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Orange Roughy (*Hoplostethus atlanticus*) Eastern Zone stock assessment incorporating data up to 2014: Supplement – Constant catch scenarios

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Important disclaimer

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1 Summary

This document is a supplement to the 2014 stock assessment for Eastern Zone orange roughy (Upston et al. 2015). The Australian Fisheries Management Agency (AFMA) requested that the CSIRO complete model runs for three constant future catch scenarios (400, 450 and 513 t), each for the period 2015 to 2017 inclusive. Stochastic projections were completed using the sample of the posterior distribution from the MCMC simulation for the base-case model for the 2014 stock assessment (599 samples after thinning), and the model outcomes for each constant catch scenario were compared to those for the base-case model when applying the 20:35:48 Harvest Control Rule (20:35:48 HCR). The 20:35:48 HCR catch scenario used the MPD point estimates for catch in 2015, 2016, and 2017 from the 2014 Final Base-case model 0 when applying the HCR: 381 t, 512 t, and 647 t respectively. We also completed deterministic projections (MPD estimates), for reference only.

The posterior median estimates of female spawning biomass in 2018 (SB_{2018}) and 2018 female spawning depletion relative to initial (SB_{2018}/ SB_0) were the same for the scenarios, 20:35:48 HCR catches and the annual constant catch of 513 t (average of HCR catches over 3 years) (Table 1). The posterior median estimates of female spawning depletion were the same (to two significant places) for the 20:35:48 HCR catches scenario and for the scenarios with annual constant catch over 3 years of 400 t and 450 t. However, the female spawning biomass in 2018 was greater for the lower catch scenario than for the 20:35:48 HCR scenario (Table 1).

The model outcomes are dependent on *inter alia* the assumptions about future recruitment. For the MPD estimates we have assumed constant average recruitment (from the spawner recruitment curve) for the forecast period and a steepness parameter value equal to 0.75. The MCMC simulations allow for stochastic recruitment that extends into the recent and forecast periods, beyond 1980. However, there are assumptions embedded in the model regarding the degree to which the data inform estimates of recruitment in the recent (1981 to 2014) and forecast years. For example, we have applied a penalty function for the recent and forecast years when there is sparse, noisy data (given orange roughy do not recruit until ~35 years, very few fish post-1980 will have recruited in 2015) but it is possible that recruitment variability has been overly constrained for these recent years (see Upston et al. 2015).

Given the large uncertainty in predicting future recruitment, and in particular for orange roughy (Francis and Hilborn 2002), we include a future catch scenario with a lower steepness value of 0.40 and coincident lower estimates of catch in each of the three future years, for comparison with the base-case model (Table 2; MPD estimates only). We also include a scenario for the converse situation, a steepness parameter that is greater than 0.75 and coincident higher estimates of future catches. There was no evidence for supporting one level of steepness over another (model fits to data were adequate and negative log-likelihood values did not differ significantly between the scenarios – Upston et al. 2015). We note that Cordue (2014) estimated a median steepness equal to 60% with a wide 95% CI (31 to 95%) for orange roughy Mid-East Coast stock in New Zealand.

2 Tables

Table 1. Summary statistics for female spawning biomass in 2018 (beginning of year) and 2018 depletion from MCMC simulations for the base-case model for the 20:35:38 HCR and constant catch scenarios. [AV] Average of the total HCR catches over the three years. MPD estimates are included for reference.

	Female SB_{2018}/SB_0		
Catch scenario for 2015, 2016, 2017	**MPD estimate**	**MCMC Median**	**(95% Bayesian CI)**
20:35:48 CATCHES (381, 512, 647 t)	0.31	0.29	(0.26 - 0.32)
ANNUAL CATCH 400 t	0.31	0.29	(0.26 - 0.32)
ANNUAL CATCH 450 t	0.31	0.29	(0.26 - 0.32)
ANNUAL CATCH 513 t^{AV}	0.31	0.29	(0.26 - 0.32)
	Female SB_{2018}		
Catch scenario for 2015, 2016, 2017	**MPD estimate**	**MCMC Median**	**(95% Bayesian CI)**
20:35:48 CATCHES (381, 512, 647 t)	11,974	12,621	(11,118 - 14,309)
ANNUAL CATCH 400 t	12,052	12,702	(11,198 - 14,392)
ANNUAL CATCH 450 t	12,017	12,666	(11,163 - 14,355)
ANNUAL CATCH 513 t^{AV}	11,974	12,621	(11,118 - 14,309)

Table 2. 20:35:48 HCR catches for 2015, 2016 and 2017 and associated MPD point estimates of female spawning biomass in 2018 (beginning of year) and depletion relative to initial from the deterministic model runs with different steepness assumptions.

	20:35:48 catches (t)			Female	
	2015	2016	2017	SB_{2018}	SB_{2018}/SB_0
Base-case (Steepness 0.75)	381	512	647	11,974	0.31
Sensitivity (Steepness 0.40)	235	310	387	12,381	0.32
Sensitivity (Steepness 0.80)	394	531	672	11,959	0.31

3 References

Cordue, P.L. (2014). A Management Strategy Evaluation for orange roughy. ISL Client Report for Deepwater Group Ltd, 42 p. (website: http://deepwatergroup.org/species/orange-roughy/msc-assessment-of-new-zealand-orange-roughy-fisheries-2/).

Francis, C. and Hilborn, R. (2002). A Review of the 2002 Orange Roughy Stock. Review completed for the Australian Fisheries Management Authority, 14 p. (Unpublished report held by AFMA, Canberra).

Upston, J., Punt, A.E., Wayte, S., Ryan, T., Day, J. and Sporcic, M. (2015) Orange Roughy (Hoplostethus atlanticus) Eastern Zone stock assessment incorporating data up to 2014. Report to Australian Fisheries Management Authority. CSIRO Marine and Atmospheric Research, Hobart. p 66.