Yield potential

fish5106stockrec Spawning stock, recruitment and production

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December 19, 2016

Introduction

Y/R and S/R known for each F. Also,

$$R = \frac{\alpha S}{1 + S/K}$$

The equilibrium size of the spawning stock

$S = (S/R)R$, which implies

$$
\begin{aligned}
S &= (S/R)\frac{\alpha S}{1+S/K} \\
\Rightarrow \quad 1 &= (S/R)\frac{\alpha}{1+S/K} \\
\Rightarrow \quad 1 + S/K &= \alpha(S/R) \\
\Rightarrow \quad S &= K\left[\alpha(S/R) - 1\right]
\end{aligned}
$$

Equilibrium yield

$$Y = (Y/R)R = (Y/R)\left[\frac{\alpha S}{1 + S/K}\right].$$

The equilibrium yield curve

The previous methodologies can be combined into the following steps:

- Fix F
- Compute the yield per recruit (Y/R)
- Compute spawning stock biomass per recruit (S/R)
- Next compute S using S/R and α, K
- Finally compute R and then Y

Can do this for range of F and plot Y against F.

Maximum of this curve: MSY.

Corresponding F: F_{MSY}

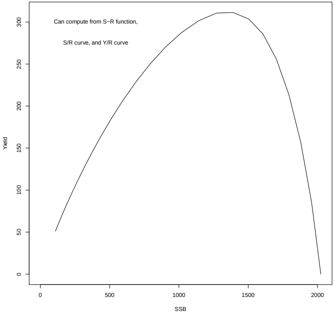

Figure : Equilibrium yield for cod in Icelandic waters (from Danielsson et al, 1996)

Caveats

We assume equilibrium!

No variation is included

Other stock-recruitment relationships

Can also use the Ricker curve equation to get

$$S = K\left[\ln(\alpha S/R)\right]$$

The cushing equation $R = \alpha S^{\beta}$ gives

$$S = \left[\alpha(S/R)\right]^{1/(1-\beta)}$$

Extensions

Can easily add cannibalism by juveniles

Density-dependent growth can also be included