Biomass dynamic model fit comparisons

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Walters and Hilborn (1976) presented a difference form of the continuous Schaefer

$$B_{t+1} = B_t + rB_t\left(1 - \frac{B_t}{k}\right) - qE_tB_t \quad (1)$$

where B_t is the biomass at time t, r is the population growth rate, k is the carrying capacity, q is catchability, and E_t is effort. From the assessment database, estimates of the biomass ($\hat{B}_t$) and catch ($\hat{C}_t$) are provided. For clarity, equation (1) is re-written

$$\hat{B}_{t+1} = \hat{B}_t + r\hat{B}_t\left(1 - \frac{\hat{B}_t}{k}\right) - \hat{C}_t \quad (2)$$

Estimates of the uncertainty are not generally available so the $\hat{B}_t$ and $\hat{C}_t$ are treated as knowns. The question is, how to obtain parameter estimates and resulting reference points from these series? Walters and Hilborn (1991) suggest two methods: regression and time-series fitting.

Regression

Surplus production is given by

$$S_t = B_{t+1} - B_t + C_t \quad (3)$$

where S_t is the surplus production at time t (Hilborn, 2001). Re-formulating equation (2)

$$\hat{S}_t = \hat{B}_{t+1} - \hat{B}_t + \hat{C}_t = rB_t\left(1 - \frac{B_t}{k}\right) \quad (4)$$

which can be written as a surplus production rate over biomass.

$$\frac{\hat{S}_t}{B_t} = r\left(1 - \frac{B_t}{k}\right) \quad (5)$$

$$= r - \frac{r}{k}B_t \quad (6)$$

References

Hilborn, R. (2001). Calculation of biomass trend, exploitation rate, and surplus production from survey and catch data. Canadian Journal of Fisheries and Aquatic Sciences, **58**(3):579–584.

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