DETERMINING AN APPROPRIATE TARGET BIOMASS REFERENCE POINT FOR THE NEW ZEALAND HOKI FISHERY

Adam Langley
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This paper provides a brief, non technical summary of the key outcomes of the analysis.

Background

1. The New Zealand Harvest Strategy Standard (HSS) specifies that a key component of a Fisheries Plan is the determination of a **target level** for each QMS fish stock which is at least consistent with that specified in the HSS. The target level is formulated to enable yields from stock that are consistent with the MSY while maintaining the biomass of the stock well above the level that would compromise the biological sustainability of the stock (**limit** reference points).The HSS has adopted default values for the **soft limit** and **hard limit** based on international best practice. The default soft limit is 20% B_0, while the default hard limit is 10% B_0 (see Figure 1).
2. Fish stocks rarely remain in an equilibrium state and the inherent variability in stock biomass should be incorporated in the formulation of the target level for a stock. A target level expressed as a specific reference level (for example, 40% of SB_0) will only ever be attainable in a transitory sense. To avoid frequent and potentially unnecessary management interventions, the biomass of a stock should be allowed to fluctuate about the target level within a specified **tolerance** (bracketed by a lower and an upper **threshold** level). A decline in the level of biomass below the lower threshold would invoke a management response that is intended to return the biomass to approximate the target level, whereas, a biomass level above the upper threshold may enable additional catch to be taken from the stock. The **lower threshold** of the target level should be established at a level that ensures there is sufficient time to implement a management measure (or set of measures) that maintains the stock at above the soft limit.

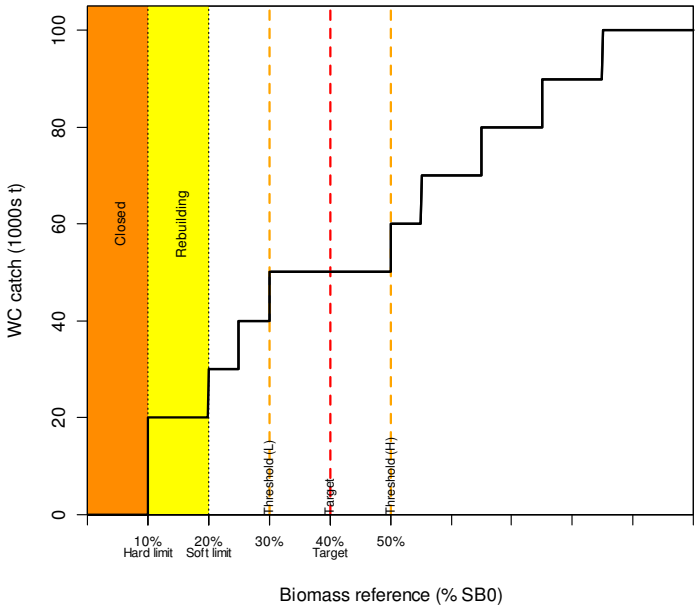

Figure 1. An example of a harvest strategy control rule that would conform with the Harvest Strategy Standard (modified from Ministry of Fisheries 2008). The dashed red vertical line represents the target biomass level and the dashed orange lines represent the lower and upper threshold biomass levels.

3. The current Interim Management Target (IMT) for the hoki fishery is 35–50% of the unfished spawning biomass (SB_0) which is considerably higher than the B_{MSY} level of about 25%. However, B_{MSY} is not an appropriate target for the fishery as managing the stock at this level would result in a high risk of the biomass falling to (very) low levels. A higher level of target biomass provides a buffer that affords managers sufficient time to detect and respond (through a reduction in TACC) to a sustained period of low recruitment. Further, a higher target biomass level enables fishery catch rates to be maintained at a desirable level.

Current study

4. The study applied a Management Strategy Evaluation (MSE) approach to evaluate the IMT and other alternative levels of target biomass and catch scenarios. An equivalent target biomass level is assumed for both stocks (eastern and western). Catch scenarios included a constant catch for the Chatham Rise fishery of 30 000 t, 40 000 t or 50 000t and a constant catch of 10,000 t for the Sub Antarctic. Catches from the WCSI and Cook Strait fisheries were varied about a target catch level (50 000 t or 60 000 t for WCSI; 25 000 t for Cook Strait).
5. The MSE was undertaken using an operating model that was based on the most recent (2009) hoki stock assessment. The MSE simulates a range of plausible trends in future stock biomass and the annual monitoring (by trawl surveys) and assessment. Simulated management actions, in response to trends in stock biomass and recent recruitment, were codified using a series of decision rules.
6. The specific target biomass levels were evaluated against a number of performance indicators defined in collaboration with quota owners at a previous meeting (19 August). The principal criterion for sustainability was the risk of the spawning biomass declining below the soft limit (20% SB_0). Performance criteria related to utilization included maximizing the level of catch, minimizing the frequency of changes in catch limits (stability of TACC) and maintaining fishery CPUE and fish size at or above current levels.

Main conclusions

7. A target biomass range of 30-45% or 30-50% SB_0 is recommended based on an evaluation against the main performance criteria. The lower threshold of the target level enables moderate levels of catch to be maintained while ensuring a low probability of the stock declining below the soft limit (20% SB_0), while also achieving the other utilization criteria. The upper limit (threshold) of the target range is less critical and represents a compromise between stability of TACC (50% SB_0) or a slight increase in average catch (45% SB_0).
8. The recommended target biomass range resulted in a slightly higher level of catch from the WCSI fishery than achieved under the IMT (35–50% SB_0).
9. These conclusions need to be considered relative to the operating model that was used, including the set of decision rules. It is not intended that a set of decision rules would be formally adopted and applied to the management of the hoki fishery. Nonetheless, the evaluation of each of these scenarios is dependent on the decision rules and, therefore, in adopting of a specific target biomass level (e.g. 30-45% or 30-50% SB_0) the fishery managers must be cognisant of the associated management strategies required to support the management of the fishery about the specific target level. For example, the decision rules invoke an immediate reduction in catch if the spawning biomass is "assessed" to be below the lower threshold of the target biomass. A similarly rapid response would be required by fisheries managers to ensure that there was no increase in the probability of the stock declining below the critical bench marks (soft and hard limits).

10. Recent recruitment in the western stock has been highly variable between years and also included a sustained period of low recruitment. The MSE analysis incorporated a high degree of variation in simulated future recruitment. The decision rules specified a range of "management" responses depending on simulated survey estimates of future recruitment. Specifically, catches were reduced from high levels if recent recruitment is estimated to be below average. Adherence to these decision rules resulted in a reduction in the probability that the spawning biomass would decline below the soft limit. This result indicates that these data should continue to be incorporated into annual assessments as is currently done through stock projections.
11. The high variation in recruitment resulted in considerable variation in the level of catch for the WCSI fishery. The results indicated that, for the recommended level of target biomass, an annual average catch of about 130,000 t was sustainable, although total catch levels would be anticipated to vary by ± 20,000 t with changes in the WCSI catch limit each 2-3 years [This assumes a constant catch of 50,000 t for Chatham Rise, 10,000 t for Sub Antarctic and fluctuations in WCSI and Cook Strait catches around a target level of 50,000 t and 25,000 t]. However, the magnitude of the catch and the level of variation are dependent on the assumptions regarding the level of recruitment (based on 1992-2007 recruitment).
12. For all analyses, the eastern stock is maintained at a higher level than the western stock and the constraint of Cook Strait catches not exceeding 30,000 t limits the opportunity to maximise catches from the eastern stock. Further, the current decision rules limit the opportunity to maximise catch at higher biomass levels, particularly for the WCSI fishery, due to the constraints related to the magnitude of the increase in catch between years.
13. A MSE approach provides the opportunity to evaluate alternative monitoring strategies, for example a consideration of the frequency of trawl surveys and assessments. A detailed analysis is beyond the scope of the current study, although some preliminary analyses were conducted that compared scenarios with annual and biennial trawl surveys of the Sub Antarctic. The switch to biennial surveys (and assessments) resulted in a small increase (approx 2%) in the probability of the western stock declining below soft limit (20% SB_0).