Glossary of terms for harvest strategies, management procedures and management strategy evaluation

- This glossary was developed to encourage a consistent use of terms associated with harvest strategies, management procedures and management strategy evaluation processes underway across the five tuna RFMOs.
- It was developed from a range of sources, including ISSF, Rademeyer *et al*. 2007, IOTC, PEW Charitable Trust and a range of MSE practitioners with broad experience across tuna and other fisheries.
- A draft of the glossary was reviewed by participants in the 2018 Joint tuna RFMO Management Strategy Evaluation Working Group Meeting in Seattle and adopted for the purposes of improving consistency and clarity of communication in tRFMO MSE processes.
- The glossary is available for use by others with appropriate acknowledgement. (Anon. 2018. Glossary of terms for harvest strategies, management procedures and management strategy evaluation, http://www.tuna-org.org/Documents/MSEGlossary_tRFMO_MSEWG2018.pdf.)

Terms commonly used in Management Strategy Evaluation or Management Procedure literature

Term	Definition	Abbreviation/Symbol
Average Annual Variation (in catch/TAC)	The absolute value of the proportional TAC change each year, averaged over the projection period.	**AAV**
Biomass	Stock biomass, which may refer to various components of the stock. Often spawning stock biomass (SSB) of females is used, as the greatest conservation concern is to maintain the reproductive component of the resource.	**B**
Candidate Management Procedure	An MP (defined below) that has been proposed, but not yet adopted.	**CMP**
Conditioning	The process of fitting an Operating Model (OM) of the resource dynamics to the available data on the basis of some statistical criterion, such as a Maximum Likelihood. The aim of conditioning is to select those OMs consistent with the data and reject OMs that do not fit these data satisfactorily and, as such, are considered implausible.	
Error	Differences, primarily reflecting uncertainties in the relationship between the actual dynamics of the resource (described by the OMs) and observations. Four types of error may be distinguished, and simulation trials may take account of one or more of these: • Estimation error: differences between the actual values of the parameters of the OM and those provided by the estimator when fitting a model to the available data; • Implementation error: differences between intended management actions (as output by an MP) and those actually achieved (e.g. reflecting over-catch); • Observation error (or measurement error): differences between the measured value of some resource index and the corresponding value calculated by the OM; • Process error: natural variations in resource dynamics (e.g., fluctuations about a stock-recruitment curve or variation in fishery or survey selectivity /catchability).	

Term	Definition	Abbreviation/Symbol
Estimator	The statistical estimation process within a population model (assessment or OM); in a Management Strategy Evaluation (MSE) context, the component that provides information on resource status and productivity from past and generated future resource-monitoring data for input to the Harvest Control Rule (HCR) component of an MP in projections.	
Exceptional circumstances	Specifications of circumstances (primarily related to future monitoring data falling outside the range covered by simulation testing) where overriding of the output from a Management Procedure should be considered, together with broad principles to govern the action to take in such an event.	
Feedback Control	Rules or algorithms based, directly or indirectly, on trends in observations of resource indices, which adjust the management actions (such as a TAC change) in directions that will change resource abundance towards a level consistent with decision makers' objectives.	
Harvest Control Rule (also Decision Rule)	A pre-agreed and well-defined rule or action(s) that describes how management should adjust management measures in response to the state of specified indicator(s) of stock status. This is described by a mathematical formula.	**HCR**
Harvest Strategy	Some combination of monitoring, assessment, harvest control rule and management action designed to meet the stated objectives of a fishery. Sometimes referred to as a Management Strategy (see below). A fully specified harvest strategy that has been simulation tested for performance and adequate robustness to uncertainties is often referred to as a Management Procedure.	**HS**
Implementation	The practical application of a Harvest Strategy to provide a resource management recommendation.	
Kobe Plot	A plot that shows the current stock status, or a trajectory over time for a fished population, with abundance on the horizontal axis and fishing mortality on the vertical axis. These are often shown relative to B_{MSY} and to F_{MSY}, respectively. A Kobe plot is often divided into four quadrants by a vertical line at $B=B_{MSY}$ and a horizontal line at $F=F_{MSY}$.	
Limit Reference Point	A level of biomass below, or fishing mortality above, which an actual value would be considered undesirable, and which management action should seek to avoid.	**LRP**
Management Objectives	The social, economic, biological, ecosystem, and political (or other) goals for a given management unit (i.e. stock). These typically conflict, and include concepts such as maximising catches over time, minimising the chance of unintended stock depletion, and enhancing industry stability through low inter-annual variability in catches. For the purposes of Management Strategy Evaluation (MSE) these objective need to be quantified in the form of Performance statistics (see below).	**Objectives, MOs**

Term	Definition	Abbreviation/Symbol
Management Plan	In a broad fisheries governance context, a Management Plan is the combination of policies, regulations and management approaches adopted by the management authority to reach established societal objectives. The management plan generally includes the combination of policy principles and forms of management measures, monitoring and compliance that will be used to regulate the fishery, such as the nature of access rights, allocation of resources to stakeholders, controls on inputs (e.g. fishing capacity, gear regulations), outputs (e.g. quotas, minimum size at landing), and fishing operations restrictions (e.g. closed areas and seasons). Ideally, the Management Plan will also include the Harvest Strategy for the fishery or a set of principles and guidelines for the specification, implementation and review of a formal Management Procedure for target and non-target species.	
Management Procedure	A management procedure has the same components as a harvest strategy. The distinction is that each component of a Management Procedure is *formally specified, and **the combination*** of monitoring data, analysis method, harvest control rule and management measure has been simulation tested to demonstrate adequately robust performance in the face of plausible uncertainties about stock and fishery dynamics.	**MP**
Management Strategy	Synonymous with harvest strategy. (But note that this is also used with a broader meaning in a range of other contexts.)	
Management Strategy Evaluation	A process whereby the performances of alternative harvest strategies are tested and compared using stochastic simulations of stock and fishery dynamics against a set of performance statistics developed to quantify the attainment of management objectives.	**MSE**
Maximum Economic Yield	The (typically annual) yield that can be taken continuously from a stock sustainably (i.e. without reducing its size) that maximizes the economic yield of a fishery in equilibrium. This yield occurs at the effort level that creates the largest positive difference between total revenues and total costs of fishing (including the cost of labor, capital, management and research etc.), thus maximizing profits.	**MEY**
Maximum Sustainable Yield	The largest (typically annual) yield that can be taken continuously from a stock sustainably (i.e. without reducing its size). In real, and consequently stochastic situations, this is usually estimated as the largest average long-term yield that can be obtained by applying a constant fishing mortality F, where that F is denoted as F_{MSY}.	**MSY**
Observation Model	The component of the OM that generates fishery-dependent and/or fishery-independent resource monitoring data from the underling true status of the resource provided by the OM, for input to an MP.	

Term	Definition	Abbreviation/Symbol
Operating Model(s)	A mathematical–statistical model (usually models) used to describe the fishery dynamics in simulation trials, including the specifications for generating simulated resource monitoring data when projecting forward in time. Multiple models will usually be considered to reflect the uncertainties about the dynamics of the resource and fishery.	**OM(s)**
Performance statistics/measures	A set of statistics used to evaluate the performance of Candidate MPs (CMPs) against specified management objectives, and the robustness of these MPs to important uncertainties in resource and fishery dynamics.	
Plausibility (weights)	The likelihood of a scenario considered in simulation trials representing reality, relative to other scenarios also under consideration. Plausibility may be estimated formally based on some statistical approach, or specified based on expert judgement, and can be used to weight performance statistics when integrating over results for different scenarios (OMs).	
Precautionary Approach	An approach to resource management in which, where there are threats of serious irreversible environmental damage, lack of full scientific certainty is not used as a reason for postponing cost-effective measures to prevent environmental degradation.	**PA**
Reference case (also termed reference scenario or base case)	A single, typically central, conditioned OM for evaluating Candidate MPs (CMPs) that provides a pragmatic basis for comparison of performance statistics of the CMPs.	**RC (or BC)**
Reference set (also termed base-case or evaluation scenarios)	A limited set of scenarios, with their associated conditioned OMs, which include the most important uncertainties in the model structure, parameters, and data (i.e. alternative scenarios which have both high plausibility and major impacts on performance statistics of Candidate MPs).	**RS**
Research-conditional option	Temporary application of an MP that does not satisfy conservation performance criteria, accompanied by both a research programme to check the plausibility of the scenarios that gave rise to this poor performance and an agreed subsequent reduction in catches should the research prove unable to demonstrate implausibility.	
Robustness tests	Tests to examine the performance of an MP across a full range (i.e. beyond the range of the Reference Set of models alone) of plausible scenarios. While plausible, robustness test OMs are typically considered to be less likely than the reference set OMs, and often focus on particularly challenging circumstances with potentially negative consequences to be avoided.	
Scenario	A hypothesis concerning resource status and dynamics or fishery operations, represented mathematically as an OM.	

Term	Definition	Abbreviation/Symbol
Simulation trial/test	A computer simulation to project stock and fishery dynamics for a particular scenario forward for a specified period, under controls specified by a HS or MP, to ascertain the performance of that HS or MP. Such projections will typically be repeated a large number of times to capture stochasticity.	
Spawning Biomass, initial	Initial spawning biomass prior to fishing as estimated from a stock assessment.	SSB_0
Spawning Biomass, current	Spawning biomass (SSB) in the last year(s) of the stock assessment.	$SSB_{current}$
Spawning Biomass at MSY	The equilibrium spawning biomass that results from fishing at F_{MSY}. In the presence of recruitment variability, fishing a stock at F_{MSY} will result in a biomass that fluctuates above and below SSB_{MSY}.	SSB_{MSY}
Stationarity	The assumption that population parameter values are fixed (at least in expectation), and not varying systematically, over time. This is a standard assumption for many aspects of stock assessments, OMs and management plans.	
Stock assessment	The process of **estimating** stock abundance and the impact of fishing on the stock, similar in many respects to the process of conditioning OMs.	
Target Reference Point	The point which corresponds to a state of a fishery and/or resource which is considered desirable and which management aims to achieve.	TRP
Trade-offs	A balance, or compromise, achieved between desirable but conflicting objectives when evaluating alternative MPs. Trade-offs arise because of the multiple objectives in fisheries management and the fact that some objectives conflict (e.g. maximizing catch vs minimizing risk of unintended depletion).	
Tuning	The process of adjusting values of control parameters of the Harvest Control Rule in a Management Procedure to achieve a single, precisely-defined performance statistic in a specified simulation test. This reduces confounding effects to allow the performance of different candidate MPs to be compared more readily with respect to other management objectives. For example, in the case of evaluating rebuilding plans, all candidate MPs might be tuned to meet the rebuilding objective for a specified simulation trial; then the focus of comparisons among MPs is performance and behaviour with respect to catch and CPUE dimensions.	
Weight(s)	Either qualitative (e.g. high, medium, low) or quantitative measures of relative plausibility accorded across a set of scenarios.	
Worm plot	Time series plots showing a number of possible realizations of simulated projections of, for example, catch or spawning biomass under the application of an MP for a specific OM or weighted set of OMs.	