

Appendix K: Scope of Work for Additional Modeling Effort

Proposed Scope of Work
Version dated: June 10, 2009

Note: *Proposed scope was first discussed by an ad-hoc subcommittee of the Abalone Advisory Group (AAG) on June 3, 2009. The draft scope was presented to the full AAG at its meeting on June 8, 2009. The final, proposed scope, below, was discussed, revised and agreed upon by AAG ad-hoc subcommittee members (Tom Barnes, Chris Voss, Jim Marshall, Ian Taniguchi, Jessie Alstatt, John Ugoretz, John Butler, Bill Bernard, and Terry Maas) on June 10, 2009. Sara Valencia and Alicia Bonnette also participated in the June 10 discussion.*

A. Background and Objectives

The Abalone Advisory Group is charged with exploring the possibility of a red abalone fishery at San Miguel Island. To this end, the group enlisted a Technical Panel (TP) and a Review Committee (RC) to evaluate Total Allowable Catch (TAC) options for a potential fishery. Abalone resource data already input into the TAC modeling effort includes previous commercial catch statistics and 2 years of dive survey data that helped assess population density and the size of abalone counted during these survey events. In addition, demographic information such as growth, reproduction and mortality estimates for red abalone in southern California has been included. The TAC modeling work includes a Statistical Catch at Age/Size (SCA) model produced by the TP which was reviewed by the external peer Review Committee (RC).

Both the TP and the RC have recommended that each of the potential TAC options generated by the SCA model should be used as the basis for a Risk Analysis. This Risk Analysis should be run into the future to determine the possible risks to SMI abalone populations using different fishing scenarios such as different TAC and size limits. These Risk Analysis runs will use *Monte Carlo simulations* to evaluate which potential fishing options and their associated risks would yield a sustainable population.

Monte Carlo simulations are repeated random samples computed to assess uncertainty. The results are not single estimates but rather probabilities of different outcomes. Levels of acceptable risk are a qualitative decision that will be debated within the AAG using information from multiple sources including modeling results.

B. Work to be Performed

Yan Jiao will conduct a Risk Assessment using the SCA modeling approach. Both the TP and the RC recommend a formal risk analysis for examining the tradeoffs associated with different TAC levels and size limits. Formal risk assessment using different fishing rates (or TACs) can be conducted using a Monte Carlo simulation study. In this way the TP, AAG and Fish and Game Commission will be able to visualize the various risks associated with the decisions they will be making.

The recent San Miguel Island survey data in 2006, 2007 and 2008 will be used as *Bayesian priors*. Age and length data from the surveys will be used to structure the SCA model. A revised SCA model is needed to estimate the historic levels of stock and recruitment as well as current stock structure. (For a full description of the SCA model please refer to Dr. Jiao's Final Report "Improving the Stock Assessment of California Red Abalone (*Haliotis rufescens*) at San Miguel Island" dated January 2009).

Multiple stock recruitment relationships can be investigated given the high degree of uncertainty in this relationship for red abalone and its influence on the population projections. Key assumptions should be noted in model results. The estimated age/size structure determined for the population during the 2008 fishery independent surveys in combination with various stock/recruitment relationships models can be used to start the projections.

The TP recommends examining both short (1-5 year) and long term projections (10+ years) knowing that the uncertainty levels for the long term projections will be greater than those for the short term projections. We recommend certain variables be programmed such that they can be manipulated to look at changes in risk with different parameter values such as the TAC and the size limit.

The three major work objectives below provide guidance on the overall scope of work to be performed. In addition, the Department will work with the contractor to further refine the details of the final work plan.

Objective 1: Revise SCA Model

A number of revisions have been recommended by the RC (see their full report "Evaluation of the Red Abalone Stock Assessment") for the existing SCA red abalone model. These revisions include the following:

- Double check historic catch data in coordination with the Department of Fish and Game
- Explore the use of a flexible functional form to model selectivity
- Focus on 2006-2008 survey data rather than additional fishery independent survey information (e.g. CINPs surveys)
- Explore use of a multinomial with the actual number of animals sampled each year for the likelihood for proportions-at-length likely over weights these data because of their lack of independence
- Explore options such as shrinkage to the mean of estimates of more recent year class success as this is being fit as a stock-recruitment relationship within the SCA model.

Objective 2: Conduct Risk Assessment

The modeler will conduct Monte Carlo simulations to help assess uncertainty of the model outputs given a number of TAC and fishing levels. The TP and RC recommend exploring a number of fishing mortality rates. In this case, proposals for how many abalone can be taken (TAC) can be simulated using different fishing mortality rates (specifically $F=0.1$, 0.05 , 0.02 and 0) applied to the population estimates generated by the survey data, to examine short and long term sustainability. In addition, the recommendation was made by the RC to explore a suite of size limits including the former commercial size 197mm and a larger size limit of 203mm . These analyses will be conducted given different types of stock recruitment relationships (as this relationship is not known for red abalone) in a formal risk analysis framework. Conduct these analyses for each of the three regions on SMI (NW, SW and SE).

For each of the risk analyses runs, indicate whether the following minimum thresholds of 2,000, 1,500, 1,000, 500, and 100 abalone per hectare were exceeded. Threshold numbers will be generated by applying these threshold population estimates times the size of one of the survey zones at SMI (e.g. 230 Ha in SW zone).

- Evaluate risk over short and long time (>20 years) frames.
- Year class strength projections can be explored sampling from lognormal distributions with mean, variance and first order autocorrelations determined from the previous 20 years or from other abalone resources
- Biological reference points can be explored using this risk framework by projecting the SCA model forward until the age/size structure stabilizes

Objective 3: Final Report and Working Model

The modeler will produce brief but concise (1-2 page) progress reports every six weeks to the Department during the scope of this work. These progress reports should be easily read and understood. As requested by the AAG, the progress reports will be followed up by a conference call with the modeler, Department staff, and interested AAG members.

The modeler at the conclusion of this contract will submit a project report that can be easily read and understood with figures fully described and labeled, and transmit a completed working model. A spreadsheet or table summarizing key model runs and their results should be included in this final report. Based upon the results of the initial draft report, the contract manager will indicate which model results should be included in the summary table.

The final report will not be considered complete until approved by the contract manager.

Based upon comments received from the AAG and the Department, the modeler will revise an initial draft project report to produce a final project report.

The modeler will travel to California at the end of their work to present the final product to an audience of managers, the AAG, and other interested parties.

The draft project report will explain the results of the risk analysis for each of the various scenarios of fishing mortality rate, size limit, and area.

The model will be documented in detail so that it can be worked on for trouble shooting and updated in the future, as needed.

The working model will become the property of the California Department of Fish and Game and is designed for use by the AAG. A complete transfer of the model as a package with user instructions will be provided so as to allow user groups to change the fishing mortality rate, the size limit, and threshold abundances.. In this way the model will be useful in showing the tradeoffs associated with different management decisions and their impact on population sustainability. Upon transmittal, the model should be in a commonly used and user-friendly software format (e.g. Excel) and produce a graph of the risk analysis results (population abundance on the Y axis and Time on the X axis) for each management scenario (model run).

Proposed Timeline & Deliverables:

It is anticipated that this contract will begin in summer 2009.

- Draft report including a revised SCA Model and the results of the risk analyses (Objective 1 and 2, above): due 3 months after start of contract.
- Final report and Transmittal of Model including user instructions in a user-friendly format: due 6 months after the start of the contract.
- Presentation to AAG, Department and Interested parties: Date to be determined before the conclusion of the contract.