation of the data)
  * Harvest control rules – rules for determining catch or effort limits
* Define Operating Models: working hypotheses for population/fishery dynamics
* Explore implications and trade-offs of alternative objectives

Management Strategy Evaluation - Roles

Managers/Stakeholders

* Identify objectives for the stock and fishery;
* Identify management procedures and performance measures to evaluate MPs;
* Identify acceptable risk
* Make decisions on the final management procedure

Scientists

* Quantify the objectives for the stock and fishery;
* Identify the range of management procedure choices;
* Identify uncertainties (data, assessment, management) to represent in the operating model(s);
* Evaluate outcomes, and
* Communicate results, highlighting trade-offs.

Management Objectives

Statements About Things that Matter

* Ecological value (Stock sustainability)
  * Abundance
  * Size/age composition
  * Spatial distribution
* Socio-economic value (Fishery sustainability)
  * Food, social, ceremonial
  * Average annual catch
  * Catch stability
* Cultural value (Sustainability of Participation)
  * Fishing opportunities
  * Traditional use

Four Good Qualities

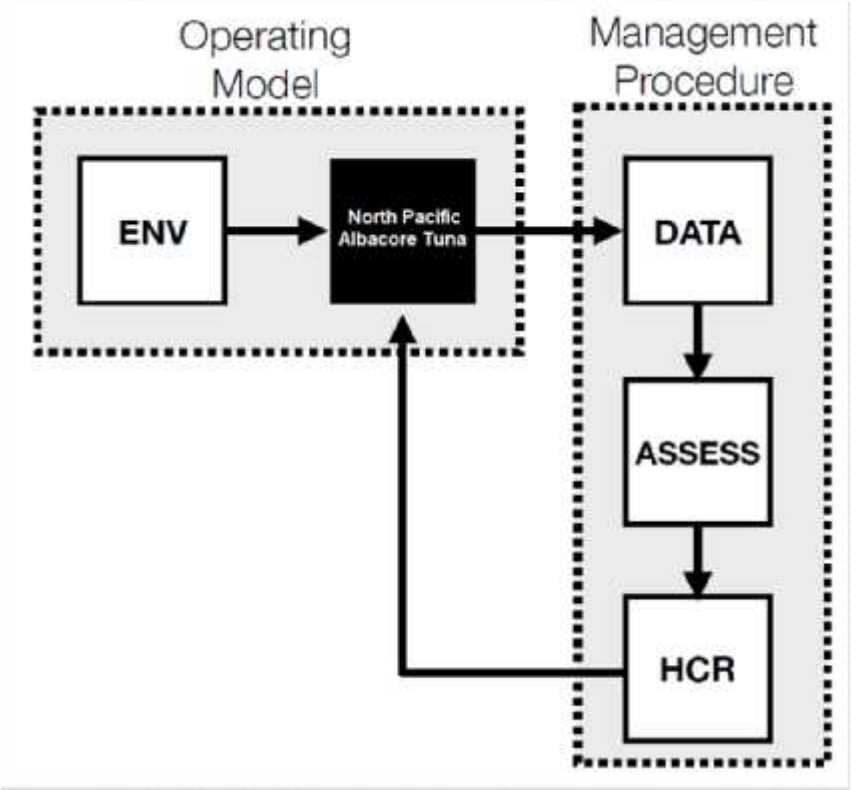
1. Complete
   * Nothing important is left out
2. Concise
   * 6-10 clear statements of what matters
   * No duplication
3. Understandable
   * Immediately clear and understood by everyone;
   * Directly connected to what matters
4. Sensitive
   * An objective should be useful in distinguishing among alternative MPs

Canadian Sablefish Management Objectives**

1. Maintain spawning stock biomass above the limit reference point LRP = 0.4BMSY, where BMSY is the spawning biomass at maximum sustainable yield, in 95% of years measured over two Sablefish generations (36 years);
2. When spawning biomass falls in the Cautious Zone, limit the probability of decline over the next 10 years from very low (5%) at the LRP to moderate (50%) at the TRP. At intermediate stock status levels, define the tolerance for decline by linearly interpolating between these probabilities;
3. Maintain the spawning biomass above the TRP in 50% of projection years measured over two generations;
4. Maintain 10-year average annual variability in catch (AAV) of less than 15%; and
5. Maximize the median average catch over the first 10 projection years.

**Cox et al. 2008. Environ. Conserv. 40(4): 318-328.

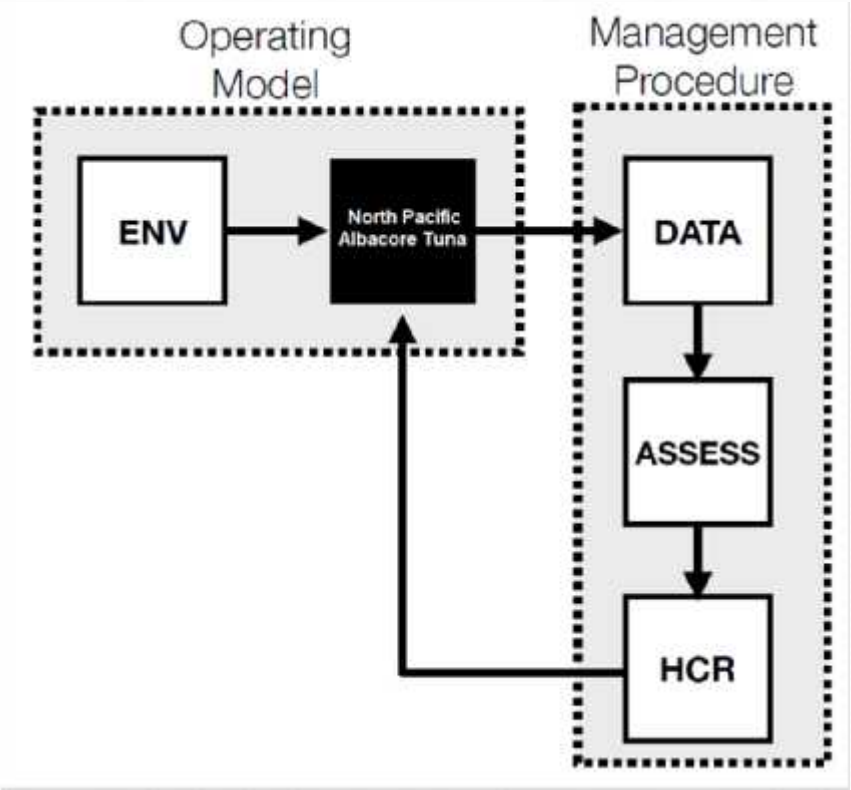
Simulation Testing



- Operating Model = Scenarios: Alternative states of nature
- Structural hypotheses about the stock &/or fishery dynamics. For example, future recruitment, spatial dynamics, IUU
- Can be several plausible OMs
- Operating models generate the data used in the Management Procedure
- Plausible Operating Models are conditioned on existing data
- Differences in how data are evaluated (with/without assessment model), elements of HCRs (LRP, TRP, harvest rates) constitute different Management Procedures
- Management procedures should be designed to achieve Management Objectives

From Sean Cox, Simon Fraser University, BC, Canada

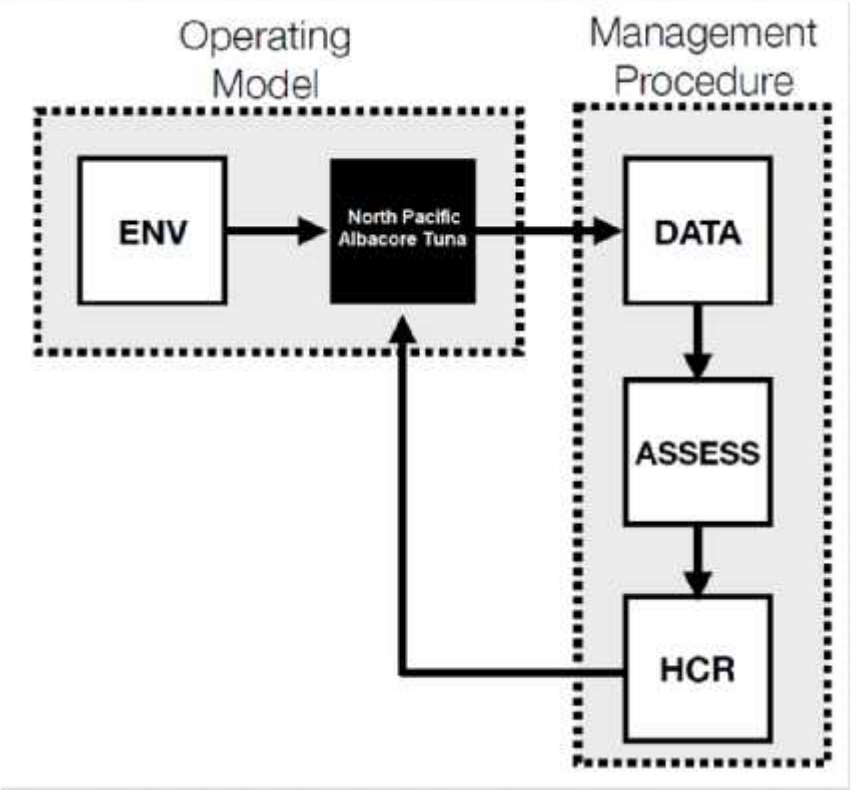
Simulation Testing



- Robustness of management procedure is evaluated by testing across several operating models
- "Best management procedure" is the one that most closely meets the management objectives over a range of plausible scenarios
- Robust to uncertainties about the real world

From Sean Cox, Simon Fraser University, BC, Canada

Simulation Testing



* Success of MPs is judged by comparing a set of statistics collected over pre-determined period of time (performance indicators/criteria)
* Performance indicators/criteria are obtained by simulating the MPs into the future using simulated data collected up to each point in the future.
* A successful management procedure should, on average, achieve the desired management objectives even if the stock assessment component of the procedure is incorrectly structured or the results are erroneous.

From Sean Cox, Simon Fraser University, BC, Canada

Harvest Control Rules

* Harvest control rules are pre-agreed rules used to determine catch or effort levels.
* Reference points are not Harvest Control Rules (HCRs), but may be used as control points in a HCR
* Limit Reference Point:
  * A threshold state of a stock (or fishery) that is undesirable based on scientific information; e.g., collapse, weak recruitment, genetic selection, irreversible changes, uneconomical fishing
  * Avoid with high probability; e.g., 80%-95% of years
* Target Reference Point:
  * A state of a stock/fishery that is considered desirable and at which management action should aim; often based on socio-economic criteria
  * Achieve with moderate probability; e.g., 50-75% of years

NPALB Objectives

Policy Goals

* *"The management objective for the NP albacore fishery is to maintain the biomass, with reasonable variability, around its current level in order to allow recent exploitation levels to continue and with a low risk of breaching the Limit Reference Point."* (North Pacific Albacore Management Framework, NC10 Summary Report).

Management Objectives

* Ecological
  * "Maintain biomass with low risk of breaching the LRP ($20\%SSB_{current\ F=0}$)"
* Socio-economic
  * "Maintain biomass around its current level in order to allow recent exploitation levels to continue"
  * "Maintain biomass around its current level with reasonable variability"

NPALB Objectives

Policy Goal

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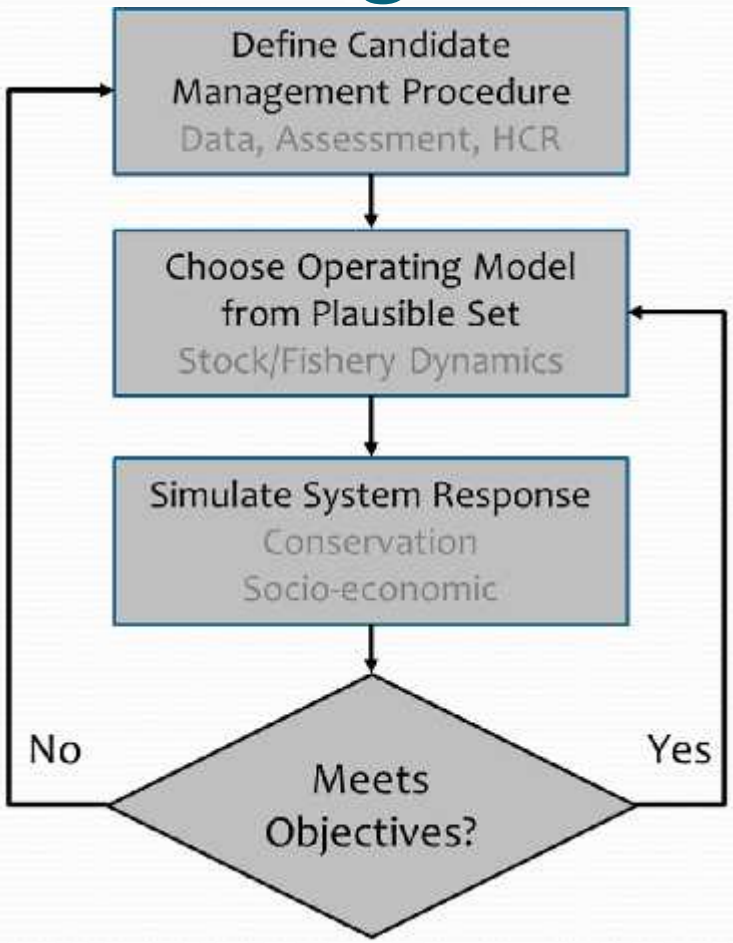
Operational Objectives

* Management objectives need to be quantified into operational objectives for evaluation in MSE
* 3 components of good operational objectives:
  1. target or threshold value (e.g., abundance, inter-annual variation in catch, etc.);
  2. a time period for measurement (e.g., 2-3 generations for abundance, 5-10 yr for catch or catch variability); and
  3. an acceptable probability of either achieving the target or avoiding a threshold (e.g., 50% chance of being above a target, 5% chance below a threshold)

Management Strategy Evaluation – Evaluating TRPs



* Scientific tractability
* Manage broader range of risks
* Logical approach to resource allocation
* Yes – test for robustness across different states of nature
* No – repeat with different MP

From Sean Cox, Simon Fraser University, BC, Canada

Moving MSE Forward: ISC-ALBWG Proposal to NC11

* Preliminary NC member input @ WCPFC12 (HSW-IP-02 NC11-IP-12)
* Management Strategy Evaluation Workshop for Managers/Stakeholders (April 2016) (hands-on)
* Why? Results of evaluations need to be relevant to you
* Goals:
  1. Develop operational objectives (threshold values, time horizon for measurement, probabilities or acceptable risk);
  2. Performance Indicators for each objective;
  3. Harvest Control Rules - model-based rely on quantities estimated by assessment model so evaluated every 3 simulated years; data-based rules using catch/effort data so evaluated every year; and
  4. Operating Model Scenarios (states of nature) – e.g., recruitment regimes, fishery dynamics

Questions?

- The next assessment in April 2017 is the primary focus of ISC-ALBWG scientists
- An MSE analyst (person dedicated to working on MSE) is needed to make sustained progress on this project under the guidance of the ALBWG
- MSE analyst will require about 1 year to deliver prototype simulation environment
- Two timelines:
  - Optimistic? 3-yr to initial delivery of results
  - Realistic? 4-5 yr to delivery of initial evaluations