Evaluating the Performance of a Proposed 40-10 Harvest Control Rule Rebuilding Rule Revision Relative to the Current Rebuilding Rules

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Motivation

The Pacific Fishery Management Council has opted to explore modifying the current rebuilding rules for rebuilding stocks. The current rebuilding rules define the rebuilding catch based on the adopted Rebuilding Plan SPR harvest rate or specified harvest control rule until the relative spawning biomass exceeds the management target. The proposed alternative approach would combine the current rebuilding rules where harvest is defined by a Rebuilding Plan and the species-specific harvest control rule dependent upon the relative spawning biomass. Similar to the current rebuilding rules, the rebuilding catch would be defined by the rebuilding SPR harvest rate determined in the Rebuilding Plan while the stock's relative spawning biomass is below the species specific minimum stock size threshold (MSST; e.g., flatfish $0.125B_0$, rockfish $0.25B_0$). However, in contrast to the current rebuilding rule, the proposed option would base the rebuilding catch on the harvest control rule (e.g., flatfish 25-5, rockfish 40-10) when the stock's relative spawning biomass exceeded the MSST. This analysis provides comparison between the current rebuilding rules and the proposed alternative.

Methods

Pacific ocean perch (*Sebastes alutus*) and yelloweye rockfish (*Sebastes ruberrimus*) are currently managed under Rebuilding Plans, and were used to evaluate the proposed rebuilding alternative, termed "hybrid rebuilding". Pacific ocean perch and yelloweye rockfish were selected as example species because each were below the MSST at the time of the most recent update of full assessment (Hamel and Ono, 2011; Taylor and Wetzel, 2011), allowing for full application of the hybrid rebuilding approach (harvest defined either by the Rebuilding Plan *SPR* or the harvest control rule).

The currently adopted Rebuilding Plans and the associated median projected biomass were evaluated to determine when the stock was projected to exceed the MSST. The catches were fixed with the "Rebuilder" based on the rebuilding *SPR* while the stock was below the MSST and the program was run with the new fixed catches. The rebuilding quantities for this new analysis were based upon the projected harvest control rule (40-10) within the Rebuilder program. The projected rebuilding trajectories were compared to the current Rebuilding Plan estimates.

An additional run was produced based on the low productivity of both species. The steepness (h) value estimated in the last assessment for both Pacific ocean perch and yelloweye rockfish (Pacific ocean perch: $h = 0.40$; yelloweye rockfish: $h = 0.441$) precludes the stocks from reaching $0.40SB_0$ with the default harvest rate of $SPR_{0.50}$ (this *SPR* is based on a steepness of 0.60 to stabilized the stock at or about the target biomass). The *SPR* that would equilibrate the stocks at the target

biomass were calculated for each species (Pacific ocean perch: $SPR_{0.625}$; yelloweye rockfish: $SPR_{0.59}$) and applied in the rebuilding plan (rather than the $SPR_{0.50}$).

Results

The results for the proposed hybrid rebuilding were consistent for both Pacific ocean perch and yelloweye rockfish. The hybrid rebuilding that applied a harvest rate of $SPR_{0.50}$ failed to rebuild either stock to the target biomass, due to the misalignment of the harvest rate and the assumed or estimated steepness values within the assessment (Figs. 1 and 2). Hence, all comparisons will be made to the current rebuilding approach to the hybrid rebuilding with the adjusted *SPR* during rebuilding.

The rebuilding times for the hybrid rebuilding alternative was greatly extended for both species relative to the current rebuilding plan (Figs. 1 and 2). Yelloweye rockfish was projected to be rebuilt in year 2165 under the hybrid rebuilding approach vs. 2067 in the current rebuilding plan, with Pacific ocean perch rebuilding in year 2130 vs. 2051. The catches predicted by the hybrid rebuilding plan were substantially higher (in the short term and long term) compared to the current rebuilding projected catches based on the current Rebuilding Plan SPRs for each species (Pacific ocean perch: $SPR_{0.864}$; yelloweye rockfish: $SPR_{0.76}$) (Figs. 3 and 4).

Discussion

This analysis highlights the trade-offs between rebuilding approaches. The proposed hybrid rebuilding would result in greater harvests once a stock is rebuilt to above the MSST. However, this increased catch comes at the expense of longer rebuilding periods. This is due to the large difference between the Rebuilding Plan *SPR*s and the harvest control rule *SPR* for rockfish.

The results here are based upon the two species currently estimated to have biomass levels below the MSST. More productive species would be expected to recover relatively more quickly under the 40-10 or 25-5 rules, but then the rebuilding SPR would likely produce a more similar harvest level (as was the case for petrale sole [Haltuch, 2011]).

References

Haltuch, M.A. 2011. 2011 petrale sole rebuilding analysis. Pacific Fishery Management Council, 7700 Ambassador Place NE, Suite 200, Portland, OR 97220. 49 pp.

Hamel, O.S. and Ono, K. 2011. Stock assessment of Pacific ocean perch in waters of the U.S. west coast in 2011. Pacific Fishery Management Council, 7700 Ambassador Place NE, Suite 200, Portland, OR 97220. 168 pp.

Taylor, I.G. and Wetzel, C.R. 2011. Status of U.S. yelloweye rockfish resource in 2011 (Update of 2009 assessment model). Pacific Fishery Management Council, 7700 Ambassador Place NE, Suite 200, Portland, OR 97220. 227 pp.

Figures

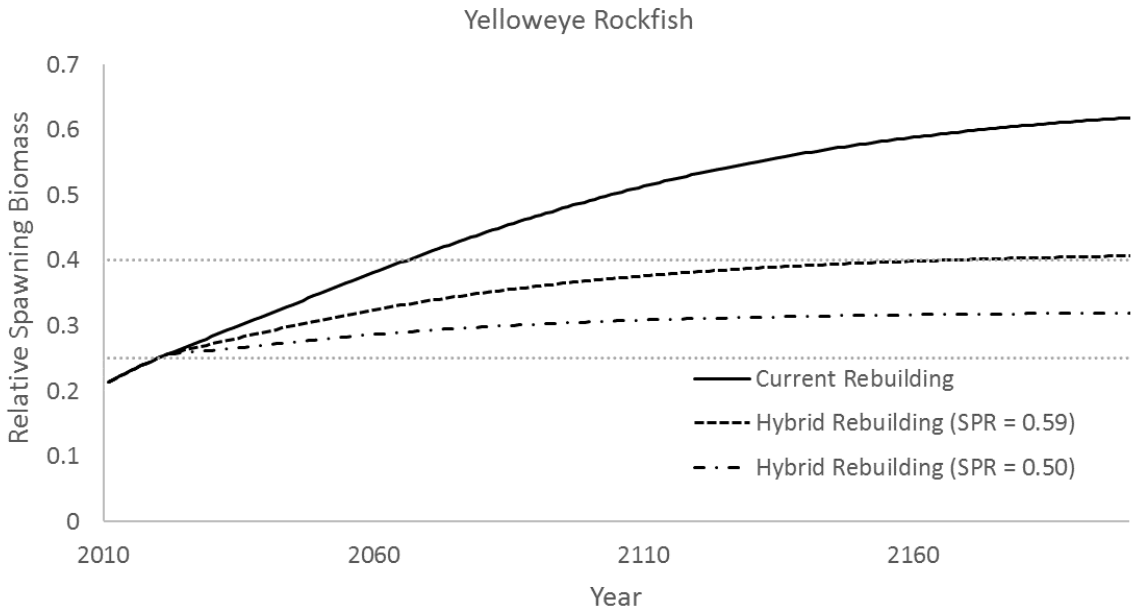

Figure 1. The yelloweye rockfish projected trajectories of relative spawning biomass over the rebuilding period for the current rebuilding plan, hybrid rebuilding with $SPR_{0.59}$, and hybrid rebuilding with $SPR_{0.50}$. The horizontal dashed grey lines indicate the MSST and the target biomass ($B_{0.40}$).

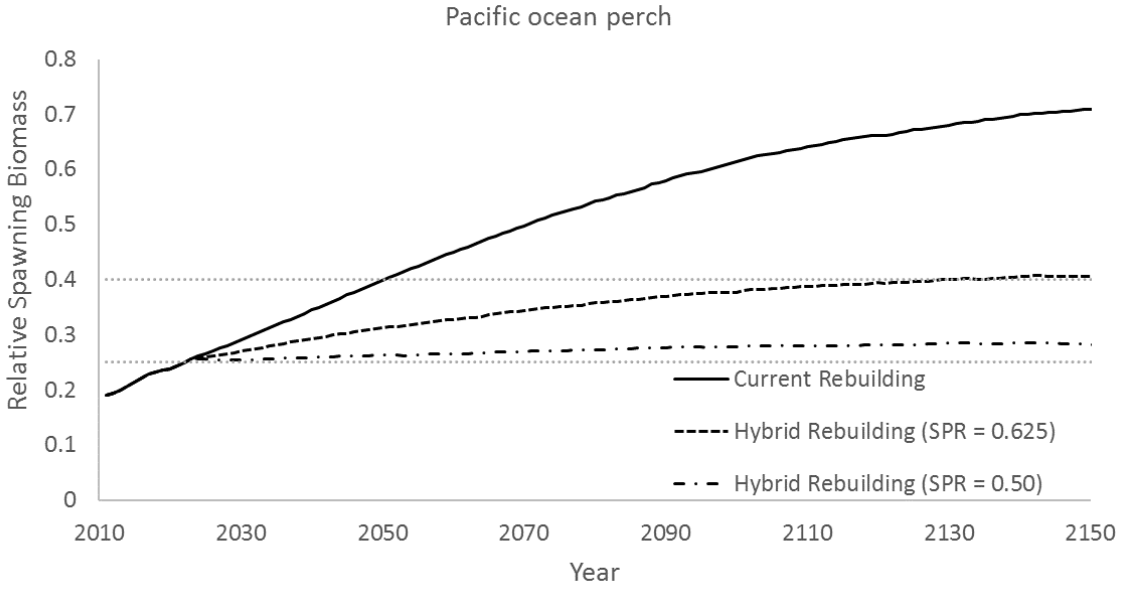

Figure 2. The Pacific ocean perch projected trajectories of relative spawning biomass over the rebuilding period for the current rebuilding plan, hybrid rebuilding with $SPR_{0.625}$, and hybrid rebuilding with $SPR_{0.50}$. The horizontal dashed grey lines indicate the MSST and the target biomass ($B_{0.40}$).

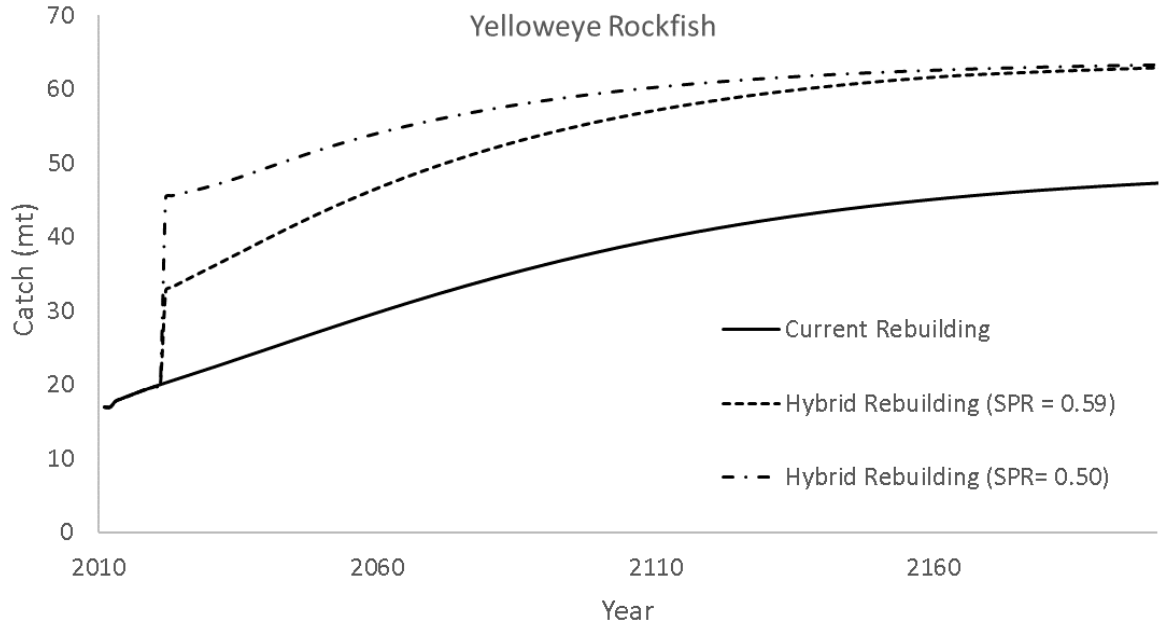

Figure 3. The yelloweye rockfish projected catches over the rebuilding period for the current rebuilding plan, hybrid rebuilding with $SPR_{0.59}$, and hybrid rebuilding with $SPR_{0.50}$.

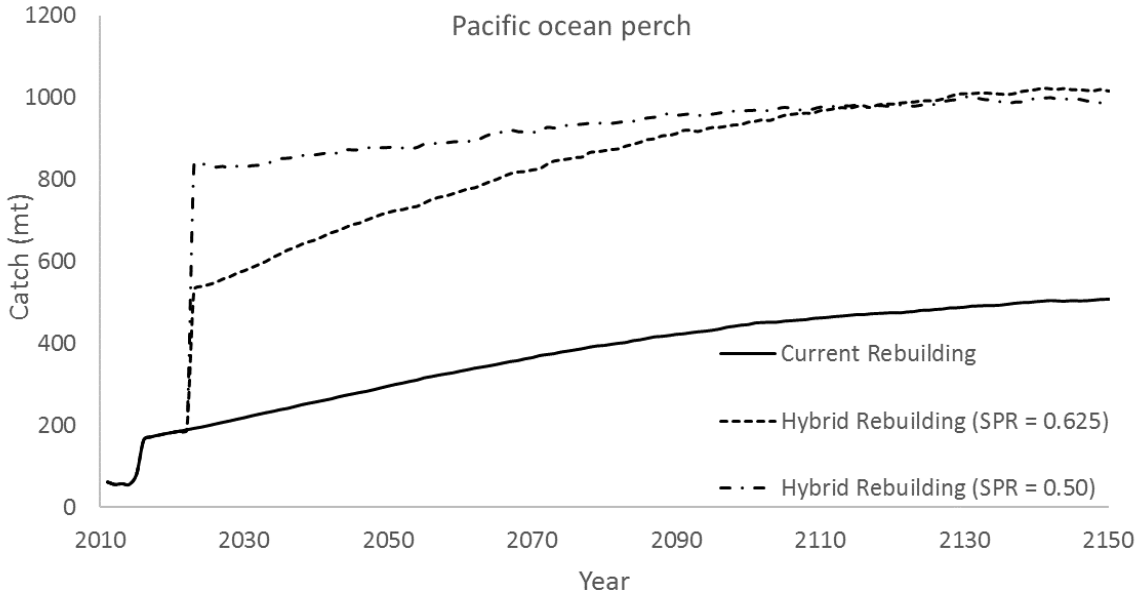

Figure 4. The Pacific ocean perch projected catches over the rebuilding period for the current rebuilding plan, hybrid rebuilding with $SPR_{0.59}$, and hybrid rebuilding with $SPR_{0.50}$.