# Bio-economics Model Worksheet

**Part One:** Introduction to the Fisheries Explorer

We begin by examining an output controlled fishery at a static equilibrium.

Answer the following questions by examining the various variables (eg. Biomass, CPUE and Profit), you can select which variables to plot on the right hand side of the screen.

**Q1**. Find MSY and MEY

MSY Profit: \_\_\_\_\_\_\_\_\_\_\_ MSY Catch: \_\_\_\_\_\_\_\_\_\_\_

MEY Profit: \_\_\_\_\_\_\_\_\_\_\_ MEY Catch: \_\_\_\_\_\_\_\_\_\_\_

*Hint: You will need to plot additional variables to determine the MEY*

**Q2**: Why does the marginal cost of catching each additional tonne increase as the TACC is increased?

*Hint: Think of the cost in terms of the other variables that can be examined.*

**Part Two:** Exploring the Static Fishery

We will now explore the effect of various parameters on our model fishery. You can select parameters to modify from the “Parameters” menu and use their sliders to adjust their values.

**Q3**: Select “Population Dynamics” from the “Parameters” menu. These parameters control the biological aspects of our fishery. The population growth rate determines the rate at which animals grow and recruit to the fishery. If environmental factors decreased the growth rate, what is the effect on MSY and MEY? (circle one answer per row).

|  |  |  |  |
| --- | --- | --- | --- |
| MSY Profit | Decreases | Unchanged | Increases |
| MSY Catch | Decreases | Unchanged | Increases |
| MEY Profit | Decreases | Unchanged | Increases |
| MEY Catch | Decreases | Unchanged | Increases |

*Hint: Note that the x axis range may change as the growth rate is adjusted.*

**Q4**: Before using the interface to explore further, discuss and answer the following two questions:

|  |  |  |
| --- | --- | --- |
| Will adjusting economic parameters change MSY? | Yes | No |
| Will adjusting economic parameters change MEY? | Yes | No |

**Q5**: Reset the model by selecting “Reset Model” from the “Model” menu (this resets the parameters to their initial values). For the following questions, we will be adjusting the economic parameters of the model which are modified by selecting “Economic Parameters” from the “Parameters” menu.

You will now explore the relationship between MSY and MEY by adjusting the economic parameter values. Each of the rows in the following table corresponds to a change in an economic parameter. In each column indicate whether the MSY/MEY, catch/profit will increase or decrease.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Economic Change** | **MSY Catch** | **MSY Profit** | **MEY Catch** | **MEY Profit** |
| Increased Fixed Cost |  |  |  |  |
| Increased Marginal Cost |  |  |  |  |
| Increased Beach Price |  |  |  |  |

**Q6**: Reset the model to return the parameters to their original values. If the beach price dropped to $20 would the modelled fishery exist? Yes / No

If not, what changes could enable a fishery to exist under this condition?

**Q7**: Reset the model and select the “Fleet Dynamics” parameters. Currently the fleet size is fixed independent of the TACC. The fleet restructure rate is the rate at which the fleet size may change (in vessels per year). What happens to the profits if the fleet size is allowed to change (by selecting a non-zero value)?

In this situation why would fishers remain in the industry?

*Hint: What does a profit of zero actually mean in this model?*

# Part Three: A dynamic world!

We will now change to a dynamic perspective. Select “Dynamic” from the “Model” menu. The x-axis now represents time in years from the present. The net present value – NPV – is shown in the bottom left corner. If you reset the model you will see a situation where the biomass is initially at a level that is slightly elevated from the equilibrium. After about 5 years the fishery has reached equilibrium.

**Q8:** Select “Management Controls” from the “Parameters” menu. You can now explore the effects of different TACs. Determine the MEY and MSY (rough estimates are sufficient).

MSY NPV: \_\_\_\_\_\_\_\_\_\_\_ MSY Catch: \_\_\_\_\_\_\_\_\_\_\_

MEY NPV: \_\_\_\_\_\_\_\_\_\_\_ MEY Catch: \_\_\_\_\_\_\_\_\_\_\_

*Hint 1: Can you crash the fishery by changing the TAC?*

*Hint 2: This is exactly the same model as considered in Parts One and Two.*

**Q9:** Reset the model and select the “Economics” Parameters. In the dynamic perspective a new parameter is available - the discount rate. This controls how much future profits are worth today. Consider the effect of the discount rate on the Discounted Profit relative to the Profit.

If management aims to maximise NPV (the sum of the discounted profits) will a higher discount rate put more focus on management for the: Short term / Long term ? (circle one)

**Q10:** What is the MEY harvest strategy with an extreme discount rate (eg. 0.9)?

*Hint: Which TAC maximises the NPV (in the bottom left corner)*

**Q11:** What is the lowest discount rate at which the MEY harvest strategy crashes the fishery? \_\_\_\_\_\_\_\_\_\_\_

**Q13**: Reset the model. Now consider the effect of letting the fleet size change over time by change the fleet resize rate (available under “Fleet Dynamics” from the “Parameters” menu). What happens to profits as the resize rate is set to a value greater than one?

*Hint: Consider your response to question 7*