Discussion Document to Guide PDT Recommendations for MSY, OFL, ABC, OY, ACL and Target TAC

The National Standard 1 Guidelines envision the following process for setting MSY, OFL, ABC, and, eventually, allowable catch levels (ACL/TAC):

1. The Council informs its Scientific and Statistical Committee of the risk of exceeding the overfishing limit (OFL) that it is willing to accept. NMFS does not consider a 50-50 risk to be acceptable under most circumstances. The Council has not informed the SSC of the risk tolerance that is acceptable for red crab.

2. The SSC expects to receive a "risk neutral" estimate of MSY through the stock assessment process. In the case of red crab, the best available science is presumed to come from the Data Poor Stocks Working Group report published in January, 2009. The PDT may want to advise the SSC on the risk neutral nature of the MSY estimates from the DPSWG, i.e., whether those estimates incorporated precautionary assumptions.

3. The Scientific and Statistical Committee (SSC) must also set the overfishing limit (OFL). The overfishing limit is the product of the fishing mortality rate that will produce MSY and the current biomass. The PDT should advise the SSC regarding the OFL that results from applying Fmsy to the current biomass.

4. The SSC will recommend a buffer between OFL and the allowable biological catch (ABC) to take into account scientific uncertainty. (The Council may not set a catch level that exceeds the SSC recommendation. If the estimate of OFL that is provided to the SSC already includes precautionary assumptions, the SSC will inadvertently double up on precaution. That's why the SSC wants a risk neutral assessment to start with.

5. In the case of red crab, the FMP has not been amended to incorporate ACLs and accountability measures (AMs), so the Council will use the MSY, OFL, and ABC to set OY and a target TAC. The PDT needs to recommend OY and a target TAC to the Council.

Based on the above outline, the PDT needs to consider the following issues:

1. What is a "risk neutral" estimate of MSY? Does the long-term average catch represent a risk neutral estimate of MSY? Do the results of the DCAC model provide a risk neutral estimate of MSY? If the DPSWG provided precautionary estimates of MSY, does the PDT have recommendations for a risk neutral estimate?

   The Data Poor Stocks Working Group relied heavily on the "congruence between average landings and results from the Depletion Corrected Average Catch (DCAC) model" to conclude that MSY ranges from 1700-1900 metric tons of males and to

recommended "a catch limit that mimics both recent and long term mean annual landings."

The first question facing the PDT is whether the MSY estimate put forth by the DPSWG is risk neutral. The implementation of the DCAC model used for the DPSWG incorporated precautionary assumptions in the model inputs. Specifically, the model was run with an assumed zero depletion delta, rather than the depletion delta of -0.27 (a 27% increase in male biomass 90+mm) or -0.2 (a 20% increase in the biomass of fishable size males) that would be calculated from the biomass estimates in the two surveys. The model was run with the zero delta because an increase in biomass when going from an unfished state to the exploited state does not follow the logistic growth model that forms the theoretical basis for the DCAC model. However, a zero delta does not follow that theory either. The use of a zero delta has the effect of defining the sustainable catch as the average catch, making it meaningless that there is congruence between the DCAC model results and the long-term average catch. By choosing a zero delta, the DCAC model produces an average catch that is defined as sustainable, but with no indication of where that sustainable catch falls on the sustainable yield curve.

The DCAC model produces an estimate of the sustainable catch that depends on the depletion delta that is used. The DCAC model does not estimate MSY unless one assumes that the initial biomass approximates the unfished condition and the ending biomass approximates Bmsy. Nothing in the theory behind the DCAC model suggests that the long-term average catch equals MSY unless the fished portion of the population was reduced by approximately 60% from the unfished level during the period covered by the catch.

The precaution that is embedded in the estimate of MSY derived from the DCAC/long-term average catch model is evident from the discussion on page 192 of the DPSWG Report concerning the alternatives for estimating Bmsy. If we assume that MSY equals the long-term average catch that results from running the DCAC model with a zero depletion delta, we must also assume that the ending biomass is Bmsy. In the case of red crab, we have a high degree of confidence in the ending biomass estimate of 36, 247 metric tons of fishable size males. The DPSWG specifically rejected the ending biomass as an estimate of Bmsy because "it implies MSY=Fmsy*Bmsy levels of about 0.7 (0.1) * 36,253 = 2,538 mt per year. This estimate is substantially larger than the long term average catch which has a pronounced effect on the relative abundance of large males."

The DPSWG Report includes the following statement under the list of uncertainties: "Historical catches may understate MSY to the extent that fishing mortality has been less than Fmsy during recent years. Thus, there is appreciable risk that reference points in this report will result in unnecessarily foregone catches." Whereas the procedures in effect for setting ABC bring about further reductions from the sustainable yield estimate, the probability of unnecessarily foregone catches goes up.

If the PDT agrees that the results from the DPSWG constitute precautionary estimates of MSY, the PDT may want to submit the estimate of the sustainable catch from the DCAC model when the depletion delta from the surveys is used. If we assume that the increase

in fishable males from 30,302mt to 36,247mt observed in the surveys was real, the depletion delta is then -0.20. The DCAC model then estimates a sustainable catch (median DCAC result) of 2,165 mt with M=0.10.

2. What overfishing limit should the PDT recommend to the SSC?

   The overfishing limit is obtained by multiplying Fmsy times the current biomass. If the average long-term catch did not reduce the biomass of fishable males (depletion delta used in DCAC model = 0), or may have allowed it to increase (depletion delta = -0.2 from survey biomass, indicating a 20% increase in biomass of fishable males), and catches since the survey (2003-2007) have approximately equaled the average long-term catch (1795mt cf 1775mt), we would expect the biomass of fishable males to have remained relatively stable.

   If Fmsy=cM, and c=.7[1], M=0.1, and Bcurr = 36,247mt, then OFL = 36,247 * 0.07 = 2,537mt.

   If the SSC accepted that estimate of OFL, and applied the same 30% buffer that it proposed during its August 11 meeting, the resulting ABC would be 1776mt. 1776mt is the long term average catch. If the Council sets the OY and TAC at 1776, it would seem to be following the recommendation of the DPSWG to set "a catch limit that mimics both recent and long term mean annual landings."

3. OY/Total Allowable Catch Specification Alternatives

   The issue with regard to Optimum Yield (OY) arises from the possibility that the SSC will not specifiy ABC to fall within 5% of MSY. The Red Crab FMP calls for OY to be 95% of MSY. The purpose of the reduction is to approximate maximum economic yield, which, according to the classic fishery production function, is almost always obtained at a catch (and effort) somewhat less than MSY. If the SSC sets ABC at less than 95% of MSY, two options for setting OY present themselves.

   First, OY might continue to be set at 95% of MSY, with part of the OY held in reserve until scientific uncertainty is reduced to the point where the ABC can be set at 95% of MSY and OY can be achieved. A provision for an OY reserve is referred to in the National Standard 1 Guidelines.

   Alternatively, OY could be set equal to ABC or ACL using the reasoning that for whatever reason, the allowable catch must be optimum. This approach seems to devalue the concept of optimum yield and reduce the incentive to move the fishery toward a more meaningful OY.

[1] The DPSWG used c=0.7 when illustrating the MSY that would result from using the current biomass as Bmsy and c=0.8 in the DCAC model runs.