SPRFMO THIRD WORKSHOP - DEEP WATER WORKING GROUP

SCW3-04 – Overview of existing and potential reference points for demersal fisheries in the SPRFMO

OBJECTIVES

1. Consider reference points used by different countries and how limit and target reference points may need to be applied to assist with provision of scientific advice on bottom fishing to SPRFMO.

RATIONALE

Reference points are a common component of fishery harvest strategies and allow scientists and managers to apply the results of stock assessments to the setting of biologically sustainable catches. Reference points often vary between different jurisdictions, and may also vary within those jurisdictions based on the species, fishery characteristics and other factors. For example, New Zealand and Australia adopt slightly different limit and target reference points as part of their domestic fishery harvest strategies. These differences need to be considered, and potentially resolved, to enable the establishment of equitable and accepted catch limits and approaches to dealing with stocks that may be 'overfished' or 'subject to overfishing'.

Australia

Harvest strategies for key commercial species taken in Australia's Commonwealth fisheries are designed to pursue the objective of maximising the economic yield from the fishery, and ensure fish stocks remain above levels at which the risk to the stock is unacceptably high.

The Harvest Strategy Policy specifies minimum standards for reference points as detailed below:

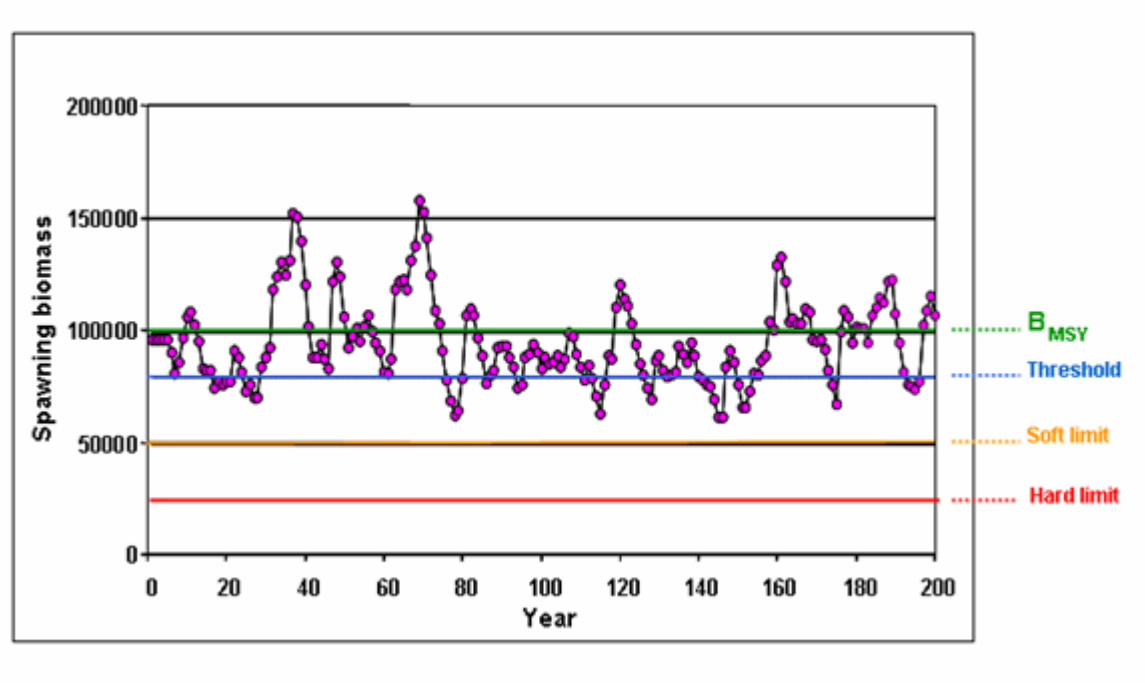
- B_{TARG} (or proxy) equal to or greater than B_{MEY}. In cases where B_{MEY} is unknown, a proxy of $1.2B_{MSY}$ (or a level 20% higher than a given proxy for B_{MSY}) is to be used. AFMA may approve the use of an alternative proxy for B_{MEY} if it can be demonstrated that a more appropriate alternative exists;
- B_{LIM} (or proxy) equal to or greater than ½ B_{MSY} (or proxy);
- F_{LIM} (or proxy) less than or equal to F_{MSY} (or proxy)
- F_{TARG} (or proxy) at the level required to maintain the stock at B_{TARG}.

New Zealand

The Harvest Strategy Standard for New Zealand Fisheries recommends default proxies for B_{MSY} (expressed as $\%B_0$) and F_{MSY} (expressed as $F_{\%SPR}$ levels from spawning biomass per recruit analysis).

Default proxies for B_{MSY} and F_{MSY}		
Productivity level	$\%B_0$	$F_{\%SPR}$
High productivity	25%	F30%
Medium productivity	35%	F40%
Low productivity	40%	F45%
Very low productivity	≥45%	≤F50%

The following figure illustrates the basis for the threshold, soft limit and hard limit: the threshold should encompass most of the range of natural fluctuations; the soft limit should generally be near or below this range; and the hard limit should be well below the natural range of fluctuations for a well-managed stock. This figure is for illustrative purposes only. The Harvest Strategy Standard itself does not require the use of a threshold.



Australia's orange roughy harvest strategy

Most domestic orange roughy stocks in Australia are managed under the harvest strategy framework for the Southern and Eastern Scalefish and Shark Fishery. Under this framework, a stock is defined as *subject to overfishing* if the current fishing mortality rate exceeds the limit reference point FLIM for a particular biomass value. FLIM is the fishing mortality rate that would result in a spawning biomass of BLIM (the default proxy for which is B20). The stock is defined as *overfished* if the biomass is estimated to be below BLIM.

Orange roughy stocks in Australia are managed using the proxy biomass limit and target reference points (B20 and B48, respectively).

Tier 1

For integrated stock assessments, the recommended maximum fishing mortality rate and the harvest control rule (HCR) inflection point occurs at a proxy of F35. The target fishing mortality rate FTARG represents the fishing mortality rate that would result in a spawning biomass of BTARG (equal to BMEY). The default value for FTARG is F48, the value of F corresponding to a BTARG of B48.

Recommended biological catches (RBCs) are determined for different 'tiers' of stock assessment. For tier 1 (integrated) stock assessments, where there is a robust quantitative assessment that provides estimates of BCURR, B35, B20 and F48, the formula for calculating FTARG is as follows:

F_{TARG}	**Biomass level**
$F_{TARG} = F_{48}$	where $B_{CUR} > B_{35}$
$F_{TARG} = F_{48} * (B_{CUR}/B_{20} - 1)$	where $B_{35} > B_{CUR} > B_{20}$
$F_{TARG} = 0$	where $B_{CUR} < B_{20}$

The RBC is calculated by applying FTARG to BCURR to calculate the total catch (including discards) in the next year, using the agreed base case assessment model:

RBC = Catch(FTARG -> BCURR)

At tier 1, BLIM = B20, the maximum value for FTARG = F48 and the breakpoint in the HCR occurs at B35.

Tier 3

The Tier 3 HCR applies to species and/or stocks that do not have a quantitative stock assessment, but where estimates of fishing mortality and other biological information are available. Tier 3 HCR information can be found at: http://www.afma.gov.au/wp-content/uploads/2014/11/Harvest-Strategy-Framework-SESSF-Feb-2014.pdf

Tier 4

The Tier 4 HCR applies to species and/or stocks where there is no reliable information available on either the current biomass or current exploitation rate. It is assumed that there is information available on current catch levels and trends in catch rates.

The Tier 4 control rule is of the form:

$$RBC = C * \max\left(0, \frac{\overline{CPUE} - CPUE_{\lim}}{CPUE_{targ} - CPUE_{\lim}}\right)$$

where: CPUEtarg is the target catch per unit effort (CPUE) for the species, CPUE lim is the limit CPUE for the species, CPUE is the average CPUE over the most recent m years, C* is a catch target derived from a historical period that has been identified as a desirable target in terms of CPUE, catches and status of the fishery.

No Australian orange roughy stocks are managed under the tier 3 or 4 HCRs.

New Zealand's Orange Roughy Harvest Strategy

The principal objective of the Orange roughy Harvest Control Rule (HCR) is to maintain stock status within the target range:
Target reference point 50% B_0
Limit reference point 20%B_0

The HCR has been tested using Management Strategy Evaluation (MSE), which estimates that it will maintain stock status around 42% B_0 and within the management target range 97% of the time. It also estimates that, under this HCR, the stock will not decline below 20% B_0. Under this HCR, catch limits would be set based on an F_{mid} of 0.045. This means that if a stock is estimated to be at 40% B_0, the midpoint of the target range, the recommended catch would be based on F = 0.045 (i.e. 4.5% of the current vulnerable biomass).

If a stock is estimated to be within the target range, the recommended catch limit would be estimated, based on the slope of the HCR within this range (i.e. between 0.034 at 30% B_0 and 0.056 at 50% B_0). When the stock status is estimated to be greater than 40% B_0, the HCR allows removal of more catch to return the stock to 40% B_0 (i.e. a 'fish down'). Conversely, when the stock size is estimated to be at the lower bound of the management target range, the recommended catch limit would be reduced to 75% of F_{mid} (i.e. to F = 0.034) to provide for the stock size to increase back towards 40% B_0.

For stocks that are outside the management target range (either higher or lower) the HCR provides for an additional 'rescaling' multiplier to provide the required robustness at low stocks sizes and to enable a greater catch to be taken at high stock sizes. The rescaling is designed to prevent the stock declining below 20% B_0 and results in a very high probability of stocks fluctuating within the management target range in the long term. Rescaling would operate at stock sizes below 30% B_0 and above 60% B_0.
At stock sizes below 30% B_0 'rescaling' will decrease the recommended catch limit to ensure the stock moves back into the management target range more quickly and to reduce the risk of the stock continuing to decrease. For example, for a stock at 25% B_0, the recommended catch limit would be calculated based on the slope of the line determined by the HCR (i.e. F =0.025) and, because the stock size is below the management target range, the catch limit would be scaled down by an additional ~8% (i.e. F = 0.023). The exact scalar depends on the stock assessment results. If the stock remains below the target range in subsequent assessments the catch limit could be again scaled down. Similarly, for stock sizes >60% B_0, the catch limit derived from the HCR line would be scaled up by 10% (i.e. F = 0.062).

RELATED PAPERS

SCW3-03 Draft stock assessment framework

Best Practice reference Points for Australian Fisheries

Deepwater Group Orange Roughy Harvest Strategy (http://deepwatergroup.org/wp-content/uploads/2014/08/Orange-Roughy-Harvest-Strategy-w-Appendix-14082014.pdf)

Definitions

Biological Reference Point: A benchmark against which the biomass or abundance of the stock, or the fishing mortality rate (or exploitation rate), or catch itself can be measured in order to determine

stock status. These reference points can be targets, thresholds or limits depending on their intended use (Harvest Strategy Standard for New Zealand Fisheries 2008).

Soft limit: A biomass limit below which the requirement for a formal, time-constrained rebuilding plan is triggered (Harvest Strategy Standard for New Zealand Fisheries 2008).

Hard limit: A biomass limit below which fisheries should be considered for closure (Harvest Strategy Standard for New Zealand Fisheries 2008).

Biomass limit reference point (BLIM): the point beyond which the risk to the stock is regarded as unacceptably high (Commonwealth Fisheries Harvest Strategy Policy, 2007).

Target biomass (BTARG): the desired condition of the stock (Commonwealth Fisheries Harvest Strategy Policy, 2007).