proportion of the six fleets in future harvests is assumed to be the same as the last year (2004) in the model.

The results in Table 20 suggest that a reduction in population size will occur for the NCS under the two control rules based only on the F_{MSY} proxies. In contrast, the projections for the remaining control rules suggest that some increase in reproductive output will occur. The extent of this increase is greatest for the most conservative OY control rule ($F_{50\%}$ with a 60-20 adjustment) and least for the least conservative control rule ($F_{45\%}$ with a 40-10 adjustment). The projections for the SCS model beyond 2006–07 should be interpreted with considerable caution because they are influenced by the (strong, but uncertain) 2000 year-class.

Projections based on alternative states of nature for each substock were explored to capture uncertainty in population conditions. For the NCS, the low and high *M* scenarios refer to different assumptions about sex-specific natural mortality and were selected to represent the 95% confidence intervals for terminal spawning biomass based on the Hessian approximation. The low scenario assumes $M = 0.2 yr^{-1}$ and 0.25 yr^{-1} for females and males respectively, while the high scenario assumes 0.3 yr^{-1} and 0.35 yr^{-1} respectively. For the SCS, the low and high depletion rates refer to depletion rates in 2005 of roughly 20% and 35%, respectively.This range of depletion for the SCS was determined by the STAR panel to adequately cover uncertainty in its value and was determined by modifying the year 2000 man-made fleet mean weight CV value (*e.g.* an increase in the CV lead to a less depleted resource in 2000). These states of nature attempt to capture the uncertainty in current depletion based on the uncertainty in the magnitude of the 2000 recruitment. Probabilities for each state of nature were calculated, as directed by the STAR panel, assuming a normal probability density function (pdf) parameterized by the expected base case depletion rate and its asymptotic standard deviation.These respective substock pdfs were used to estimate the cumulative densities at the low and high depletion rates of 0.3 and 0.49 for the NCS and 0.2 and 0.35 for the SCS. Each cumulative density, representing the mid-point of the total density of each state of nature, was then doubled to determine the associated probability for each state of nature. Results from each of the states of nature are given in Figure 65.

Decision analysis population projections are provided in Table 21 for each state of nature and several state-dependent future catch series. The NCS will drop below the overfished level if catch levels are based on the 40-10 rule and the high *M* scenario, but the true state of nature is either the base case or low *M* scenario. This also occurs if catches are based on the base case model but the low *M* state of nature is correct. All other scenarios lead to depletion levels above 25% in 2016. Under the 60-20 rule, only the high *M* catch with a low *M* true state of nature leads to a depletion level in 2016 below 25%. In the SCS, all combinations of catch and true state of nature under either control rule lead to a depletion level in 2016 larger than 25%.

Response To STAR Panel Review

The STAR panel, during its review of the assessment, made several recommendations for further model exploration. The following is a list of these recommendations and the subsequent STAT team responses:

1. SCS Fleet 3 year 2000 mean weight datum: The STAR panel recommended further exploration of the effects of the mean weight datum for the SCS for 2000. This request was met and lead to examination of model fits with and without the mean weight datum for 2000, specifically to the length-composition data for the PBR fleet (the only fleet with length fits post-1999). Fits with and without the mean weight datum for the PBR fleet in 2000 are included in Figure 62 and lead to greater confidence in the existence of a large 2000 year-class in the SCS.

2. TENERA adult survey: The NCS model was sensitive to the exclusion of the TENERA adult survey so the STAR panel requested to see the model fits when this survey was included. This request was met and model fits with and without the TENERA adult survey are shown in Figure 60. The STAR panel also suggested comparing the trend in abundance indicated by the TENERA survey to the CPFV CPUE trend for Morro Bay. This request was met (Figure 26).

3. Effective sample sizes: The STAR panel expressed concerns over the method used to determine the effective samples sizes for the length-composition data. Specifically, there were orders of magnitude differences in effective samples sizes among years within some fleets. An alternate method of calculating effective samples sizes was defined. This request was met by an additional sensitivity run for each substock (Table 19) that found no notable differences in model outputs between the two methods for calculating effective sample sizes.

4. Local minima in the steepness profiles: The STAR panel felt that the likelihood profiles for steepness needed additional work to address the lack of smoothness and suggested finer increments when calculating these profiles. This request was met, but the profiles remained clunky (Figs. 62 and 63), suggesting local minima.

5. One sex model: The STAR panel suggested the exploratory development of a one-sex model because the nest-guarding behavior of males should increase their contribution to future reproductive output and thus their value in the population dynamics. This request was met and a one-sex model was produced, but it ultimately just combined the male and female spawning biomasses. It did highlight, however, the issue of what population metric, instead of spawning biomass, should be used when males contribute more than just sperm to reproductive output.

6. Location-specific CPUE analysis: In addition to the IRI spatial catch analysis, the STAR panel suggested the STAT team produce CPUE trends for each location within a substock and compare trends among areas. This analysis was completed and its results are presented in Figs 26 and 27.

Research Recommendations

1. Accurate accounting of removals, especially from the recreational and live-fish fisheries: Fisheries primarily exploited by recreational and live-fish commercial fisheries are traditionally hard to monitor. More effort to monitor these fishery sectors may be necessary to accurately monitor fishing mortality.