Factors Driving High Fishing Mortality Reference Points in Cape Cod-Gulf of Maine Yellowtail Flounder Stock Assessment

The Cape Cod-Gulf of Maine yellowtail flounder stock has an unusually high fishing mortality reference point in comparison to past estimates for the stock or other groundfish in the region. Several factors contribute to these high values. Firstly, the natural mortality rate (M) for the Cape Cod-GUlf of Maine stock is now higher than it was previously, which is generally associated with an increase in fishing mortality (F) reference points. Secondly, estimates of selectivity for recent years are now much older than the age of maturity for CCGOMi, allowing spawning to occur prior to the full effect of the F reference point value. The fleet selectivity reaches its highest value in the plus group with younger ages less than 100% selected. This means the fishing mortality rate applied at younger ages is much less than the F reference point.

In previous Virtual Population Analysis (VPA) assessments for Cape Cod-Gulf of Maine, fleet selectivity was set equal for ages four through six plus. The new selectivity patterns, however, increase considerably from age four to six plus, meaning that the new F reference points are not directly comparable to the previous F reference points for these stocks. A demonstration of how these factors interact to result in high F reference values is provided below.

Table 1 shows the spawner per recruit values used in the calculations, along with a spawning fraction of 0.4166667. The two natural mortality rates (M Low and M High) reflect the changes between previous VPA assessments and the current research track assessments. The two selectivity patterns were selected to reflect a flat-topped pattern with A50 similar to the maturity A50 (Sel Low) and an increasing selectivity pattern that peaks in the plus group (Sel High). The four combinations of M and selectivity (high and low) were used to estimate spawners per recruit (SPR) for values of F ranging from zero to two (Figure 1). The relative spawners per recruit (relSPR) were calculated by dividing each of the SPR values for a run by the SPR value when Fmult is zero (Figure 2). This allows direct comparison of the F40% values (the horizontal dashed blue line in Figure 2). The F40% value increases with an increase in either M or selectivity, but the combination of the two produces a dramatic increase in F40%.

Table 1. Input values used in this demonstration of how F40% responds to changes in natural mortality (M) or selectivity (Sel).

Age	1	2	3	4	5	6
WAA	0.126	0.254	0.308	0.368	0.404	0.405
Maturity	0	0.564	0.992	1	1	1
Sel Low	0	0.5	0.9	1	1	1
Sel High	0.004	0.024	0.122	0.445	0.84	1
M Low	0.2	0.2	0.2	0.2	0.2	0.2
M High	0.4	0.4	0.4	0.4	0.4	0.4

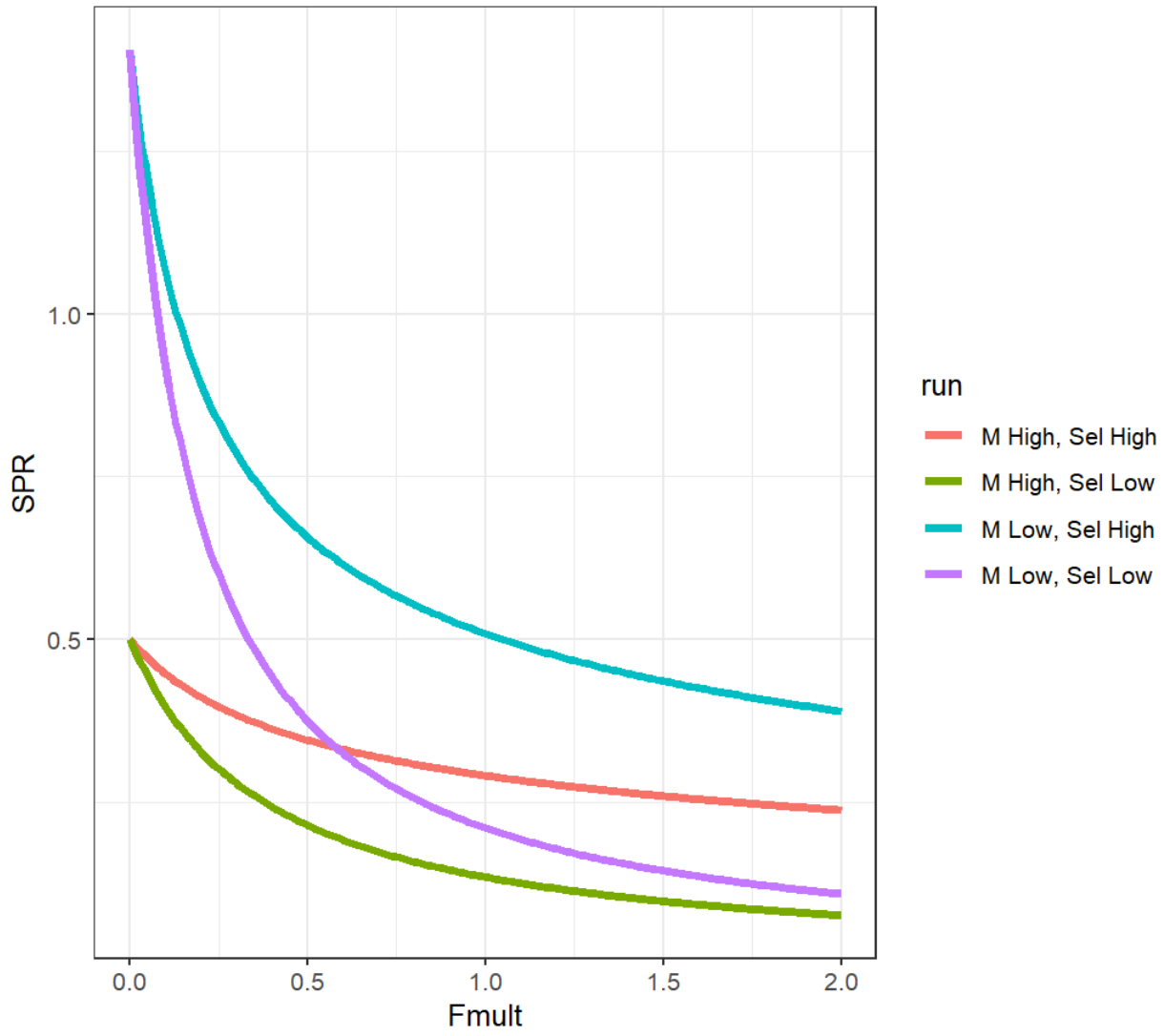

Figure 1. Spawners per recruit (SPR) as a function of the fishing mortality rate multiplier on the fully selected age (Fmult) for four combinations of natural mortality (M) and selectivity (Sel).

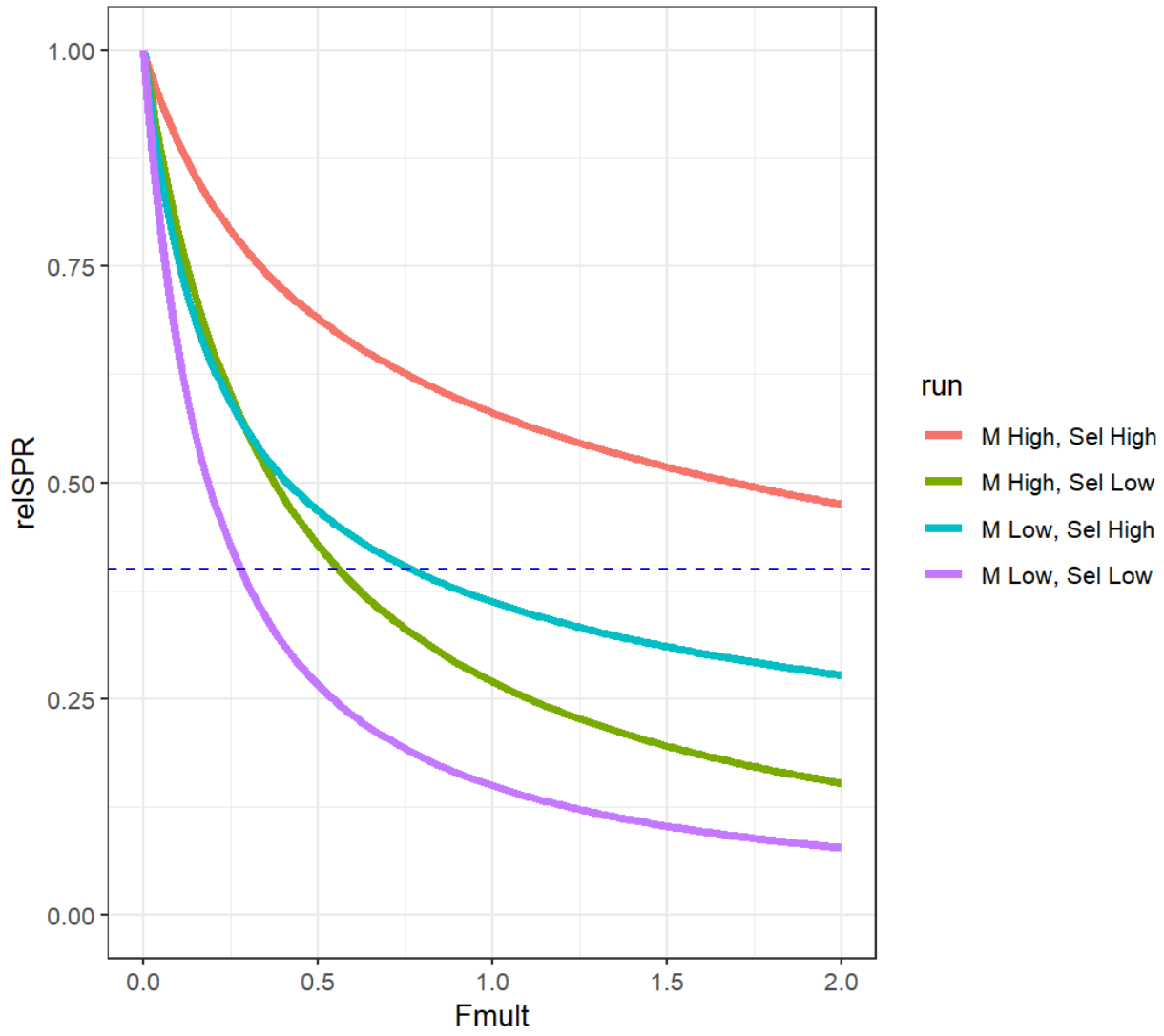

Figure 2. Relative spawners per recruit (relSPR) calculated as the SPR divided by SPR when fishing mortality is zero as a function of the fishing mortality rate on the fully selected age (Fmult) for four combinations of natural mortality (M) and selectivity (Sel). The horizontal dashed blue line represents F40%, a common F reference point used in the region.