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3.21 Using Ecosim for Stock Reduction Analysis

A very useful technique for using long term data in stock assessment is Kimura's "stock reduction analysis". In this technique, historical catches are treated as fixed, known quantities, and are subtracted from simulated stock size over time so as to aid in estimating how large (and/or productive) the stock must have been in order to have sustained those catches and to have been reduced by some estimated fraction from its historical level. In some assessment literature, treating catches as fixed knowns is also called "conditioning on catch". A drawback of treating catches as fixed values is that catches in fact arise from the interaction of fishing effort and abundance, and ignoring this dynamic interaction amounts to treating the catches as purely depensatory impacts on stock size (when simulated stock size declines, the fixed catches can cause progressively larger calculated fishing mortality rates *F*, leading to a depensatory spiral of rapid collapse in the simulated stock, which may or may not have been possible in the real system).

When creating historical reference csv files for model testing (see Import time series), all or part of a catch time series for any group(s) can be treated as a forcing input (with simulated *F* calculated each year as (input catch)/(simulated stock size)) by setting its data type to -6 (rather than the usual 6 for fitting catch data). Note that the catch time series for a group can be entered in two columns, with one column set to data type 6 and one to data type -6, where catches for years to be treated as forcing are placed in the -6 column and catches for years when catch is to be predicted from effort or assessment *F*s placed in the 6 column. Most often, this splitting of catches into two columns should be used in cases where there are no independent assessments of *F* for some early years.

The Monte Carlo simulation interface in Ecosim can be used to search for ecopath biomasses needed to have sustained historical catches. We cannot search for such initial biomass values by simple nonlinear search methods, due to the biomass constraints implied by ecopath mass balance. The Monte carlo simulation interface can do a large number of simulations with randomly varying trial values of ecopath biomasses, and can retain trial values that result in improved model fit; such a search or fitting procedure is known as a "Matyas search".