HIGHLY MIGRATORY SPECIES MANAGEMENT TEAM REPORT ON INTERNATIONAL ISSUES INCLUDING INTER-AMERICAN TROPICAL TUNA COMMISSION (IATTC) MEETING AND NORTH PACIFIC ALBACORE MANAGEMENT STRATEGY EVALUATION

Management Strategy Evaluation (MSE)

In our previous report on MSEs (see Agenda Item E.1.a, HMSMT Report), the HMSMT recommended criteria that should be considered in MSEs conducted by the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). The concepts described in this report could be applied to any ISC stock, for example Pacific bluefin tuna. The HMSMT recommendations were similar to the U.S. proposal to conduct an MSE on north Pacific albacore (NPALB) submitted to the IATTC in 2014 (see Appendix 5d to the Minutes of the 87th IATTC meeting, July 2014). The HMSMT would like to highlight some differences and identify potential new elements to consider, since National Marine Fisheries Service has learned that the ISC's Albacore Working Group intends to evaluate criteria included in the 2014 U.S. proposal. This report clarifies some differences between the U.S. proposal and the HMSMT report. Additionally, the HMSMT provides economic elements to consider for inclusion in the MSE; the current U.S. proposal does not contain any economic criteria.

The 2014 U.S. proposal paired F-based target reference points with spawning stock biomass (SB) limit reference points, while the HMSMT provided separate lists of target and limit reference points that could be evaluated in any or all combinations.

Agenda Item E.1.a, HMSMT Report also recommended testing precautionary catch limits based on a proportional reduction in relation to SB. The 2014 U.S. proposal included a specific application of this concept as a harvest control rule (HCR): "if $SB_{curr} \geq$ SB-limit, TAC [total allowable catch] for the subsequent three years set to correspond to F-target at B_{curr}; if $SB_{curr} <$ SB-limit, TAC for the subsequent three years set to correspond to (F-target*SB_{curr})/SB-limit at B_{curr}". Figure 1 illustrates this relationship between current SB and the corresponding TAC that would be applied.[1] The 2014 U.S. proposal included a parallel rule for an effort-based HCR, which is not part of the HMSMT report recommendations.

The HMSMT report recommended a TAC based on the target reference point. For clarity and consistency, it should be mentioned that, as part of the HMSMT recommendation, the precautionary reduction should be applied in cases when SB falls below the limit.

[1] In the figure, the Y axis is labeled as the ratio of F to F_{TARGET}. F could be converted to a TAC based on the estimated value of current biomass at the time of the management intervention.

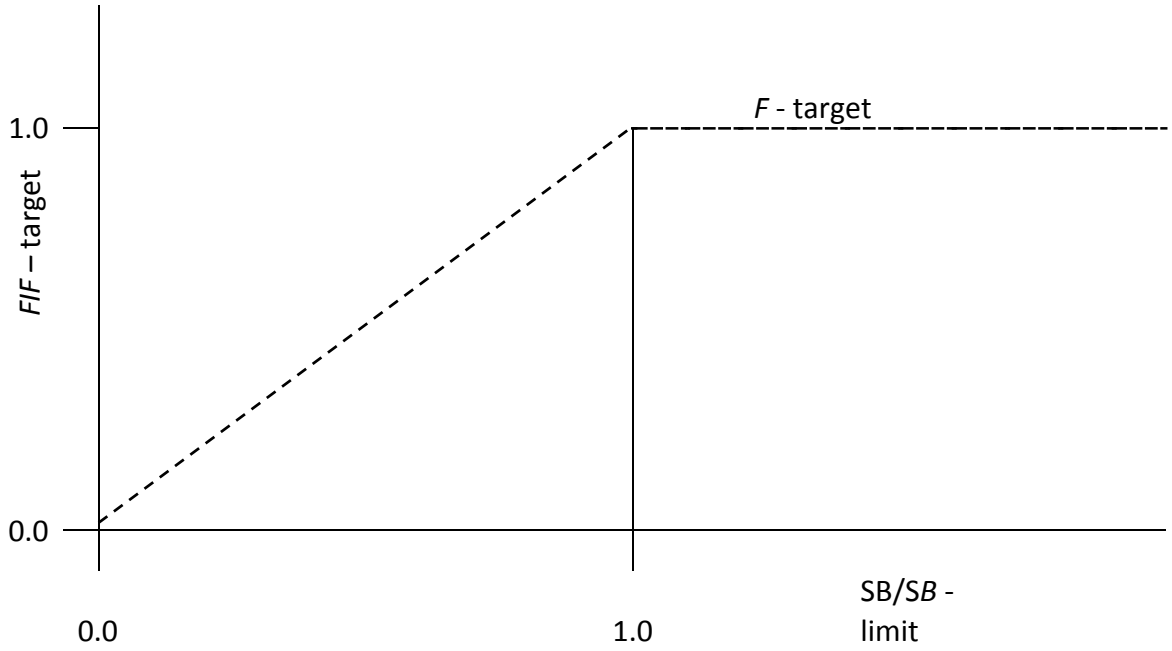

Figure 1. Illustration of the harvest control rule described in the 2014 U.S. proposal.

Additionally, the HMSMT recommends the following economic criteria be considered when evaluating performance of management strategies. See Appendix I for more information on each of these topics.

- Measures of profitability
- Endogenous economic feedback
- Population structure effects
- *De minimis* catch allowances
- Technical change
- Metrics for economic uncertainty

Appendix I – Economic Criteria

At the May 2015 HMSMT meeting in La Jolla, CA, Dr. Gerard DiNardo presented the proposed ISC work plan for MSE research on NPALB. Dr. DiNardo discussed the potential benefits stemming from the application of MSEs, and suggested including economic considerations in the MSE process. This report discusses possible economic elements that could be included in MSEs as they are developed for NPALB and various other HMS stock assessments.

Measures of Profitability

Profitability measures can be used to compare the economic effects of alternative management strategies. It is possible to convert projected biomass removals under alternative conservation management scenarios into measures of variable profits (e.g. quasi-rents) by using fisheries-level price data from landings databases, unit cost data from cost and earnings surveys and a round-to-

dressed weight conversion factor. With a discount rate assumption, the discounted present value of variable profits can be calculated. Because MSE projections account for feedback from current removals on future stock status, the opportunity cost of current management on future profitability would be implicitly considered in the discounted present value calculation.

Endogenous Economic Feedback

Endogenous economic feedback refers to the human behavioral response to changing conditions in a fishery. While existing MSE methodology routinely models biological feedback from current removals and population growth on future stock status, predictable changes in human behavior are not similarly considered. Examples of potential economic feedback to management changes include supply response and demand response.

Supply response describes the effect of changes in fishing costs on the market supply of fish. The dependence of fishing mortality on abundance could be quantified using historic data on abundance, catch rates and participation, and used to parameterize a model of the feedback effect of future stock conditions on effort; this approach could lead to less volatile MSE projections of future abundance in cases where an inverse relationship between effort and abundance results in an automatic stabilizing effect. Other supply response examples include the effects of changes in taxes or subsidies, the retail price of fish, fuel costs or labor costs on fishing effort, catch, landings, revenues, and profits.

Demand response occurs when management actions that affect supply have a feedback effect on the price of fish, due to the inverse relationship between quantity and price along the demand curve. Price flexibilities measure the price response to a change in supply. Price flexibility measures could be included in an MSE to allow quantifying the effect of price response to management measures on revenues and profits.

Population Structure Effects

Management measures to address population structure concerns have potential economic effects that could be measured using the MSE operating model. For example, an overfished SB could lead to management measures to reduce effort in the fishery sectors with high levels of adult mortality. A spatial model of population age structure could be tied to information on the age selectivity of constituent fleets to jointly estimate the spatial population and economic impacts under alternative management strategies. Such information could be important for trans-Pacific HMS fisheries such as those for albacore or Pacific bluefin tuna, whose component fisheries differ by gear selectivity and local age structure.

De Minimis Catch Allowances

De minimis catch allowances are a strategy to increase management effectiveness by avoiding costly regulatory measures for fisheries which contribute a minimal share of *F*. Regulating a fishery with a small share of total *F* may create an economic loss to the fishery and regulatory authorities that exceeds the marginal benefits of stock conservation. The difference in discounted present value of future profits under with- and without-*de minimis* catch allowances can be used to measure the opportunity cost of lost conservation benefits due to *de minimis* catch allowances.

Technical Change

Technical change leads to changes in fishing power ("catchability"). The incentive to increase profits through higher catch rates plus the potential to borrow emerging technologies from other industries creates a bias over time towards increased fishing power. A possible implication is that effort controls may fail to achieve their full intended effect in case of offsetting increases in fishing power due to technical change. Various modeling strategies, such as a random walk model with increasing trend, have been developed to account for the effects of technical change on fisheries operation.

Metrics for Economic Uncertainty

Economic uncertainty concerns the effect of unpredictable fluctuations in stock conditions on the management response, and related impacts on allowable effort, catch, revenues, profits and fishing capital. Management strategies which appear best from a biological perspective may prove suboptimal in consideration of economic uncertainty. For example, managing to a target reference point which includes a buffer for process and observation error could potentially reduce negative economic impacts and management volatility due to frequently imposed regulatory limits on effort or catch when a limit reference point is exceeded. Metrics could be developed to quantify the economic uncertainty effects of management alternatives.

PFMC
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