**FISH 505. Exercise 9**

Applying DLM Tool to evaluate the trade-offs of different candidate management procedures for student case studies.

The aims of this exercise are

1) To familiarize students with how to perform MSE calculations to evaluate candidate management procedures for a fishery of interest.

2) To develop skills and understanding of students in the development of alternative operating models for MSE in a given fishery.

3) To develop the ability of students to evaluate trade-offs associated with different candidate management procedures.

4) To familiarize students with generic MSE software for evaluating management procedures for data limited fisheries (i.e., DLM tool) and to learn how to apply this software to evaluate candidate management procedures for fisheries of interest to them.

Your report on this exercise is due on April 25th at 5pm.

**Steps and Questions**

1. *State a minimum of one fishery objective and one conservation objective for your case study fishery and use the three-point guidelines for management objective specification from the seminar slides presented in the first FISH 505 session on MSE.*

**Table 1.** Management objectives for the Stone’s sheep harvest in WMU7-42. Harvest objectives are catered towards maximizing the number and value of harvestable males, while conservation objectives seek to avoid recruitment overharvest.

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| --- | --- | --- |
| Objective | Time frame to meet objective | Probability of obtaining the objective |
| *Harvest/conservation*  Keep harvest rate, F, at or below FMSY | Long-term  Harvest should not surpass MSY between 2016 and 2056, the final year of simulation | *Probability:* 90%  Harvest rates should not surpass FMSY in more than 10% of simulations |
| *Harvest*  Maximize the length of horns available for harvest | Long-term  Average harvested horns should be be >90cm after 2036 | *Probability*: 50%  Over 90% of simulations should ensure that the average harvested horn length is greater than 90cm |
| *Conservation*  Maintain the mature male population above 5% of the total female population (this should avoid recruitment overharvest; | Long-term  The male population should not drop below 5% of the female population at any point in the 40 year simulation | *Probability*: 90%  The mature male population must not drop below 5% of the female population size in at least 90% of simulations |

Harvest objective: maximize the number of mature males available for harvest by 2030 – a 20 year time span would allow for

Harvest objective: maximize the average length of horns being harvested by hunters

Conservation objective: keep the number of mature males (i.e. those aged six years or higher) above 5% of the total female population (assuming that the female population is unaffected by hunting and remains relatively constant through the time series)

1. Identify and list the types of information available from which you can formulate an operating model for your case study fishery.
2. Make a copy of the Example\_Chile\_Hake Excel file in the Excel directory of the Exercise subdirectory and rename your new file to your case study fishery name. This Excel file contains tabs for the Stock, Fleet, Observation, Implementation and other operating model attributes of the operating model, revise the specifications in each of these tabs to the “base case” attributes for your case study operating model. Provide a print-out of the tabs of your updated Excel file and list brief justifications for your entries into each of the tabs of this file.
3. Identify which alternative management procedures in the DLM tool software would be appropriate and of interest to evaluate for your case study fishery.

Management procedures for this analysis should focus on input controls – once hunters have obtained hunting permits, they are able to capture one ram. Therefore input control is the primary management tool available for harvest managers.

1. In DLM tool read in your Excel file containing the stock, fishery, data and overages objects and formulate your operating model object using the attributes within the Excel file.
2. Apply the plotting features in DLM tool to plot out the various attributes of your operating model and make appropriate adjustments to make sure that your operating model shows intuitively correct attributes.
3. Evaluate the performance of the candidate management procedures (MPs) using the base case operating model and select set of performance metrics in DLM tool. Show the plots of trade-offs in performance metrics for the different candidate MPs. Provide also a summary table of key performance metrics for each of the candidate MPs under the base case OM.
4. Formulate at least three other credible operating models for your case study fishery which represent different types of uncertainty in your operating model settings. Using each of these “stress test” operating models, compute the performance metrics for the candidate MPs and plot the trade-offs for the candidate MPs under each of these alternative OMs. Identify which MPs are most robust to uncertainty.

Operating models:

+ Hunter selectivity is “perfect” – captures ONLY males who are full curl adults

+ Beverton-Holt steepness is higher by 1.5x

+ Effort decreases over time

Base case - Hunter selectivity matches historic patterns such that non-legal males (less than full curl) are vulnerable

- Beverton-Holt steepness is lower by 1.5x

- Effort increases over time

*Alter implementation?*

1. Based on your analyses, rank the performance of the candidate MPs and justify your approach for ranking the performance of the candidate management procedures.
2. Provide a brief summary of the key strengths and potential weaknesses of your analysis.

Strengths: robust to which uncertainties?

Weaknesses: sensitivities to certain parameters, no sex-specific processes, assumes perfect implementation

11. Along with your report, please e-mail also, the csv files that you used to form your base case operating model.