Production models

fish5108statass Statistical stock assessment methods

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History

Stock-production models: Typical for whales, shrimp, nephrops and other difficult to age species

Originally: Assumed equilibrium (oversimplified)
Now: Use dynamic stock-production models

An equilibrium model

A simple equilibrium production model:
$Y = rB(1 - \frac{B}{K})$

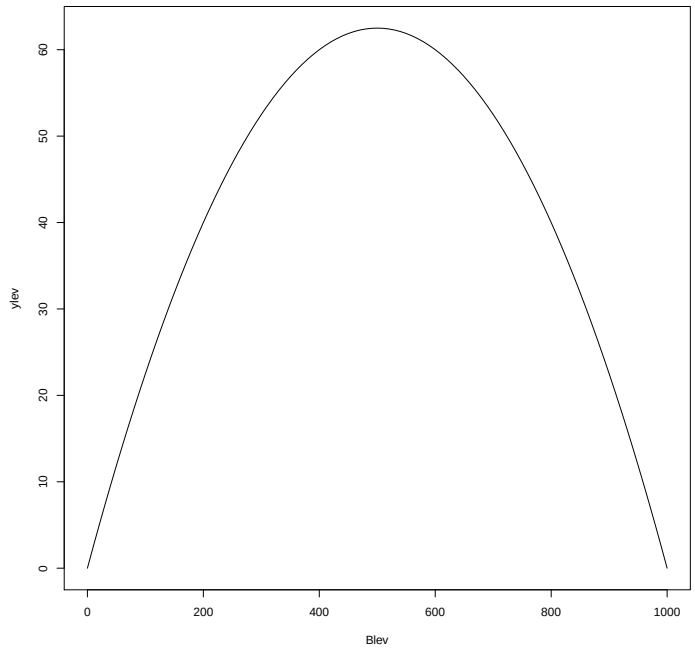

Figure : Equilibrium yield and biomass

Simple forward projections

Given B the production is $rB(1 - B/K)$.

If the catch is Y the stock biomass will become

$$B + rB(1 - B/K) - Y.$$

Notably, the stock increases if Y is less than the production and vice versa.

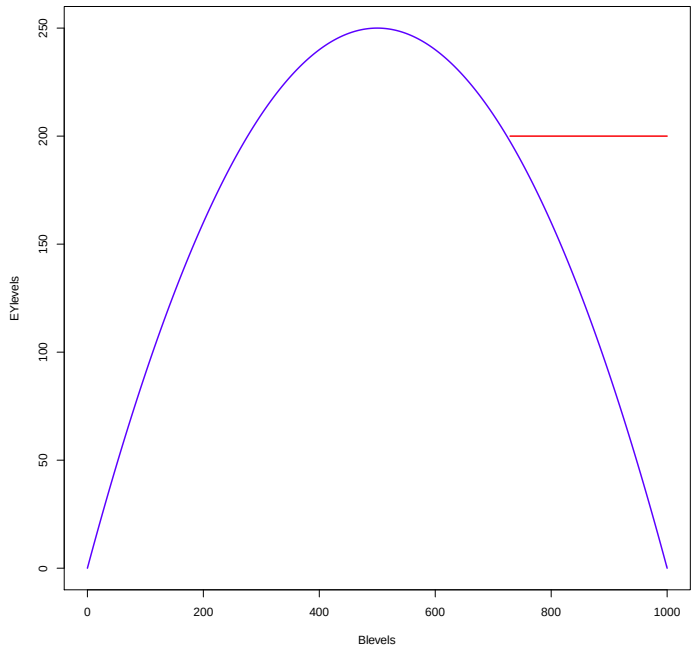

Figure : Equilibrium yield with a constant catch line.

The problem with equilibrium models

Over-fished=catch above sustainable yield

Observed biomass and catch all above the underlying curve

Note: Will overestimate production if assume equilibrium

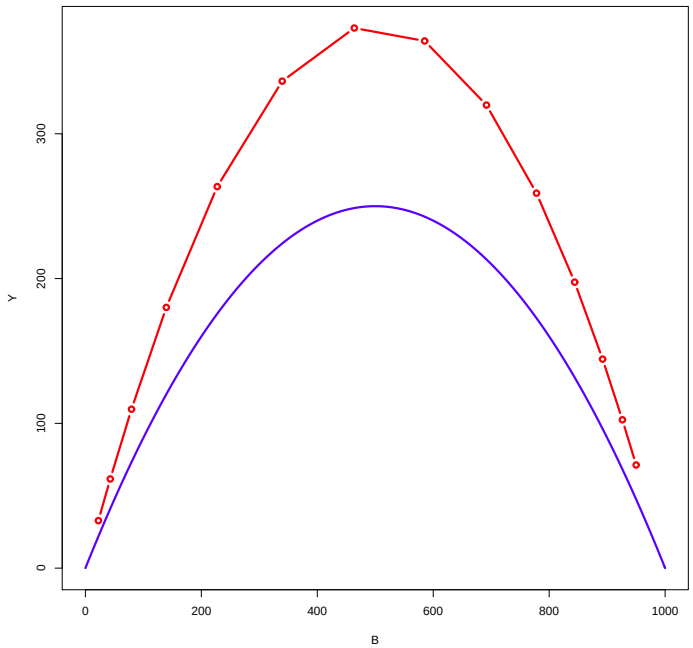

Figure : The bias issue when estimating data from an equilibrium model. The solid line is the true model and the dot/dashed line is from generated data when fishing is 1.5 times the equilibrium catch.

A dynamic biomass model

A simple forward projection model:

$$B_{y+1} = B_y + rB_y(1 - B_y/K) - Y_y$$

where the catch is specified according to some rule, e.g. proportional harvest:

$$Y_y = pB_y.$$

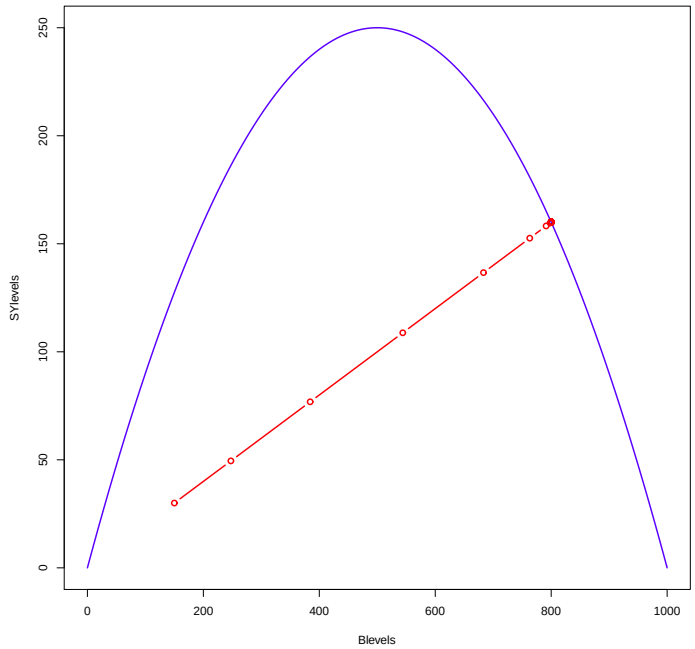

Figure : Equilibrium yield and curve describing the trajectory of catch and biomass under a constant harvest strategy.

Unknown parameters

Model: $B_{y+1} = B_y + rB_y(1 - B_y/K) - Y_y$
Unknown parameters: r, K, and B_0.

- Given model and parameters, the trajectory can be generated.
- Assumes catches are known constants (no error)
- Parsimony: May (need to) assume $B_0 = K$.