Mid-Atlantic Fishery Management Council
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MEMORANDUM

Date: September 19, 2018

To: Council

From: Brandon Muffley, Staff

Subject: Risk Policy Framework: Update

Overview of Current Risk Policy and ABC Control Rule:

In 2011, the omnibus amendment to all Mid-Atlantic Fishery Management Council (Council) fishery management plans (FMPs) implemented the Council's current risk policy and Acceptable Biological Catch (ABC) control rule as necessary to comply with the 2006 re-authorization of the Magnuson-Stevens Act (MSA). Under the current Risk Policy, the Council's acceptable probability of overfishing (P*) for a given stock is conditional on current stock biomass (B) relative to B_{MSY} and the life history of the species (see Figure1). The P* is 0 percent if the ratio of B/B_{MSY} is less than or equal to 0.10 to ensure the stock does not reach low levels from which it cannot recover. The probability of overfishing increases linearly for stocks defined as "typical" as the ratio of B/B_{MSY} increases, until the inflection point of $B/B_{MSY} = 1.0$ is reached and a maximum 40 percent probability of overfishing is utilized for ratios equal to or greater than 1.0. The same approach applies to those stocks defined as "atypical", currently applied to ocean quahog, except the maximum probability of overfishing when the B/B_{MSY} ratio is equal to or greater than 1.0 is 35 percent. The Council's Scientific and Statistical Committee (SSC) determines whether a stock is typical or atypical each time an ABC is recommended and whether or not the atypical life history has been fully addressed in the stock assessment.

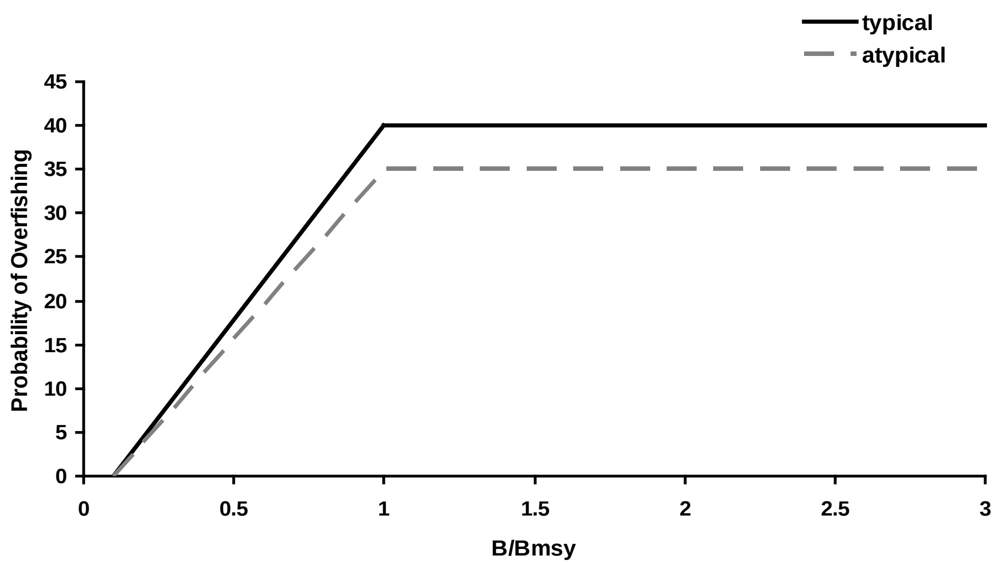

Figure 1: Current MAFMC Risk Policy

The current ABC control rule utilizes a multi-level approach in setting an ABC that is based on the overall level of scientific uncertainty associated with each species stock assessment. This approach identifies four levels of overall assessment uncertainty defined by characteristics of the stock assessment and other relevant information. The SSC determines which level the assessment for a particular stock belongs when setting ABC specifications. Then the processes described within each level are used to calculate ABC. The four levels are summarized below but generally, the higher levels contain assessments with greater detail and lower scientific uncertainly; therefore, ABC recommendations become more precautionary as an assessment moves from level 1 to level 4.

- **Level 1:** all important sources of uncertainty are fully and formally captured in the stock assessment model and the probability distribution of the OFL (OFL CV) estimated directly from the stock assessment is used. Under this level, the ABC will be determined solely on the basis of a P*, determined by the Council's risk policy, and the probability distribution of the OFL from the assessment.

- **Level 2:** this level assessment has greater uncertainty than Level 1. Specifically, the estimation of the probability distribution of the OFL directly from the stock assessment model does not include some important sources of uncertainty, necessitating expert judgement by the assessment team during the stock assessment process to develop a probability distribution of the OFL. The OFL probability distribution developed during the assessment then needs to be deemed as best available science by the SSC. In this level, ABC will be determined by using the Council's risk policy (P*) but with the OFL probability distribution based on the specified distribution in the stock assessment.

- **Level 3:** attributes of a stock assessment are the same as Level 2, except the assessment does not contain estimates of the probability distribution of the OFL or the probability distribution provided does not, in the opinion of the SSC, adequately reflect uncertainty in the OFL estimate. The SSC then adjusts the distribution of the OFL and develops an ABC recommendation by applying the Council's risk policy (P*) to the modified OFL probability distribution. The majority of the Mid-Atlantic stocks fall under this level.

- **Level 4:** assessments are deemed to have reliable estimates of trends in abundance and catch, but absolute abundance, fishing mortality rates, and reference points cannot be developed. Stocks in this level do not have point estimates of the OFL or probability distributions of the OFL that are considered best available science. For stocks in this level, the SSC will use ad hoc types of control rules based on biomass and catch history and the Council's risk policy. Surfclam, longfin squid and *Illex* squid currently fall under this level.

Background on Council Evaluation of Risk Policy and ABC Control Rule:

In 2016, five years after implementation, the Council included a review and consideration of potential modifications to the existing risk policy and ABC control rule to its 2016 Implementation Plan. The Council reviewed possible issues relative to the current risk policy and ABC control rule and discussed potential solutions/options to the problems identified. The elements identified by the Council for further evaluation through a framework action were as follows:

- Adjustments to the maximum probability of overfishing value (P*)
- Constant or stepped P* (i.e. remove the linear ramping, see Figure 1)
- Limiting response (+/-) in annual ABC changes
- Alternative/different risk policies for different life histories or species groups
- Formulate an Overfishing Limit (OFL) Coefficient of Variation (CV) decision document

Throughout 2017, a variety of analyses were conducted to evaluate the elements outlined above in order to help inform the Council's deliberations regarding possible modifications to the existing risk policy. A management strategy evaluation (MSE) was conducted by Dr. John Wiedenmann from Rutgers University that included an evaluation of five different risk policy alternatives assuming two different OFL CV distributions (60% and 100%) with variable natural mortality, recruitment and stock assessment data. These analyses were conducted using stock assessment information for summer flounder, scup and butterfish. The five different risk policy alternatives evaluated were as follows:

1. Constant P* equal to 0.4
2. Two step P* - constant P* equal to 0.4 for B/B_{MSY} ratios less than 1.0 and a constant P* at 0.45 for B/B_{MSY} ratios equal to or greater than 1.0
3. Three step P* - constant P* at 0.35 for B/B_{MSY} ratios less than 0.75, constant P* at 0.4 for B/B_{MSY} ratios between 0.75 and 1.0 and a constant P* at 0.45 for B/B_{MSY} ratios equal to or greater than 1.0

4. Current risk policy – linear ramping with a maximum P* of 0.4 when the B/B_{MSY} ratio is equal to or greater than 1.0 (see next section and Figure 1 below)
5. Linear ramping with a maximum P* of 0.45 when the B/B_{MSY} ratio is equal to or greater than 1.0

In December 2017, based on the results of that MSE evaluation, staff recommended the Council adopt the *status quo* alternative and not modify the existing risk policy. The MSE results indicated that while all risk policy alternatives did limit overfishing under baseline/average conditions (median probability of overfishing below the 50% threshold for each stock), the linear ramping P* alternatives (i.e. those like the current Council risk policy) were better at preventing overfishing and reduced the risk of a population declining to low levels. Under "good" conditions (i.e. below average natural mortality, above average recruitment and assessments that under estimated terminal biomass), stock biomass tended to remain above B_{MSY} and the risk of overfishing was low under all alternatives across all species. However, there was greater overfishing risk for butterfish due to inherent variability in its stock dynamics. Under "poor" conditions (i.e. above average natural mortality, below average recruitment and assessments that overestimated terminal biomass), the stepped or constant P* alternatives had nearly double the risk of overfishing and a 5-10% higher risk of stocks becoming overfished than the linear ramping alternatives. This analysis supports the intent and rationale for the current risk policy to prevent stocks from becoming overfished by reducing the probability of overfishing as stock size falls below B_{MSY}. Staff noted that while this feature of the risk policy is not a mandatory requirement of the MSA, results of the MSE indicated that the current control rule offers additional protection for stocks when environmental conditions are poor. Therefore, the Council's current risk policy may provide for additional stock protection as environmental conditions continue to change in the Mid-Atlantic as a result of climate change and increased variability.

The MSE results also highlighted potential trade-offs associated with the various alternatives ability to limit overfishing and the short and long-term yield from the fishery. For a given stock, short-term yield (first 5 projection years) under varying future conditions were generally consistent across all alternatives. The maximum P* value, 0.40 versus 0.45, played a larger role in short-term yield than any specific control rule shape (constant, stepped or ramped). There were differences in long-term yield (final 15 years of 30 year projections) across the alternatives for each species and was dependent upon future stock conditions. Under baseline/current conditions, the ramped alternatives when compared to the stepped alternatives resulted in yield that was 13-16% lower for butterfish, 3% lower for summer flounder and 9-11% lower for scup. Under "good" future conditions, all alternatives generally performed similar with the maximum P* value playing a greater role in determining long-term yield. Under "poor" future conditions, particularly when all factors are poor, the ramped alternatives resulted in slightly higher yield (approximately 4% higher) compared to the stepped alternatives. In addition, the fixed and stepped alternatives tended to result in generally lower inter-annual variability in yield when compared to the ramped options across stock and future condition scenarios. Butterfish yield scenarios were the most variable under all alternatives due to higher stock dynamic variability.

Current Framework Status and Next Steps:

During the discussion at the December 2017 second framework meeting, the Council expressed interest in not only considering biological factors when evaluating the risk policy, but it may want to also consider economic and social factors. Therefore, the Council agreed to take a pause on deciding how to proceed with the framework to allow time for the potential development of economic models to evaluate the current risk policy. Dr. Wiedenmann noted that the output of the risk policy MSE could be used in economic models to help understand the short and long-term economic impacts of the different risk policy alternatives

In February 2018, the Council was presented the results of an MSE conducted by Dr. Doug Lipton with the NMFS Office of Science and Technology that evaluated the economic impact of stock assessment timing and data lags in the management process. This evaluation focused on the commercial and recreational summer flounder fisheries and concluded there was about $70 million in net economic benefits when stock assessments are updated every two years with a one year data management lag compared with a five year updating and two year data lag.

Given the applicability of the risk policy MSE and the existing economic MSE for summer flounder, Dr. Lipton indicated the potential opportunity to continue development of the risk policy MSE with an economic evaluation specific to summer flounder. Over the last six months Dr. Lipton, with the assistance from a post-doctoral fellow, have been building a summer flounder economic model to integrate with the risk policy MSE model to evaluate the economic effects of the five different risk policy alternatives. At the October 2018 Council meeting, an overview of the summer flounder economic MSE and preliminary results will be presented by Dr. Lipton. The Council will not take any action on the risk policy framework at the October meeting. The final results of the summer flounder economic MSE will then be presented at the December 2018 meeting and, based on all analyses conducted, the Council will consider next steps and whether or not to continue with the development of a Risk Policy framework.

In addition, an SSC OFL CV working group developed a draft decision document for the SSC to use when defining the appropriate level of uncertainty to be applied to the OFL. The intent of the document is to provide the SSC, and Council and public, with a replicable and consistent evaluation process based on defined decision criteria that can be supported with evidence when determining the OFL CV for each stock assessment. The working group and full SSC will finalize this discussion document in early 2019 and will present its recommendations to the Council in the spring of 2019.

Project Update: Economic Trade-offs of Alternative ABC Control Rules for Summer Flounder

Cyrus Teng (University of Maryland College Park)
Doug Lipton (NOAA Fisheries Senior Scientist for Economics)

with: John Wiedenmann (Rutgers) and Barbara Hutniczak (OECD)

Report to the Mid-Atlantic Fishery Management Council

October 2, 2018

Background

At the February 2018 Mid-Atlantic Fishery Management Council meeting, John Wiedenmann presented his results on the "Evaluation of Alternative ABC Control Rules for Mid-Atlantic Fisheries". Control rules were varied as to how the probability of overfishing (P*) was implemented: fixed, 2-step, 3-step, and ramped. Using a management strategy evaluation (MSE) simulated over 30 years for scup, summer flounder and butterfish; performance of the control rules was evaluated in terms of the average biomass, long-term and initial catch, probability of overfishing, probability of becoming overfished, risk of very low biomass, mean F/F_{MSY}, and year-to-year catch variability. The study found that the chosen control rule's performance mattered more, in term of the variables being evaluated, under poor future conditions such as high natural mortalilty, low recruitment and overestimates of stock size. The current analysis attempts to translate the predicted changes in harvest and stock size to changes in economic benefits generated by the fishery.

The Study

The present analysis is based on a modification of a similar study, using management strategy evaluation, looking at the impacts of the timing of stock assessment updates and data management lags on the commercial, recreational and consumer benefits for summer flounder (Hutniczak et al. 2018)[1]. For example, from that study we found the difference between a one year stock assessment update interval with a data lag of two years (base scenario), and a five year update interval with a two year data lag is only 10 000 metric tons of fish harvested over a 27 anthe two scenarios is about USD 102.7 million.

The economic estimate was generated from estimating models for summer flounder price (demand model), summer flounder net fishing revenue model and a summer flounder recreational fishing valuation model. We will apply the same methodology to the fish landings, and biomass output generated in the ABC control rule analysis scenarios for summer flounder (see attached table of scenarios considered).

[1] Hutniczak, B, Lipton, D, Wiedenmann, J and Wilberg M. 2018. Valuing changes in fish stock assessments. (Under second review at Canadian Journal of Aquatic and Fisheries Sciences.)

Progress to Date

The following steps are needed to complete the project:

1) Hiring of replacement programmer (Hutniczak hired by OECD, Teng hired as replacement) COMPLETED
2) Transfer of model code to Teng. Verification of functionality. (Completed)
3) Obtain model output from Wiedenmann for beta testing of new model runs (Completed)
4) Full set of model output for relevant scenario runs (see attached table) transferred from Wiedenmann to Teng. (Completed)
5) Run model scenarios (Initiated)
6) Analyze scenarios, write report and present to Council (December 2018)

Table 1 . Summer flounder scenarios											
Stock	Future productivity / assessment error	Control rule	OFL CV	Average biomass (S/S_{MSY})	Long-term relative catch	Initial relative catch	Prob. of overfishing (P_{OF})	Risk of becoming overfished	Risk of very low biomass	Mean F / F_{MSY}	Catch *AAV*
Summer	M below average	P* fixed = 0.4	0.6	1.72	1.24	0.80	0.13	0.06	0.00	0.68	0.14
Summer	R above average	P* fixed = 0.4	0.6	1.22	1.02	0.80	0.23	0.34	0.17	0.79	0.14
Summer	Assessment under	P* fixed = 0.4	0.6	1.67	1.20	0.79	0.10	0.01	0.09	0.68	0.14
Summer	M above average	P* fixed = 0.4	0.6	0.53	0.75	0.81	0.58	0.75	0.42	1.25	0.15
Summer	R below average	P* fixed = 0.4	0.6	0.24	0.33	0.80	0.52	0.85	0.71	1.20	0.15
Summer	Assessment over	P* fixed = 0.4	0.6	0.53	0.76	0.82	0.58	0.42	0.74	1.26	0.15
Summer	M below average	2-step P*	0.6	1.64	1.29	0.80	0.13	0.08	0.00	0.73	0.15
Summer	R above average	2-step P*	0.6	1.17	1.05	0.80	0.23	0.35	0.17	0.83	0.15
Summer	Assessment under	2-step P*	0.6	1.60	1.25	0.79	0.13	0.01	0.11	0.73	0.15
Summer	M above average	2-step P*	0.6	0.52	0.75	0.81	0.58	0.77	0.42	1.29	0.16
Summer	R below average	2-step P*	0.6	0.25	0.33	0.80	0.55	0.85	0.71	1.21	0.15
Summer	Assessment over	2-step P*	0.6	0.52	0.76	0.82	0.58	0.42	0.75	1.30	0.16
Summer	M below average	3-step P*	0.6	1.64	1.29	0.79	0.13	0.08	0.00	0.72	0.15
Summer	R above average	3-step P*	0.6	1.16	1.05	0.79	0.23	0.35	0.17	0.82	0.15
Summer	Assessment under	3-step P*	0.6	1.59	1.25	0.78	0.13	0.01	0.11	0.73	0.15
Summer	M above average	3-step P*	0.6	0.53	0.74	0.79	0.55	0.77	0.41	1.24	0.16
Summer	R below average	3-step P*	0.6	0.27	0.33	0.79	0.48	0.83	0.70	1.12	0.16
Summer	Assessment over	3-step P*	0.6	0.53	0.75	0.82	0.58	0.41	0.76	1.26	0.16
Summer	M below average	Ramped P* (0.45)	0.6	1.64	1.30	0.76	0.13	0.08	0.00	0.72	0.15
Summer	R above average	Ramped P* (0.45)	0.6	1.17	1.05	0.76	0.23	0.35	0.15	0.80	0.16
Summer	Assessment under	Ramped P* (0.45)	0.6	1.59	1.26	0.74	0.13	0.01	0.11	0.72	0.15
Summer	M above average	Ramped P* (0.45)	0.6	0.55	0.74	0.77	0.52	0.77	0.39	1.18	0.18
Summer	R below average	Ramped P* (0.45)	0.6	0.32	0.34	0.77	0.32	0.82	0.66	0.92	0.18
Summer	Assessment over	Ramped P* (0.45)	0.6	0.54	0.75	0.80	0.55	0.39	0.75	1.20	0.18
Summer	M below average	Ramped P* (0.40)	0.6	1.73	1.24	0.73	0.10	0.05	0.00	0.65	0.15
Summer	R above average	Ramped P* (0.40)	0.6	1.23	1.02	0.72	0.16	0.32	0.14	0.74	0.16
Summer	Assessment under	Ramped P* (0.40)	0.6	1.66	1.20	0.71	0.10	0.01	0.07	0.65	0.16
Summer	M above average	Ramped P* (0.40)	0.6	0.56	0.73	0.74	0.45	0.74	0.35	1.10	0.17
Summer	R below average	Ramped P* (0.40)	0.6	0.32	0.33	0.73	0.29	0.81	0.63	0.88	0.18
Summer	Assessment over	Ramped P* (0.40)	0.6	0.56	0.75	0.76	0.48	0.35	0.73	1.11	0.17
Summer	Baseline	3-step P*	0.6	0.96	1.03	0.79	0.32	0.43	0.21	0.94	0.16
Summer	Baseline	Ramped P* (0.45)	0.6	0.97	1.04	0.77	0.32	0.43	0.20	0.93	0.16
Summer	Baseline	Ramped P* (0.40)	0.6	1.02	1.01	0.73	0.26	0.40	0.18	0.85	0.16
Summer	Baseline	P* fixed = 0.40	0.6	1.23	0.98	1.25	0.26	0.38	0.14	0.86	0.13
Summer	Baseline	2-step P*	0.6	1.17	1.01	1.34	0.32	0.40	0.16	0.92	0.13
Summer	Baseline	3-step P*	0.6	1.18	1.01	1.34	0.32	0.40	0.15	0.91	0.14