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A Note on the Simple Assessment of a Proposal for Mesh Regulation

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Let R be number of fish recruited at age t_c corresponding to the mean selection point of existing mesh. Let y be the mean annual catch in weight, and

$$Y = {}_1Y + {}_2Y$$

where ${}_1Y$ is the catch of fish of ages from t_c to $2t_c$, corresponding with the selection point of the proposed larger mesh, and ${}_2Y$ is the catch of all fish above this latter age. Put

$${}_1y = {}_1Y/Y \quad \text{and} \quad {}_2y = {}_2Y/Y$$

In general

$$\frac{dN}{dt} = - [F(t) + M(t) + E(t) - I(t)] N$$

from which

$$N(t) = N_0 e^{-\int_0^t (F + M + E - I) dt}$$

A general equation for the catch of fish over any age range A^t to B^t is

$$\begin{aligned} {}_A Y_B &= N_0 \int_{A^t}^{B^t} [w(t) \cdot F(t) \cdot e^{-\int (F + M + E - I) dt}] dt \\ &= N_0 \int_{A^t}^{B^t} [z] dt \end{aligned}$$

In the situation we are considering

$${}_2y = R e^{-\int_{t_c}^{2t_c} (F + M + E - I) dt} \int_{2t_c}^{\infty} [z] dt$$

Using primes to indicate post-regulation catches, we should have now if mesh were increased,

$${}_2y' = R e^{-\int_{t_c}^{2t_c} (M + E - I) dt} \int_{2t_c}^{\infty} [z] dt$$

so that

$${}_2y' = {}_2y e^{\int_{t_c}^{2t_c} F \cdot dt}$$

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The expected benefit from regulation is

$$100 \left\{ \frac{2Y' - (Y + 2Y)}{Y + 2Y} \right\} = 100 \left\{ 2Y \left[e^{\int_{t_c}^{2t_c} F dt} - 1 \right] - Y \right\} \%$$

If F is approximately constant from t_c to $2t_c$

this reduces to

$$100 \left\{ 2Y \left[e^{F(2t_c - t_c)} - 1 \right] - Y \right\} \%$$

The significance of the above result is this: the benefit of a mesh regulation to the fishery for which it is imposed, in saving small fish for later capture depends only on the proportions of fish below and above the new selection size in the pre-regulation catches and on the original fishing mortality rate over the range of fish age between the original and new selection sizes. This is true if the following conditions hold - that the change in the mesh size does not result in changes in the natural mortality rates, the pattern of migration in or out of the fished area, or in the relative intensity of the fishing on smaller and larger fish above the new selection size. Its validity does not otherwise depend on constancy of mortality rates with respect to time or age of fish, or on whether fish move in or out of the area fished by the regulated fleets. The method is **applicable** to the general prediction of benefits, and also, by consideration of single year-classes, to the subsequent verification of the prediction after regulations have been in force for a few years.