SUMMARY PAPER:

Orange Roughy Harvest Strategy

Overview

The existing orange roughy Harvest Strategy will not meet the exacting requirements of the Marine Stewardship Council (MSC) Fisheries Standard and Certification Requirements in its current format; as a consequence Deepwater Group (DWG) has revised the Harvest Strategy for those stocks undergoing assessment against the MSC Fisheries Standard.

DWG contracted Innovative Solutions Ltd to undertake a Management Strategy Evaluation (MSE) to inform and to test a new Harvest Strategy that will meet the MSC Certification Requirements. [1] This revised orange roughy harvest strategy has been developed in close collaboration with MPI. The MSE methodology has been considered by the Deep Water Working Group and accepted by MPI Science as meeting the Research and Science Information Standard for New Zealand Fisheries.

This paper summarises the outputs and Harvest Control Rules that are set out in the MSE and the revised harvest strategy agreed by ORH3B & ORH7A quota owners on 13 August 2014.

Reference Points

Reference Points	Values	Description
Deterministic B_{MSY}	26% B_0	The biomass at which the long-term sustainable average yield will be maximised.
Management Target Range	30-50% B_0	The stock is expected to fluctuate within this managemer target range.
Limit Reference Point	20% B_0	The point at which catch limits should be significantly reduced to prevent serious impairment o recruitment.

This Harvest Strategy increases the upper bound of the Management Target Range from that agreed to in 2013 at 40% B_0 to 50% B_0 and consequently increases the mid-point of the range from 35% to 40% B_0. This revised target range has been set to cope with the large periodic recruitment pulses and consequent long-term fluctuations in biomass, predicted in the MSE.

The maintenance of orange roughy stocks within a Management Target Range of 30-50% B_0 will provide high confidence that stock status will remain above both BMSY and the Limit Reference Point of 20% B_0.

The limit reference point defined within the MSC Fisheries Standard (PI 1.1.2 SG80) is *"above the level at which there is an appreciable risk of impairing reproductive capacity"* (see CB2.3.1). This is considered to be the higher of 20% B0 or 50% BMSY (see CB2.3.3.1). Modelling parameters within the MSE have been set to provide for the stock size to remain above 20% B_0.

In the event that the stock status declines to 20% B_0 then the stock size will need to be rebuilt back to the management target range to meet the MSC Certification Requirements.

The MSC Certification Requirements provide that any stock below 20% B_0 may not be certified and if a certified stock size declines to this level then the stock will have any existing MSC Certification suspended.

[1] Cordue (2014) A Management Strategy Evaluation for Orange Roughy. ISL Report for Deepwater Group. August 2014. 23p

Harvest Control Rule

The principal objective of this Harvest Control Rule (HCR) is to maintain stock status within the target range. The HCR is illustrated in Figure 1 and discussed below.

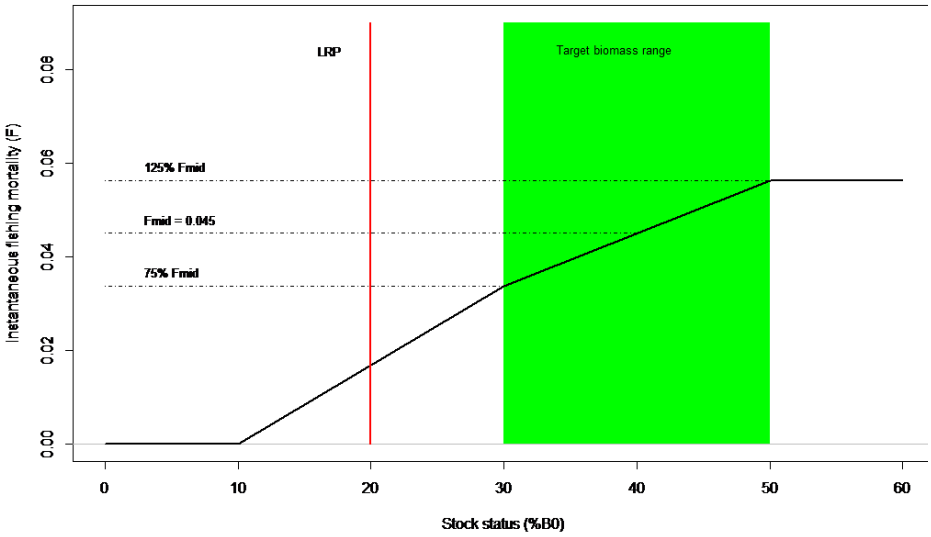

Figure 1: Orange roughy harvest control rule (HCR)

The HCR has been modelled within the 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. 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.

HCR Requires Stock Size to Remain Within Management Target Range

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% B0, 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).

This HCR combined with the rescaling provides very good performance in the long run,

maintaining stocks within the management target range 97% of the time. It also results in a higher overall yields for industry (without the rescaling component, F_{mid} would need to be 16% lower and the HCR would need to ramp down to F = 0 at 20% B_0). Both DWG and MPI propose the HCR be reviewed each 4-5 years to ensure that it remains appropriate for these fisheries.

At this time, this rescaling is not seen as presenting a major risk of reducing the catch levels from the stocks being assessed for MSC Certification.

Two of the three stocks currently under assessment against the MSC standard (ORH3B NWCR and ORH7A) are both well within the management target range and the 'rescaling' factor would not be required unless there is an unexpected change in stock status. The status of the ORH3B ESCR stock is assessed to be ~30% B_0, close to the lower bound of the management target range. A decrease in stock status in an updated stock assessment could potentially result in a requirement for this stock to be 'rescaled'.

George Clement

Chief Executive

14 August 2014

APPENDIX:

Calculating *F* for the Dynamic HCR

The HCR has a rescaling feature which gives it excellent long-term performance. Over the next few years it is unlikely that the rescaling feature will be used because ORH7A and NWCR are near the mid-point of the 30–50% B_0 range and ESCR is expected to quickly increase from 30% B_0. However, if the ESCR stock is next assessed at less than 30% B_0, then rescaling of the relationship between stock status and *F* will be done for this stock.

The relationship between stock status and F starts with F_{mid} = 4.5% (Figure A1, solid line). This relationship is scaled down every time that a stock is assessed to be below 30% B_0. The scaling factor is never lower than 0.9. There can be repeated down-scaling but the cumulative effect is limited to a total scalar of 0.3 (Figure A1, dotted line). Hence, F_{mid} is never less than 0.3 × 4.5% = 1.35%.

The relationship can also be scaled up if it has previously been scaled down and stock status is estimated to be above 60% B_0. This particular feature is very unlikely to be used in the next few years.

Tables A1 and A2 enable the easy calculation of *F* given any series of future stock assessment results and an estimate of the (future) current stock status. Table A1 is used to look up the rescaling factors for each assessment. Table A2 is used to look up the *F* from the initial relationship for the given estimate of current stock status. Three hypothetic examples are given below to illustrate the use of the tables.

Example 1: At the next assessment of ESCR, estimated stock status is 25% B_0. From Table A1 the rescaling factor is 0.92 and from Table A2 the initial F is 2.53%. The *F* to be applied to the estimate of vulnerable biomass to determine the catch limit is the product of the two numbers: *F* = 0.92 × 2.53% = 2.33%.

Example 2: Over the next three assessments of the ESCR the estimates of stock status are respectively 25%, 28% and 34% B_0. Rescaling occurs for the first two assessments but will not apply for the third assessment (as 34% is within the target range). The *F* used in the third assessment to calculate the catch limit is the product of two rescalings and the initial *F* associated with 34% B_0. From Table A1, the rescaling factors are 0.92 and 0.95. From Table A2, the initial *F* is 3.82%. Therefore, for the third assessment, *F* = 0.92 × 0.95 × 3.82% = 3.34%.

Example 3: A stock is next assessed at 28% B_0 and in subsequent assessments all estimates increase until it is assessed at 61% B_0. The first assessment causes a down-scaling of the relationship and the final assessment causes an upscaling (because there was a previous down-scaling and estimated stock status is now above 60% B_0). The rescaling factors from Table A1 are 0.95 (multiply) and 0.97 (divide). From Table A2, the initial *F* is 5.63%. Therefore, *F* = 0.95 × 5.63 / 0.97 = 5.51%.

Table A1: Values to be used to scale the relationship between stock status and *F* in the HCR when current stock status is less than 30% B_0 (multiply by the scalar) or it is greater than 60% B_0 and there has been a previous down-scaling of the relationship (divide by the scalar).

Stock status (%B_0)	Stock status (%B_0)	Scalar
22 (or less)	68 (or more)	0.90
23	67	0.91
24	66	0.91
25	65	0.92
26	64	0.92
27	63	0.93
28	62	0.95
29	61	0.97

Table A2: The initial *F* for each level of estimated stock status from the HCR for stock status above 20% B_0 (the LRP).

Stock status (%B_0)	Initial *F* (%)	Stock status (%B_0)	Initial *F* (%)	Stock status (%B_0)	Initial *F* (%)
20	1.69	31	3.49	41	4.61
21	1.86	32	3.60	42	4.73
22	2.03	33	3.71	43	4.84
23	2.19	34	3.82	44	4.95
24	2.36	35	3.94	45	5.06
25	2.53	36	4.05	46	5.18
26	2.70	37	4.16	47	5.29
27	2.87	38	4.28	48	5.40
28	3.04	39	4.39	49	5.51
29	3.21	40	4.50	50 (or more)	5.63
30	3.38				

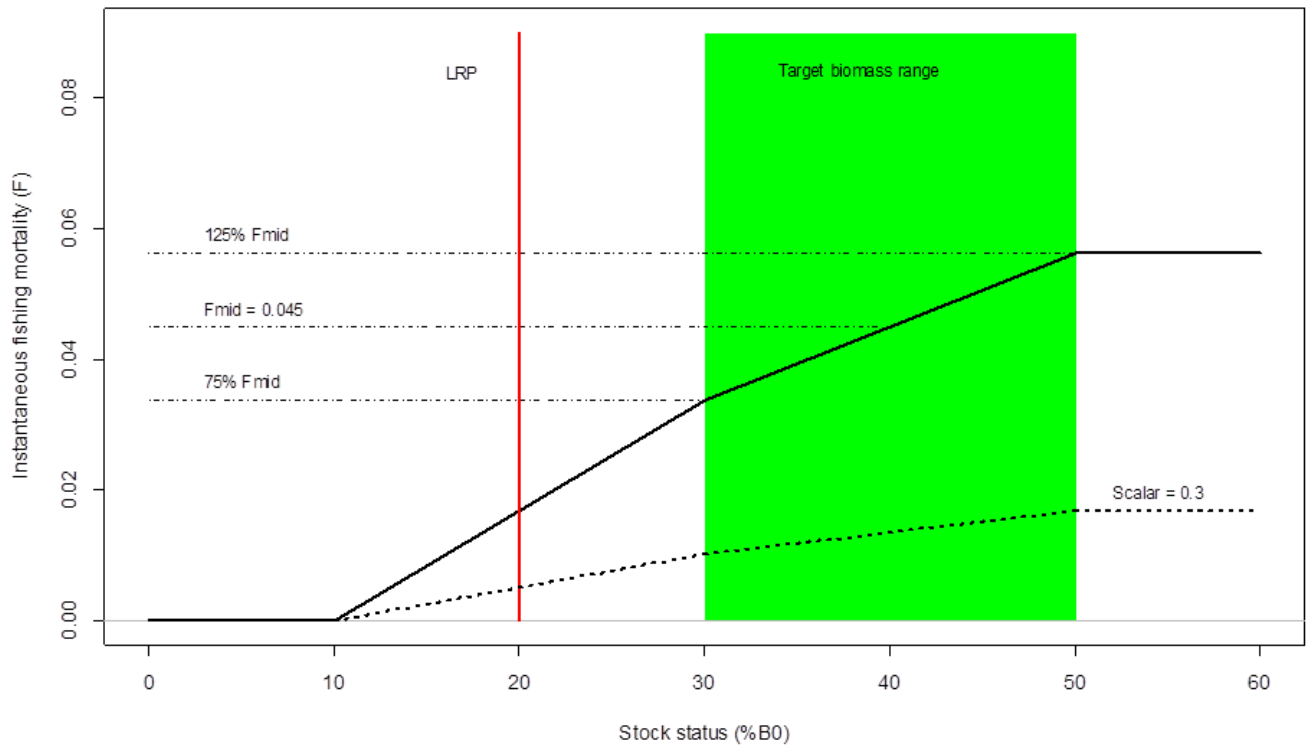

Figure A1: The initial relationship between stock status and *F* for the HCR (solid line) and the relationship when the maximum cumulative down-scaling of 0.3 has been applied (dotted line). The maximum down-scaling would require at least 12 consecutive stock assessments with stock status estimated to be below 30% B_0.