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The Catch-Trawlable Biomass Model Used in Assessment of the American Plaice in Division 3M

by

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Introduction

E. de Cardenas and M. L. Godinho in SCR Doc. 94/45 use the ratio between the catch C and the trawlable biomass B as an estimator of the product of the catchability q and the fishing mortality F based on:

$$C = q * F * B$$

This relation is only strictly correct if q and F are independent of age.

Therefore, a simulation illustrating the problem and its magnitude is presented below.

Simulation Setup

In this simulation it was assumed that the stock in numbers N(age) and the mean weights at age w(age) were as presented in Table 1. The survey result, the trawlable biomass B, depend on the catchability of the survey, q(age):

$$B = \sum_{age} q(age) * N(age) * w(age)$$

while the catch was derived from a F-at-age (F) given in Table 1.

$$C = \sum_{age} w(age) * N(age) * F(age) / Z(age) * (1 - \exp(-M-F(age))$$

Table 1 shows the results for the catchability = exp(-3*age), and F when multiplied by 1.5.

Simulation Results

Four models for the survey catchabilities were investigated:

$$q(age) = 1, \exp(-age), \exp(-2*age), \exp(-3*age)$$

and the basic set of F-at-age was multiplied by 0, 0.5, 1, 1.5, 2, 3.

The calculated C/B ratios are given in Table 2 and plotted in Fig. 1 which shows the C/B ratio plotted *vs* different levels of F and for different models of q.

Figure 1 shows, as expected, that the slope of the C/B ratio changes drastically with the catchability model applied, and also that the C/B relation is only approximately linear through the origin for q(age), not constant. However, the deviations from the model

$$C/B = \alpha * \text{F-level}$$

is not very marked.

Acknowledgement

Dr. Fred Serchuk raised the problem of when the C/B ratio is proportionate to the average catchability multiplied by the fishing mortality when the catchability varies by age.

TABLE 1. Stock definition and simulation results for q(age) = exp (-3*age) and basic F-at-age multiplied by 1.5.

Simulation of Catch/Trawlable Biomass Model						
Age	Stock	Catchability	Survey	F	Catch	Weights
6	1000	1	1000	0.15	126.5622	100
7	800	0.049787068	39.82965469	0.45	264.7131	150
8	600	0.002478752	1.487251306	0.75	290.4911	200
9	400	0.00012341	0.049363922	0.75	193.6607	250
10	200	6.14421E-06	0.001228842	0.75	96.83036	300
11	100	3.05902E-07	3.05902E-05	0.75	48.41518	300
		Biomass	106284.6173	Yield	202450.3	q*F 1.904794

TABLE 2. Simulated C/B ratios for different F-levels and different survey catchability models.

F-level	C/B q constant	C/B q=exp(-age)	C/B q=exp(-2*age)	C/B q=exp(-3*age)
0	0	0	0	0
0.5	0.15	0.49	0.69	0.77
1	0.28	0.89	1.25	1.4
1.5	0.38	1.21	1.71	1.9
2	0.47	1.48	2.08	2.32
3	0.59	1.88	2.63	2.94

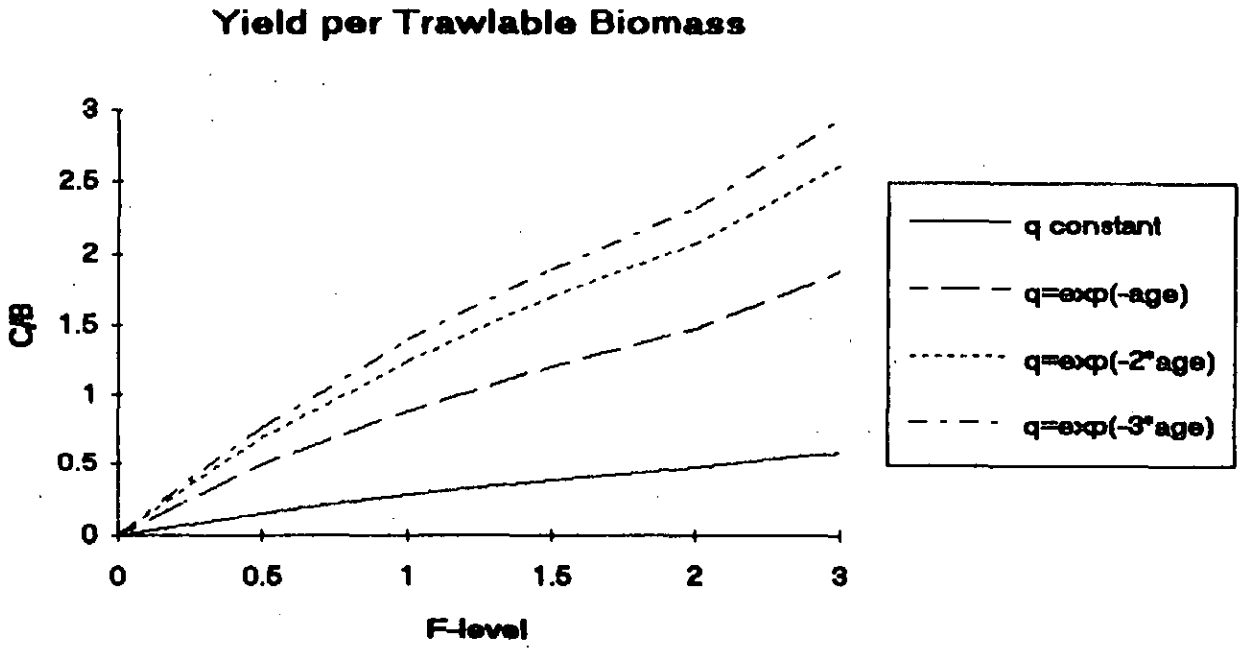

Fig. 1. C/B ratios for different F-levels and for different survey catchability models.