

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON  
REBUILDING ANALYSES FOR BOCACCIO, CANARY ROCKFISH,  
YELLOWEYE ROCKFISH, WIDOW ROCKFISH, AND WHITING

The Scientific and Statistical Committee (SSC) reviewed the documentation for the rebuilding software written by Dr. Andre Punt. This computer program was developed to implement the guidelines for rebuilding analyses developed by the SSC (SSC Terms of Reference for Groundfish Rebuilding Analyses, April 2001). It provides a default framework within which to evaluate rebuilding strategies, although individual assessment authors should continue to apply innovative approaches to evaluating rebuilding strategies. The software allows future recruitment to be generated from a density-dependent stock-recruitment relationship or by resampling recruitments or recruits/spawning output ratios from the historical estimates.

The software has been validated by comparing its results with those from computer programs developed by Drs. Alec MacCall, Rick Methot and Mr. Tom Jagielo. The SSC endorses the use of the software developed by Dr. Punt and notes that the application of the 40:10 rule in this software alters fishing mortality rather than catch. It recommends that the software be modified to correct this. This change to software would not impact any of the rebuilding analyses, except for Pacific whiting.

The SSC reviewed the rebuilding analyses for bocaccio, canary rockfish, yelloweye rockfish, widow rockfish, and Pacific whiting. The SSC agrees these rebuilding analyses are based on the assessments selected through the STAR process and conform to its guidelines and endorses them for use by the Council. Table 1 lists the years on which the calculation of  $B_0$  and future recruitment are based. It also lists the first year in which rebuilding could have been initiated. The SSC recommends that, in the future, authors of rebuilding analyses document how  $T_{MIN}$ , the minimum possible recovery time, is calculated more clearly, including specifying the first year in which rebuilding could have been initiated. The SSC requests assessment authors to provide  $T_{MIN}$  and  $T_{MAX}$  (the maximum allowable recovery period) in actual years and well as in terms of the number of years from the year in which rebuilding could have been initiated.

The SSC notes that the basis for the choice of years on which  $B_0$  and the future recruitment are based were not fully documented in the rebuilding analysis documents and recommends that rebuilding analyses address this issue prior to their incorporation in any rebuilding plans. The SSC identified an internal inconsistency in the rebuilding analyses for bocaccio and yelloweye rockfish. The SSC consequently recommends that future rebuilding analyses based on the density-dependent recruitment assumption compute  $B_0$  using recruitments from early in the time-series and base generation of future recruitment on more recent years. The years used to define  $B_0$  and to generate future recruitment should be non-overlapping.

Decisions regarding rebuilding plans are based on the Council selecting a  $T_{TARGET}$  between  $T_{MIN}$  and  $T_{MAX}$ . The SSC recommends, therefore, that figures along the lines of Fig. 4 of the canary rockfish rebuilding analysis be included routinely in future rebuilding analyses.

The SSC has the follow specific comments.

**Widow Rockfish.** The rebuilding analysis includes eight cases. The SSC recommends that the cases based on the revised catches and a catch of 856 tons for 2002 form the basis for the selection of a rebuilding strategy and a 2002 OY.

**Yelloweye Rockfish.** The rebuilding analysis for the Oregon/Washington area is based on extending the Oregon assessment by including the catches off Washington. No assessment for this combined area was presented to the 2001 yelloweye STAR Panel. The SSC notes that it is necessary to account for Washington to conduct a rebuilding analysis for yelloweye and support the approach taken in the yelloweye rebuilding analysis. The SSC was informed by the assessment author that alternative approaches exist for incorporating Washington in the assessment and encourage him to pursue this soon.

The SSC requests that, for consistency, the rebuilding analysis define  $B_0$  for the regime-shift hypothesis (scenario 2) on recruitments for the years 1967-1993 and project future recruitment for the density-dependence hypothesis (scenario 1) on recruits/spawning output ratios for the years 1983-1993. The assessment author provided the SSC with revised rebuilding analysis results.

The SSC has no clear basis to choose between the two scenarios for yelloweye. These scenarios bound the range of possibilities. However, the SSC notes that the Terms of Reference for Groundfish Rebuilding Analysis (April 2001) suggest that the density-dependent scenario should be the default case, because stocks that have declined into an overfished condition are more likely to be unproductive (e.g., low spawner-recruit steepness).

The SSC notes that the catch of yelloweye off British Columbia appears to substantially exceed the levels of catch indicated by either of the scenarios considered in the rebuilding analysis and suggests that the impact of this be examined, possibly by means of a joint assessment.

**Bocaccio.** The rebuilding analysis for bocaccio considers a number of scenarios based on alternative assessment assumptions. The SSC notes that the probability of recovery by  $T_{MAX}$  does not exceed 60% for any of these options even in the absence of catches. As noted in C.2, the SSC supports the approach used to estimate the 1999 year-class. The SSC notes that the choice of periods for defining  $B_0$  and future recruitment are inconsistent for the reason noted above. Removing this inconsistency by basing  $B_0$  on early recruitments would lead to lower OY values.

**Canary rockfish.** The rebuilding analysis for canary rockfish is based on the use of a stock-recruitment relationship to define  $B_0$  and future recruitment. The SSC endorses the use of a stock-recruitment relationship in this instance because it provides a better fit to the recruitment and spawning output data (Fig. 3 of the canary rockfish rebuilding analysis). The estimate of  $F_{MSY}$  for canary rockfish takes account of the impact of reductions of spawning output on recruitment. This estimate corresponds to  $F_{73\%}$ , i.e., substantially lower than the current default  $F_{MSY}$  proxy for rockfish of  $F_{50\%}$ .

**Pacific whiting.** The rebuilding analysis for Pacific whiting follows the guidelines established by the SSC. However, this is a particularly complicated case owing to the highly variable nature of whiting recruitment and the short lifespan of Pacific whiting. This leads to a short rebuild period even if catches remain high, although, given recruitment variability, the probability of the resource dropping below the overfishing threshold following recovery is high. The predicted rapid recovery of the Pacific whiting spawning output in the rebuilding analysis is due to the presence in the population already of the above-average 1999 year-class. The rebuilding analysis contrasts the  $F_{40\%}$ ,  $F_{45\%}$ , and  $F_{50\%}$   $F_{MSY}$  proxies in terms of the probability of the population becoming overfished following recovery. While the SSC considers the issue of reviewing the correct  $F_{MSY}$  proxy for whiting to be important, it did not have time to discuss the merits of moving from  $F_{40\%}$  to another  $F_{MSY}$  proxy at this meeting.

The SSC recognizes that a rebuilding plan for Pacific whiting is mandated owing to its overfished status. However, it is important to note that unlike bocaccio, yelloweye rockfish, canary rockfish and widow rockfish, application of the 40:10 rule is adequate to achieve recovery to  $0.4 B_0$  within 10 years. The SSC recommends that any 40:10 rule OY values be based on the results of the assessment conducted in 2002 rather than the rebuilding software because that the 2002 assessment model includes multiple fisheries and time-varying weight-at-age. The 2002 whiting STAR panel concluded that "given concerns with the current formulation of the stock reconstruction model and the dependence of yield options beyond 2002 on continued recruitment of the 1999 year-class and recruitment from year-classes not actually observed, the Panel recommends against adopting 2003 projections until another assessment is conducted." The SSC again strongly supports this recommendation.

TABLE 1. Summary of the selections on which the rebuilding analyses are based. The range of recruitments on which  $B_0$  and future recruitment are based are expressed in terms of brood year.

Species	$B_0$	Future recruitment	R/S or R	$T_{INIT}$
Widow	1965-1979	1983-1996	R/S	2001
Yelloweye (scenario 1)	1967-1982	1967-1993	R/S	2003
Yelloweye (scenario 2)	1967-1997	1967-1993	R	2003
Bocaccio	1952-1997	1952-1998	R/S	1999
Canary	S-R	S-R	S-R	2001
Pacific whiting	1970-1999	1970-1999	R	2003

1.  $T_{INIT}$ : First year in which rebuilding could have been initiated.
2. R/S: Projection based on resampling recruits/spawning output.
3. R: Projections based on resampling recruitments.
4. S-R: Projections and  $B_0$  based on inferences from a stock-recruitment relationship estimated by fitting a stock-recruitment model to the recruitment and spawner output data for the entire period of the assessment.

PFMC  
06/18/02