

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON REBUILDING ANALYSES
FOR 2009-2010 GROUND FISH FISHERIES
(EXCERPTED FROM THE SSC'S NOVEMBER 2007 REPORT ON AGENDA ITEM D.3)

REBUILDING ANALYSES

The Groundfish Subcommittee of the SSC met October 3-4, 2007 at the Alaska Fisheries Science Center in Seattle to review seven rebuilding analyses that were recently completed for overfished rockfish stocks managed by the Council, *viz.* bocaccio, Pacific ocean perch (POP), cowcod, canary rockfish, yelloweye rockfish, widow rockfish, and darkblotched rockfish

Current rebuilding harvest rates (expressed as spawning potential per recruit [SPR]) and median times to rebuild (T_{target}) for the overfished stocks are directly linked to one another and individually they reflect specific decisions the Council has previously made concerning rebuilding in as short a time as possible, taking into account the appropriate factors from the Magnuson Act. Amendment 16-4 to the FMP adopted specific SPRs and T_{target} values for each stock. From a regulatory basis, maintaining stability in current harvest rates (SPRs) would be desirable, presuming there have been no fundamental changes in our perceptions about stock productivity.

The SSC, therefore, determined (a) whether cumulative catches during the period of rebuilding exceeded the cumulative OY that was available, (b) whether the biological parameters in the stock assessment had been revised to such an extent as to warrant a change in T_{target} , (c) whether the proper data and software were used in order to satisfy all technical requirements for accuracy, (d) whether progress towards rebuilding is deemed to be adequate, (e) whether there is discrepancy between the current T_{target} and the median time to rebuild under the currently adopted rebuilding harvest rate (T_{rebuild}), and if so, what a new maximum time to rebuild ($T_{\text{max(new)}}$) should be, given the National Standard 1 guidelines and, secondarily, if the currently adopted SPR harvest rate will likely rebuild the stock before this $T_{\text{max(new)}}$. The SSC assessed whether the biological parameters in the stock assessment had been revised to such an extent as to warrant a change in T_{target} and examined, for example, whether T_{rebuild} is beyond the value of T_{max} in Amendment 16-4.

Table 1 summarizes the deliberations of the SSC in regard to issues (a) – (e). Based on this table, the SSC notes the following:

- 1) Catches of six of the seven overfished rockfish stocks have been lower than what was available as a cumulative OY during the period of rebuilding. The only exception is canary rockfish, which exceeded its cumulative OY by 14% over the period 2000-2007. This overage was due primarily to an excess harvest of 40 mt in 2001, when constraints on the groundfish fishery were first being imposed. In some instances, catches have been far below the available OY (e.g., POP, cowcod, and widow rockfish). In general, management has been quite effective at curtailing fishing mortality on the overfished stocks in order to rebuild them as quickly as possible.

- 2) All assessments that were completed in the SS2 met the appropriate technical requirements by utilizing the latest version of the rebuilding program (2.11) and by using the appropriate outputs from the rebuilding program. Likewise, the two analyses completed in ADMB (i.e., POP and widow rockfish) also were implemented and executed properly.
- 3) There are four instances where calculated times to rebuild are very similar to the T_{target} in Amendment 16-4 (POP, bocaccio, widow rockfish, and yelloweye rockfish), with the greatest discrepancy being six years. For these stocks, progress towards rebuilding is considered adequate and the SSC recommends that no redefinition of T_{target} or adjustment to the rebuilding harvest rate is warranted.
- 4) There are three stocks that depart strongly from the T_{target} values adopted in Amendment 16-4: cowcod, darkblotched rockfish, and canary rockfish; canary rockfish is very much ahead of schedule (42 years), while darkblotched rockfish and cowcod are substantially behind schedule (19 years and 23 years, respectively). For canary rockfish and darkblotched rockfish, these deviations from T_{target} are due primarily to changes in our understanding of stock productivity and depletion. In the case of cowcod, the departure from the expected rebuilding trajectory is due to correction of a technical flaw that existed in the 2005 assessment. The effect of this correction was to lower the estimated depletion level substantially, implying a longer time to rebuild the cowcod stock than was originally estimated. These changes represent fundamental revisions to our understanding of the biology of these species, which in turns warrants a revision in T_{target} .
- 5) Given the results of this year's assessments, new maximum times to rebuild ($T_{\text{max}(\text{new})}$) were calculated for each stock based on the most recent assessment models and National Standard 1 Guidelines. These are needed for the three stocks that are either markedly ahead or markedly behind schedule (canary rockfish, darkblotched rockfish, and cowcod). Rebuilding will occur for these stocks well before ($T_{\text{max}(\text{new})}$) if the current target SPR harvest rates are maintained. For this reason the SSC suggests that considering *status quo* harvest rates for all overfished stocks is a reasonable starting point for the Council's deliberative process when developing OYs for the 2009-2010 biennial cycle.

Following the June Council meeting, an error was discovered in the visual survey estimate of abundance used in the cowcod assessment. This error was corrected and the results in Table 1 are based on the corrected assessment. The SSC recommends that the assessment document for cowcod be updated appropriately for inclusion in the SAFE.

The SSC notes that the Terms of Reference for Rebuilding Analyses was last revised in 2005. Given the changes in how rebuilding analyses are now used for Council decision making, the SSC intends to revise these Terms of Reference and will develop a standardized format to summarize results. Specifications for the associated rebuilding software will also be revised.

TABLE 1.

Species	Total Catch / Total OY	Adopted SPR Harvest Rate	Current T_{target}^1	New Time To Rebuild At Current SPR ²	Difference	$T_{\text{max}(\text{new})}^3$
Darkblotched	97% (2001-2007)	60.7%	2011	2030	-19	2040
POP	42% (2000-2006)	86.4%	2017	2011	6	2037
Canary	114% (2000-2007)	88.7%	2063	2021	42	2041
Bocaccio	69% (2000-2006)	77.7%	2026	2023	3	2033
Cowcod	55% (2000-2007)	90.0%	2039	2065	-26	2098
Widow	48% (2002-2007)	95.0%	2015	2009	6	NA
Yelloweye	73% (2002-2007)	71.9%	2084	2084	0	2090

1. Current T_{target} is the value adopted in Amendment 16-4.
2. T_{rebuild} is the new time to rebuild at the adopted SPR harvest rate.
3. $T_{\text{max}(\text{new})}$ is the new maximum time to rebuild base on the updated stock assessment and rebuilding analysis.

Darkblotched Rockfish

The darkblotched rockfish rebuilding analysis presented to the SSC incorporated a number of changes to both the stock assessment on which the rebuilding analysis is based and the rebuilding analysis itself. The major changes to the 2007 assessment included use of more extensive age data, lower steepness in the stock-recruitment relationship. As such, the productivity of the darkblotched rockfish stock is perceived to be lower than implied from the 2005 assessment. Changes to the rebuilding analysis, which was last conducted in 2005, include parametric simulation of recruitments from the stock-recruitment relationship based on current estimates of productivity (i.e., B_0 , steepness, natural mortality), instead of re-sampling a range of historically estimated recruitments. Optimum yields for 2007 and 2008 were specified at 190 mt and 330 mt, respectively. Based on the new rebuilding analysis, the darkblotched rockfish stock is projected to recover 19 years later (2030) than anticipated from the 2005 rebuilding analysis. The new rebuilding time is 2030 at the currently specified SPR of 60.7% compares with the current target of 2011. However, the new rebuilding analysis suggests that the current SPR is within legal requirements of rebuilding by a newly defined $T_{\text{max}(\text{new})}$ of 2040. Due to the large difference in the rebuilding targets the SSC recommends a redefinition of T_{target} .

Pacific Ocean Perch (POP)

The 2007 stock assessment update of POP was reviewed at the June groundfish subcommittee, SSC, and Council meetings. Estimated steepness has increased from 0.55 to 0.65 and current depletion, estimated from the median of the MCMC posterior distribution, is now estimated to 31.0%, due, in large part, to an increase in the strength of the 1999 year class. POP is unusual in that the full MCMC results are used in the rebuilding analysis, which is desirable as it more adequately captures the uncertainty inherent in the assessment. Catches have been very low relative to the available OY, averaging 42% over the period 2000-2006. Moreover, the estimated time to rebuild the stock, if the current harvest rate is maintained at an SPR of 86.4%, is 2011, which is six years ahead of schedule ($T_{\text{target}} = 2017$). Given these conditions, the SSC concludes that no change is necessary to POP harvest policies and that progress towards rebuilding is adequate.

Canary Rockfish

A full assessment of canary rockfish was completed this year in SS2, which included a number of major changes to the data and modeling approach, i.e., a complete re-evaluation of the age data, simplification of time blocks for fishery selectivity, and splitting the triennial survey into two segments with separate catchability coefficients (q). Given the changes to the model structure, spawner-recruit steepness (h) could no longer be reliably estimated within the model, and a steepness prior from a hierarchical meta-analysis of west coast *Sebastes* was used instead ($h = 0.511$). Based on these revisions, the current depletion of canary rockfish is estimated to be 32.4%, compared with 9.4% from the 2005 assessment. For the rebuilding analysis, the full 2007-08 OY catches (44 mt) were pre-specified and account was taken of both uncertainty about the parameters of the spawner recruit curve and variability about that curve ($\sigma_r = 0.50$). Also, the 12 fleets represented in the stock assessment were simplified to 5 fleets in the rebuilding analysis. Rebuilding projections also incorporated uncertainty in h by weighting according to the three states of nature identified in the assessment. Results showed that if the current harvest rate is maintained (SPR = 88.7%) the stock will rebuild by 2021, which is 42 years before the T_{target} (2063) specified in Amendment 16-4. Given this marked change in our perception of when recovery will most likely occur, a redefinition of T_{target} is appropriate. If so, a newly defined $T_{\text{max(new)}}$ is 2041. If the current harvest rate is maintained, stock recovery would be expected to occur some time around 2021.

Bocaccio

Bocaccio was declared overfished in 1999 and the first rebuilding analysis for this stock was conducted in 2000. The most recent full assessment was completed in 2003 using the SS1 modeling platform, which was then updated in 2005 and again this year. This year's update indicates that current depletion is 13% of unfished, compared to 6.5% at the beginning of rebuilding. The bocaccio rebuilding analysis does not use a spawner-recruit relationship, but instead defines B_0 based on average recruitments from 1950-85 (multiplied by $\text{SPR}_{F=0}$) and, in addition, resamples recruits-per-spawner from 1970-2005 to generate future recruitment. Resampling recruits-per-spawners in this instance is justified because the estimated steepness is close to 0.20 (no density-dependence). The analysis indicates that the median time to rebuild if the current SPR harvest rate (77.7%) is maintained is 2023, which is three years ahead of schedule (current $T_{\text{target}} = 2026$). Recovery is being driven by strong 1999 and 2003 year-classes.

Given these results, the SSC concludes that progress towards rebuilding is adequate and that existing management practices are effective and not in need of change. The next full stock assessment will be implemented in SS2.

Cowcod

Although the cowcod assessment was originally scheduled to be an update during 2007, the Council recommended that a full assessment be completed, based on a number of issues that were raised in the June update review. The estimated depletion of cowcod was strongly affected as a result of including the recommended changes into a full assessment, dropping from 17.8% to 3.8%. The principal cause of the change was the correction of a technical error that was discovered in the 2005 assessment. The rebuilding projections indicate that it will not be possible to rebuild the cowcod stock by 2039 (the current T_{target}), even if all catches are eliminated. Although three states of nature were developed in the full assessment, the rebuilding analysis was conducted in a manner similar to the 2005 rebuilding analysis. Uncertainty in the outcomes of the stock assessment was propagated solely through a discretized distribution of steepness, developed from the *Sebastes* meta-analysis “prior” for cowcod; no variability in recruitment *per se* was modeled ($\sigma_r = 0$). Cumulative catches since 2000, which are very uncertain, are nevertheless substantially below the available rebuilding OY. Still, due to the substantial decline in relative abundance, the time to rebuild is now 26 years greater than the T_{target} adopted in Amendment 16-4. The SSC therefore advises a revision to T_{target} is warranted, but adherence to the current harvest rate (SPR = 90.0%) provides continuity with past management practices and should rebuild the stock within $T_{\text{max(new)}}$.

Widow Rockfish

The widow rockfish rebuilding analysis presented to the SSC was based on a 2007 update of the 2005 stock assessment and of the rebuilding analysis conducted in 2005. The new assessment update indicates that widow rockfish spawning stock biomass has increased since being declared overfished in 2001 due to low catches and recruitment of the strong 1999 year class into the spawning population, and that the current level of depletion is estimated to be 35.5%. The new projections are based on the same underlying model structure and rebuilding assumptions as before, except that recruitment is simulated from the stock-recruitment curve for 2007 and beyond, and 2007-2008 OYs are specified as 368 mt. The new median rebuilding time is 6 years earlier than previously calculated at the currently specified SPR of 95.0% (2009 compared to the current target of 2015). The widow rockfish stock is on track for recovery by the next assessment cycle.

Yelloweye Rockfish

The yelloweye rockfish rebuilding analysis presented to the SSC was based on a 2007 update of the 2006 stock assessment and of the rebuilding analysis conducted in 2006. The updated assessment corrected several technical issues associated with the previous assessment, but a change in the natural mortality rate revised the spawning stock biomass and associated depletion level down to 16.4% of B_0 . Equilibrium unfished spawning biomass was calculated from the stock-recruitment relationship, with future recruitments generated using this relationship. Despite changes to the assessment, the yelloweye rockfish stock is on track to rebuild by 2084 if the current SPR of 71.9% is maintained. The calculated new $T_{\text{max(new)}}$ is 2090. The SSC notes that the summary table is missing from the assessment document.

Other

The groundfish subcommittee considered how to treat recruitments from when a stock is declared overfished (T_0) to the start of the current update. The SSC recommended that the recruitments that occurred between T_0 and the present should be set to those estimated in the assessment because this incorporates the best available scientific information.

PFMC
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