APPENDIX 7

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Specifying Initial Conditions for Forecasting When Retrospective Pattern Present

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A Working Paper in Support of GARM Reference Points Meeting Term of Reference 1

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Summary

There is currently no generally agreed methodological approach to adjusting projections to account for retrospective patterns in the stock assessment. This paper presents three alternative approaches and compares the resulting time series of spawning stock biomass, landings, and fishing mortality rate based on a summer flounder-like stock assessment. The three adjustments for retrospective patterns all reduce landings in the quota setting year, but the magnitude of the reduction is quite variable and the implications for future years in the projections are quite different. Adjusting the fishing mortality rate in the quota setting year is not recommended in the context of rebuilding programs because the future catches are greater than the unadjusted projections. Adjusting all ages in the starting population creates the largest decrease in projected catch, but typically cannot be justified based on the patterns observed at age. Making adjustments to the starting population based on the age specific retrospective patterns produces the most consistent approach, although the overall impact is relatively minor. A number of technical questions remain regarding exactly how to compute the retrospective adjustments at age. Management strategy evaluation work is required in the future to determine if any adjustment method performs better than the others.

Introduction

Term of Reference 1 for the GARM 2008 Biological Reference Points meeting is for relevant stocks, determine the influence of retrospective patterns in parameter estimates (e.g., fishing mortality, biomass, and/or recruitment) from assessment models on the computation of BRPs and on specification of initial conditions for forecasting.

This paper addresses only the latter aspect of this TOR, methods for adjusting initial conditions for forecasting when the stock assessment exhibits a retrospective pattern.

There is currently no generally agreed methodological approach to adjusting projections to account for retrospective patterns in the stock assessment. Two types of approaches that have been tried are: 1) adjust the TAC by the amount of retrospective seen in the SSB and 2) adjust the initial population to account for the retrospective pattern. The first approach can also be constructed by adjusting the fishing mortality rate in the quota year to account for the retrospective pattern observed in F. These two approaches will produce similar changes in the quota for next year, but have widely different implications for rebuilding strategies. This is because the first approach does not adjust the population, so the reduction in quota will actually allow the population to grow more and allow more fishing during the rest of the rebuilding period. In contrast, the second approach has a compounding effect, forcing a reduction in F during the rebuilding because the initial population abundance is further away from the target than the unadjusted population. The second approach is consistent in how the retrospective adjustment impacts the projections and is favored over the first approach.

There remain a number of technical issues for how to make the adjustment to the initial population abundance. All ages in the initial population could be scaled according to some average retrospective change, or else age-specific retrospective adjustments could be applied. The calculation of the average retrospective change can also be done numerous ways, as an average of the one-year update from the last five years or as the average change from the original to the most recent assessment result from the last five years, for example. Even more complex derivations can be made to fill in how much change is expected to occur based on regression of previous changes. There was insufficient time to address these issues through management strategy evaluations (MSE), the tool needed. Instead, a number of examples are provided to demonstrate the magnitude of effect that can occur when retrospective adjustments are made.

Methods

A stock assessment similar to the summer flounder 2007 assessment was used as the basis for all comparisons. This assessment demonstrated a strong retrospective pattern with F adjusted higher and SSB adjusted lower with additional years of data (Figure 1). The SSB target for rebuilding was determined to be 89,411 metric tons. A catch of 7,762 metric tons was assumed to be caught in 2007, the quota for that year. An iterative search found the constant F needed to rebuild the stock to the SSB target in year 2012 with 50% probability when no adjustments were made to the initial population to account for the retrospective pattern (Frebuild).

Retrospective adjustments were made in three different ways:

1. The F in 2008 was adjusted from Frebuild
2. The initial population abundance at age in 2007 was reduced over all ages at the same rate

3. The initial population abundance at age in 2007 was reduced by age-specific rates

The F adjustment was made based on the average of the last 5 years single year update retrospective, meaning a 28% reduction in F2008. When the initial population abundance at age in 2007 was reduced over all ages at the same rate, the same reduction as case 1 was applied, meaning the numbers at age at the start of 2007 were all reduced by 28%. This was selected as a compromise between the lower one year adjustments to SSB and the higher full year adjustments to SSB, and to allow more direct comparison between cases 1 and 2. The third case adjusted all ages based on the age specific one year adjustments averaged over the last five years, which resulted in both increases and decreases to the initial population abundance in 2007 (Table 1).

Results

Time series of spawning stock biomass (thousand metric tons), landings (thousand metric tons), and fully selected fishing mortality rate are presented in both Table 2 and Figure 2. The landings in 2007 are assumed constant for all four runs. The median spawning stock biomass in 2012 was the target and the fishing mortality rates were solved to an extreme number of digits to ensure complete consistency with the SSBmsy target in 2012. The Base and adj F cases have the same starting population and thus the same F in 2007, while the two adj N cases have lower starting populations which require higher F in 2007 to achieve the landings. The three retrospective adjustment approaches all reduce landings in 2008 relative to the Base case. However, the adj F case then allows landings to increase above the Base case for the remaining years because the stock has been fished lighter in 2008. This increase in landings for years 2009-2012, causing the adj F case to have the highest total landings over all years. The two adj N cases both have lower catches for years 2008-2012 relative to the Base case due to starting at a lower initial stock abundance. However, the adj N by age case has nearly the same level of landings in years 2009-2012 as the Base case (less than 5% difference). This similarity is due to the large changes in retrospective adjustment occurring for the oldest ages, which wash out of the projections relatively quickly. In contrast, the adj N all ages case reduces all cohorts significantly, requiring a greater number of years to remove their impact in the projections.

Discussion

In most of the groundfish assessments examined to date, the retrospective patterns are most pronounced for the oldest ages and least pronounced for the youngest ages. This means that adjusting all ages with the same factor is not warranted. Making the age-specific adjustments will cause the short-term catch to decrease, but the effect will not last long in most cases.

There are many other ways that the retrospective adjustments could be formed. For example, the full adjustment relating the shorter time series to the full time series could be used. Other approaches could be used to estimate the corrections for incomplete cohorts and then create the average retrospective adjustment on similar time periods. However, none of the approaches have been tested using management strategy evaluations.

One question that inevitably arises when dealing with retrospective patterns is “What happens if the retrospective pattern goes away or changes direction?” In these cases, adjusting for the retrospective pattern will be worse than not adjusting. However, while changes in direction of retrospective patterns have been observed in some stocks, they are the exception.

Table 1. Average of the most recent 5 years of single year adjustments in retrospective pattern observed by age.

Age	Retro Change
0	4.8%
1	4.8%
2	4.2%
3	-0.4%
4	-6.0%
5	3.2%
6	-65.5%
7	-26.8%

Table 2. Comparison of median spawning stock biomass, landings, and fishing mortality rate time series for the unadjusted (Base) and three alternative approaches to adjusting for retrospective patterns: F, N all ages, and N by age.

Spawning Stock Biomass (thousand metric tons)

Year	Base	adj F	adj N all ages	adj N by age
2007	51.719	51.719	35.068	47.005
2008	61.535	63.644	44.193	58.433
2009	70.123	72.113	56.044	68.188
2010	78.314	79.666	68.438	77.169
2011	83.796	84.457	78.846	83.219
2012	89.411	89.411	89.411	89.411

Landings (thousand metric tons)

Year	Base	adj F	adj N all ages	adj N by age
2007	7.762	7.762	7.762	7.762
2008	7.936	5.851	3.831	7.108
2009	9.583	10.312	4.976	9.048
2010	10.882	11.643	6.303	10.644
2011	12.366	12.957	7.849	12.145
2012	13.155	13.644	9.069	13.013

Fishing Mortality Rate

Year	Base	Base adj F	adj N all ages	adj N by age
2007	0.227	0.227	0.330	0.255
2008	0.198645	0.1430244	0.14069	0.197615
2009	0.198645	0.205265	0.14069	0.197615
2010	0.198645	0.205265	0.14069	0.197615
2011	0.198645	0.205265	0.14069	0.197615
2012	0.198645	0.205265	0.14069	0.197615

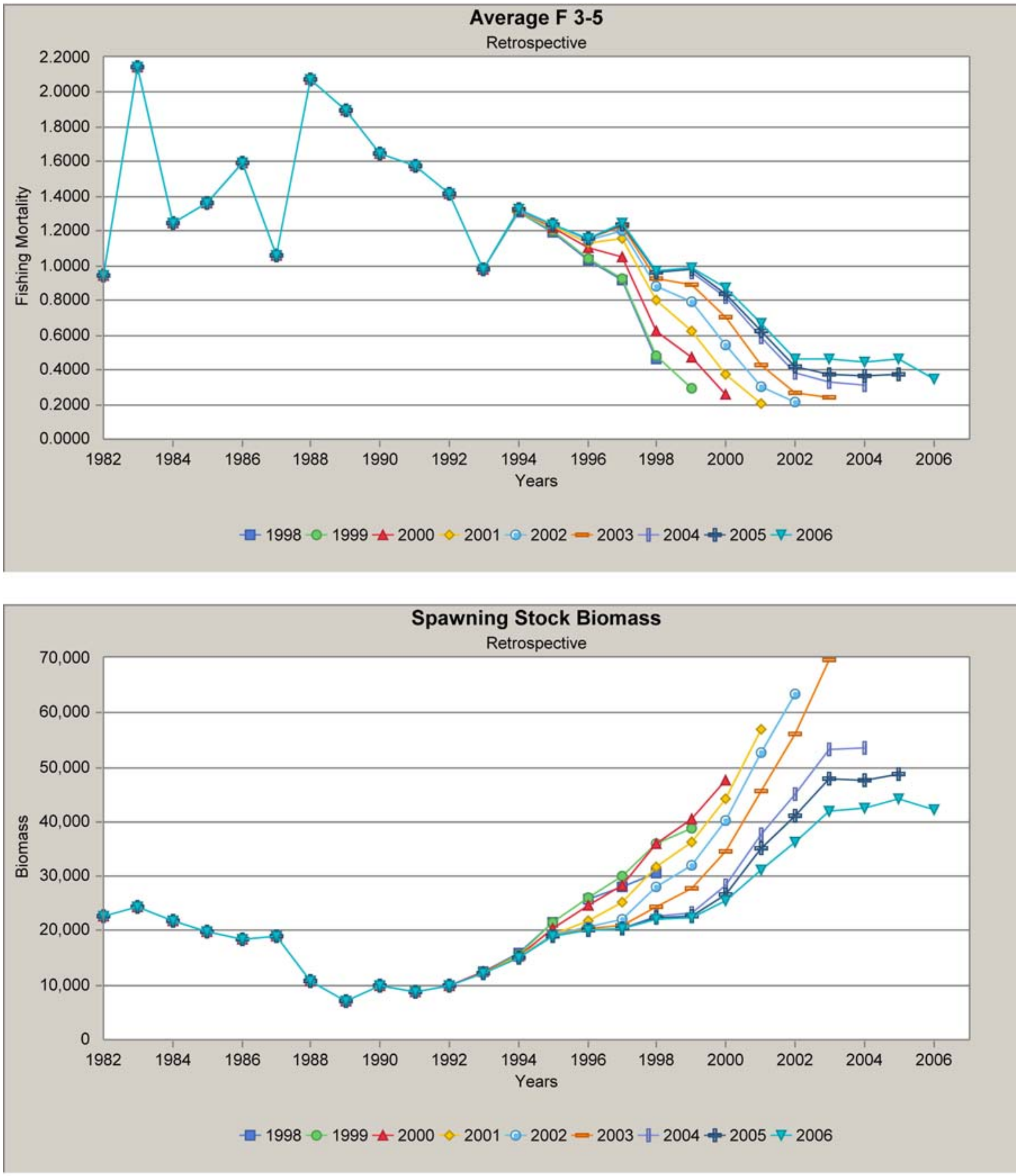

Figure 1. Retrospective patterns in average fishing mortality rate and spawning stock biomass for the example stock assessment.

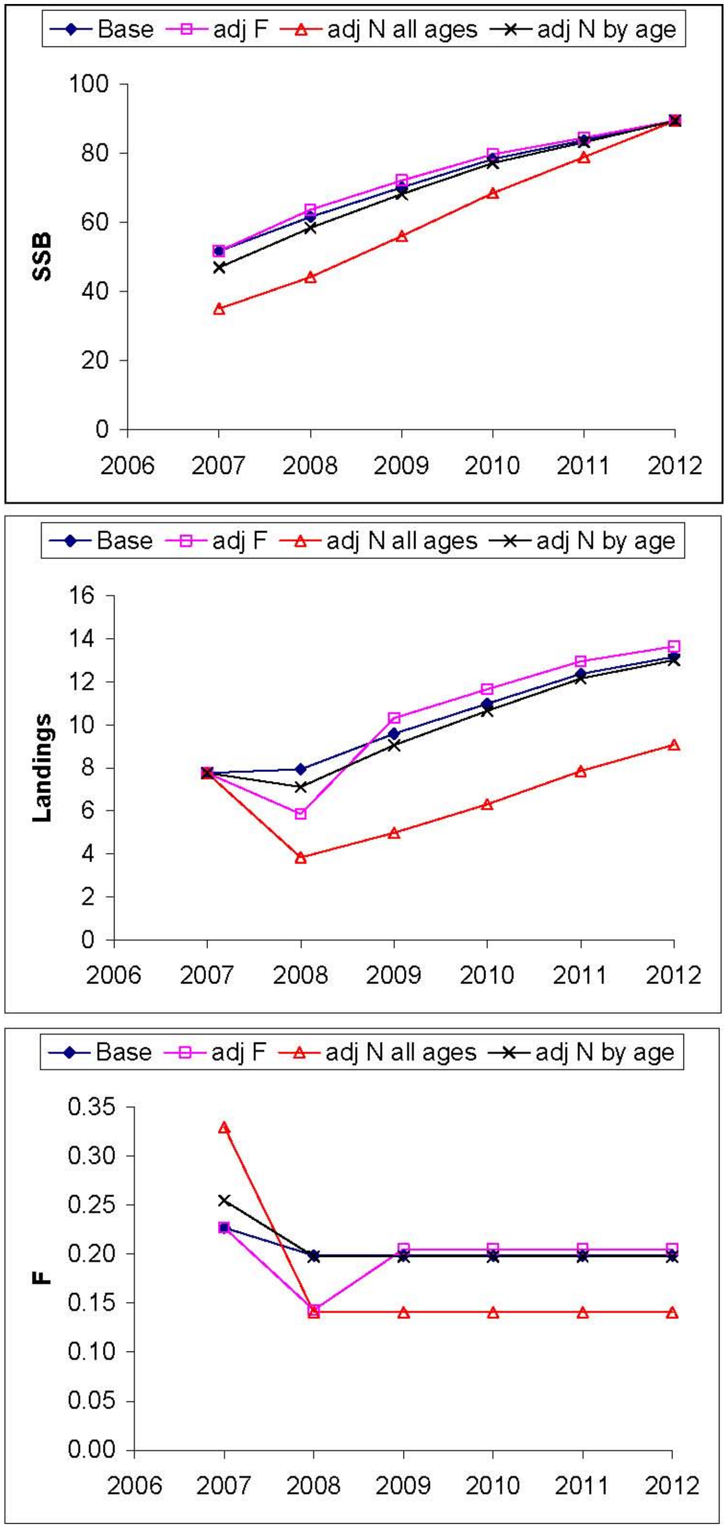

Figure 2. Comparison of median spawning stock biomass, landings, and fishing mortality rate time series for the unadjusted (Base) and three alternative approaches to adjusting for retrospective patterns: F, N all ages, and N by age.