# What if Gulf King Mackerel MRFSS B2 Fish All Died?

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At the April 2000 mackerel stock assessment panel (MSAP 2000) meeting in Miami the question arose regarding the gains to the fishery if recreational discards (MRFSS B2) were assumed to all die. Two deterministic analyses were conducted which showed potential gains to the fishery on the order of 2-2.5 million pounds for the fishing year 2000 acceptable biological catch (ABC). However, it was noted that these gains resulted almost exclusively due to a single cohort being estimated at a larger abundance when the B2 fish were assumed to die and that the uncertainty about the point estimates from bootstrapping would most likely decrease this potential gain. The MSAP recommended that this be further investigated and this manuscript documents the additional investigation conducted.

Bootstrapping has been completed for the two assumptions that the B2 fish all die and are distributed either over all ages or over only young ages (1-3) in proportions relative to the observed catch. Note that neither of these cases are thought to accurately reflect reality, they were chosen as extremes to bound the problem with the understanding that the true release mortality rate is somewhere between zero and one hundred per cent and that the age distribution of discards needs further study. Until additional information on the size and age composition of the discarded catch can be obtained, it is unlikely that additional progress on this question can be made.

The two assumptions regarding the age distribution of recreational discards, all or only young ages, result in different levels of risk of overfishing and being overfished relative to the base case scenario which assumed all B2 fish live (Table 1). The “all ages” assumption has a higher probability of overfishing than the base case while the “young ages” assumption has a lower probability of overfishing than the base case. In contrast, both assumptions when recreational discards all die have lower probability of being overfished than the base case. These patterns hold for the target levels of optimum yield benchmarks as well.

The maximum sustainable yield (MSY) and optimum yield (OY) benchmarks also change when recreational discards are assumed to die (Table 2). The yields for both benchmarks increase approximately one half or one million pounds for the “all ages” and “young ages” distributions of dead discards, respectively. Both increases in yield are associated with larger spawning stocks in equilibrium when recreational discards are assumed to die. There are a few factors causing these increases. Assuming recreational discards die causes larger population abundances to be estimated because more removals from the population are counted while the tuning indices remain unchanged. These larger populations thus have the potential to generate more yield in equilibrium, especially when the two-line stock recruitment relationship is utilized because the future recruitment values are higher when recreational discards are assumed to die than when they are assumed to live. When the fishing mortality due to the shrimp trawl fleet is reduced in the future due to implementation of bycatch reduction devices (an assumed 50% reduction), there is a larger gain to the cases when recreational discards are assumed to die than when they are assumed to live due to the higher recruitment values. Additionally, the single cohort that increased in size in the deterministic analyses is used as the expected value during the bootstrapping. So even though the increase in MSY and OY is less when measured as the median of 400 bootstraps than when only the deterministic scenario is considered, the change in that single cohort

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estimate does still influence the perceived recruitment levels and thus the future potential yield of the stock due to the use of the two-line stock recruitment relationship.

The 2000/2001 fishing year acceptable biological catch (ABC) increases when recreational discards are assumed to die under both age distribution assumptions, although the distributions overlap considerably (Table 3). Not only do the median values increase when recreational discards are assumed to die, but the distributions are stretched to produce longer tails as well (Figure 1). These stretched tails have implications for setting the ABC if F30%SPR is treated as a limit that should only be exceeded with low probability (Table 4). This means that the upper end of the ABC range from the F40%SPR distribution could be reduced due to the probability of that catch exceeding F30%SPR. In this situation, the stretched tails cause the “all ages” case to have a lower maximum ABC value than the base case when the allowed probability of exceeding the limit is less than 25%. In all three cases, treating the F30%SPR as a limit not to be exceeded with greater than 25% probability reduces the maximum ABC value from the F40%SPR distribution.

In conclusion, assuming the recreational discards all die produces larger future recruitment values which can lead to larger equilibrium yields in the future, especially when shrimp trawl bycatch is reduced. However, there is the possibility that more accurately estimating the release mortality rate and the age distributions of the discards could in fact lower short term catches as the estimated selectivity pattern changes. The overall changes in estimated stock dynamics are not great when recreational discard mortality is included, but should be researched further to allow better management of this valuable resource.

Table 1. Probability of F and spawning stock exceeding given thresholds or targets for three scenarios, the base case in which recreational discards are assumed to live, and recreational discards assumed to all die distributed over all ages or only young ages.

| | (overfishing) | | (overfished) | | |
|---|---|---|---|---|---|
| | F>MFMT | F>Foy | SS<MSST | SS<SSmsy | SS<SSoy |
| Base | 32.8% | 89.8% | 34.5% | 90.5% | 100.0% |
| B2 All | 37.0% | 90.8% | 20.3% | 81.5% | 99.8% |
| B2 Young | 14.0% | 77.0% | 18.3% | 76.8% | 99.5% |

Table 2. Maximum sustainable yield and optimum yield related benchmarks for the three scenarios of the fate and age distribution of recreational discards. Spawning stock (SS) measured in trillions of eggs, fishing mortality rate (F) measured as the rate on the fully selected age, yields (MSY and OY) measured in millions of pounds.

| | | | Base Case (B2 Live) | | | |
|---|---|---|---|---|---|---|
| | SSmsy | Fmsy | MSY | SSoy | Foy | OY |
| Median | 6.42 | 0.391 | 11.87 | 8.56 | 0.256 | 10.65 |
| 80% low | 5.74 | 0.318 | 10.38 | 7.66 | 0.214 | 9.33 |
| 80% high | 7.10 | 0.481 | 13.42 | 9.46 | 0.306 | 12.16 |
| | | | B2 100% Dead All Ages | | | |
| | SSmsy | Fmsy | MSY | SSoy | Foy | OY |
| Median | 7.18 | 0.409 | 12.43 | 9.57 | 0.264 | 11.24 |
| 80% low | 6.44 | 0.331 | 9.08 | 8.59 | 0.222 | 8.70 |
| 80% high | 8.02 | 1.582 | 14.47 | 10.69 | 0.850 | 13.06 |
| | | | B2 100% Dead Young Ages | | | |
| | SSmsy | Fmsy | MSY | SSoy | Foy | OY |
| Median | 7.03 | 0.405 | 12.80 | 9.38 | 0.269 | 11.72 |
| 80% low | 6.36 | 0.343 | 11.29 | 8.48 | 0.230 | 10.34 |
| 80% high | 7.82 | 1.682 | 14.62 | 10.42 | 0.942 | 13.32 |

Table 3. Acceptable biological catch (millions of pounds) for the 2000/2001 fishing year using the target of F40%SPR.

| | Base | B2 All | B2 Young |
|---|---|---|---|
| median | 7.0 | 7.4 | 8.0 |
| low (16%) | 5.5 | 4.5 | 6.1 |
| high (84%) | 8.8 | 9.8 | 10.2 |

Table 4. Catch (millions of pounds) for three probability levels of exceeding F30%SPR under the three assumptions regarding the fate and age distribution of recreational discards.

| P(F>F30%SPR) | Base | B2 All | B2 Young |
|---|---|---|---|
| 0.20 | 8.5 | 7.9 | 9.5 |
| 0.25 | 8.8 | 8.6 | 9.9 |
| 0.30 | 9.1 | 9.2 | 10.5 |

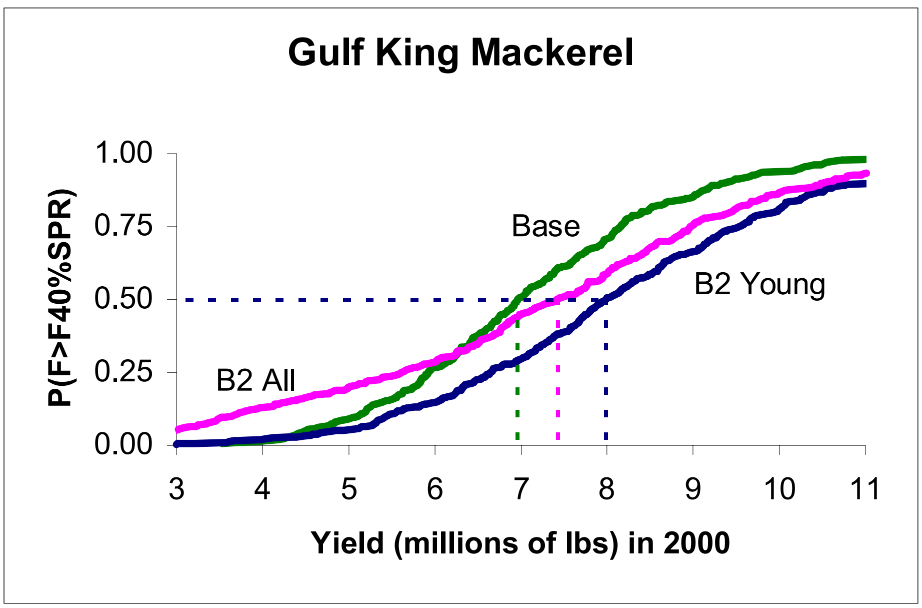


**Figure 1**. Cumulative distribution of acceptable biological catch (millions of pounds) for the 2000/2001 fishing year using the target of F40%SPR.