New England Fishery Management Council

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MEMORANDUM

DATE: August 9, 2013

TO: Scientific and Statistical Committee (SSC)

FROM: Groundfish Plan Development Team (PDT)

CC: Groundfish Oversight Committee (OSC)

SUBJECT: **Groundfish ABCs and Rebuilding Plans**

The PDT conducted analyses and/or discussed: **1) American plaice and Gulf of Maine cod rebuilding plans, (2) the Georges Bank yellowtail assessment,** and **(3) white hake ABCs.**

1) American plaice and Gulf of Maine cod rebuilding plans

Need

New rebuilding plans need to be developed for American plaice and Gulf of Maine (GOM) cod. Both stocks had original rebuilding plan end dates in 2014. However adequate progress towards rebuilding was not made, which requires new rebuilding schedules to be developed within two years (see letter to Council from Acting Regional Administrator Dan Morris dated May 30, 2012). The Magnuson-Stevens Act states that rebuilding time periods should be as short as possible, not to exceed 10 years.

Concerns about rebuilding plans

The PDT is concerned that, for most stocks, has not occurred according to plan due to: 1) starting in the wrong place (e.g., terminal year of the assessment), 2) the difficulty of setting catch advice that is related to achieving a target fishing mortality rate, and 3) recruitment that was less optimistic than what is seen in the projections.

The PDT noted that management based on rebuilding plans and F-rebuild for groundfish has not typically worked well in the past. Groundfish stocks have not rebuilt as predicted from past projections. For most stocks, updates to data and assessment models have revealed that stock size was smaller than believed when rebuilding began, that fishing mortality was higher than expected, and/or that realized recruitment was lower than predicted. For two stocks (redfish and GB haddock), rebuilding has occurred much quicker than planned, mainly because of better than expected recruitment. Redfish had a 50 year plan due to life history constraints, but the stock

rebuilt in less than 10 years. One groundfish stock (Southern New England/Mid-Atlantic (SNE/MA) yellowtail flounder) is rebuilt not because the stock biomass has increased but because biomass reference points changed in response to perceived changes in stock productivity (i.e., lower recruitment and biomass).

As rebuilding plan end dates get closer, inadequate progress toward a set biomass target can also require disproportionate cuts in catch to achieve the calculated F-rebuilding mortality rate. ABCs based on F-rebuild can dramatically change from one assessment to the next if recruitment is not realized as the rebuilding end date approaches. The enhanced PDT projection simulation work showed that long-term projections are unreliable and tend to be optimistic. ABCs based on F-rebuild are also unreliable, since F-rebuild in the near term is dependent on recruitment from longer term projections.

The PDT also discussed whether comparing short-term rebuilding, versus long-term rebuilding and comparing the outputs relative to revenues, yields and stock rebuilding would be a better approach. Another approach could be to develop biomass, trawl index, or recruitment threshold that, when exceeded, catches could be increased (e.g., to 75% F_{MSY}). Such approaches would require further discussion and development.

Revised American plaice and GOM cod rebuilding plans
Recent assessments and assumptions- American plaice was last assessed during the 2012 groundfish updates, with a terminal year of 2010 for the assessment. An estimated catch was used for the 2011 and 2012 bridge years in the projection. The SSC set 2013-2015 ABCs for American plaice using 75%F_{MSY} projections. GOM cod was assessed at SARC 55 in December 2012. Two accepted models (base and m-ramp) were used for setting constant catch ABCs for 2013-2015 by the SSC in January 2013.

The PDT proposes to develop two rebuilding plan options (see below) for each stock that meets two requirements:
1) Assume no changes in the SSC's ABC decisions.
2) F-rebuild is not allowed to be initially limiting (75%F_{MSY} < F-rebuild).

Rebuilding plan options-
1) Developed to be more conservative using a time period less than 10 years, with 75%F_{MSY} still estimated to be below but closer to the F-rebuild estimate.
2) Developed based on the maximum 10-year plan.

The PDT also based all rebuilding plans on a 50% probability of success to help avoid confusion between rebuilding timelines, probability of rebuilding, and the interaction with the ABC uncertainty buffer (75%F_{MSY} or the newer constant harvest buffers). For example, reducing the rebuilding timeline has the same effect as increasing the probability of rebuilding by a certain date. Rebuilding schedules less than the maximum 10-year or rebuilding plans with a higher probability than 50% will make it more likely that F-rebuild will be used for ABC determination in the future.

Rationale- The PDT felt that one way to rebuild stocks is with uncertainty buffers on the fishing mortality rate. Basing ABCs on F-rebuild is not desirable, since it can quickly lead to dramatic reductions in the ABCs based on less accurate longer term projections as the rebuilding end date gets closer. In addition, as F-rebuild approaches zero then it is less likely to get adopted for ABC determination (e.g., SNE/MA winter flounder). ABCs based on F-rebuild are less desirable since considerable uncertainty surrounds the F-rebuild estimate due to the estimate's dependence on future recruitment, which is difficult to predict.

Results- Rebuilding schedule development was based on the latest projection for each stock that was used for estimating the ABCs and ACLs. These projections were treated more as theoretical projections since the PDT did not change bridge year catch assumptions. The PDT also assumed the ACL catch for the three years that are already in place. However, the original bridge year catch assumptions are similar to the updated PDT catch from DIMS (See Appendix B).

The proposed rebuilding plan options that meet the PDT requirements (see above) are shown in Figures 1-3. American plaice has the 7, 8, and 10-year plan options at 50% probability of success (Figure 1; Appendix A: Tables A1-A3). GOM cod has 8 and 10-year plan options at 50% probability of success (base case Figure 2, Appendix A: Tables A4-A6; m-ramp Figure 3, Appendix A: Tables A7-A9).

    American plaice
    Option 1- rebuild in 7 or 8 years- American plaice could rebuild in seven years with a fishing mortality that is still above $75\%F_{MSY}$. A rebuild schedule of 8 years was also calculated with similar results.

    Option 2 - rebuild in 10 years- F-rebuild was estimated to be below F_{MSY} with the maximum 10 year rebuilding plan.

    GOM cod
    There is little difference in the rebuilding time needed under the accepted base case or m-ramp model (M=0.2 in projections) for GOM cod. However, the catches estimated in the out years and the SSB_{MSY} are different between the models. The m-ramp projection assumes a change in M back to 0.2. The SARC 55 Panel concluded that if m is currently 0.4, then it seemed more reasonable to assume that in the short-term m would remain at 0.4, rather than reduce to 0.2. However, a change back to 0.2 is required to rebuild the stock. It is not known when M will change back to 0.2 in the future for the m-ramp formulation, so interpretation and development of rebuilding plans using the m-ramp model is more difficult.

    Option 1-rebuild in 8 years- GOM cod requires at least eight years for F-rebuild to remain above $75\%F_{MSY}$.

    Option 2- rebuild in 10 years- F-rebuild was estimated to be below F_{MSY} with the maximum 10 year rebuilding plan.

Conclusions- The PDT discussed all the developed options for American plaice and GOM cod. The PDT discussed under what circumstances that a rebuilding time line could be extended

beyond the requirement to minimize time (i.e., species generation time, recruitment, extenuating fishery considerations). Some PDT members were concerned that even under a shorter time frame (i.e., 7 versus 10 years) fishing mortality rates might not be achieved. Recent catch estimates for American plaice and Gulf of Maine cod are in the Appendix B.

The PDT also discussed concerns that under both stock projections, catches would be increasing appreciably, even in the near term. The PDT viewed this as unrealistic and an inaccurate portrayal of potential future catch streams.

Next Steps- The PDT anticipates input on these approaches from the OSC and SSC at their August meetings. Following this feedback, the PDT plans to continue working on these plans in advance on the September OSC meeting.
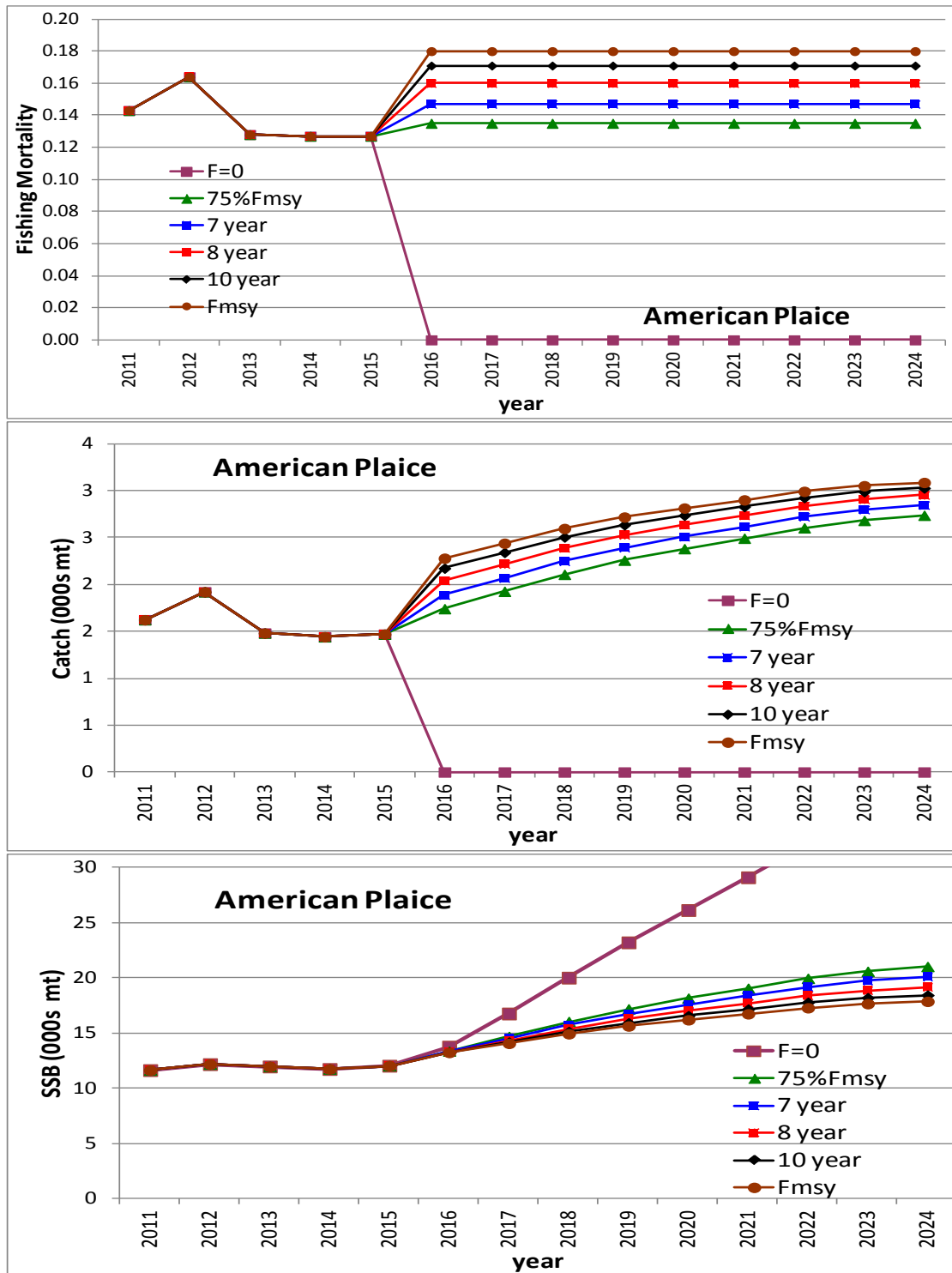
Figure 1: American plaice fishing mortality, catch, and SSB trends for F=0, 75%F_{MSY}, and F_{MSY} projections. Proposed rebuilding plans that meet the PDT requirements are shown in the 7 year, 8 year, and 10 year projections. Bridge year catch and ACL assumptions were made from 2011-2015.
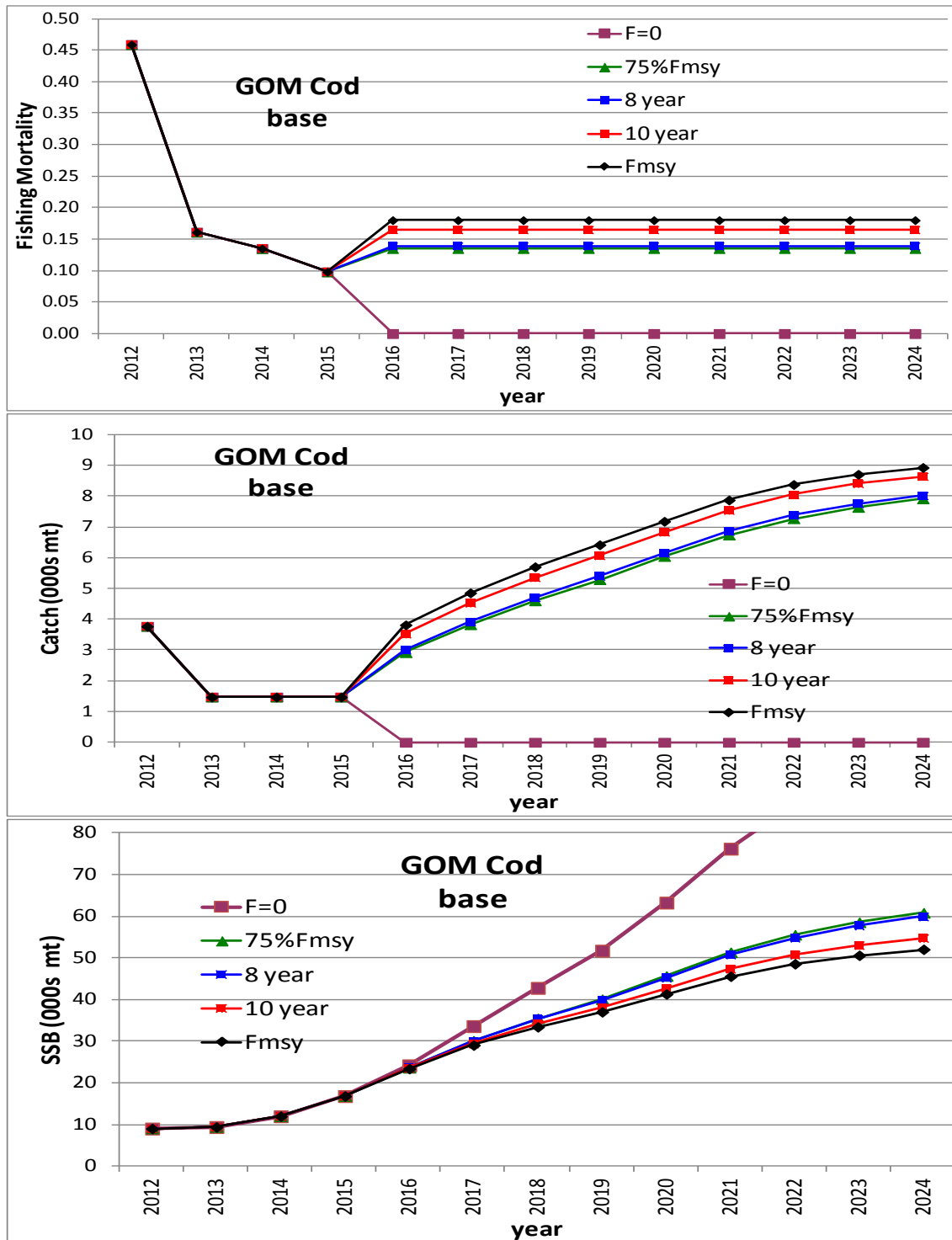
Figure 2: Gulf of Maine cod base model fishing mortality, catch, and SSB trends for F=0, 75%F$_{MSY}$, and F$_{MSY}$ projections. Proposed rebuilding plans that meet the PDT requirements are shown in the 8 and 10 year projections. Bridge year catch and ACL assumptions were made from 2012-2015.
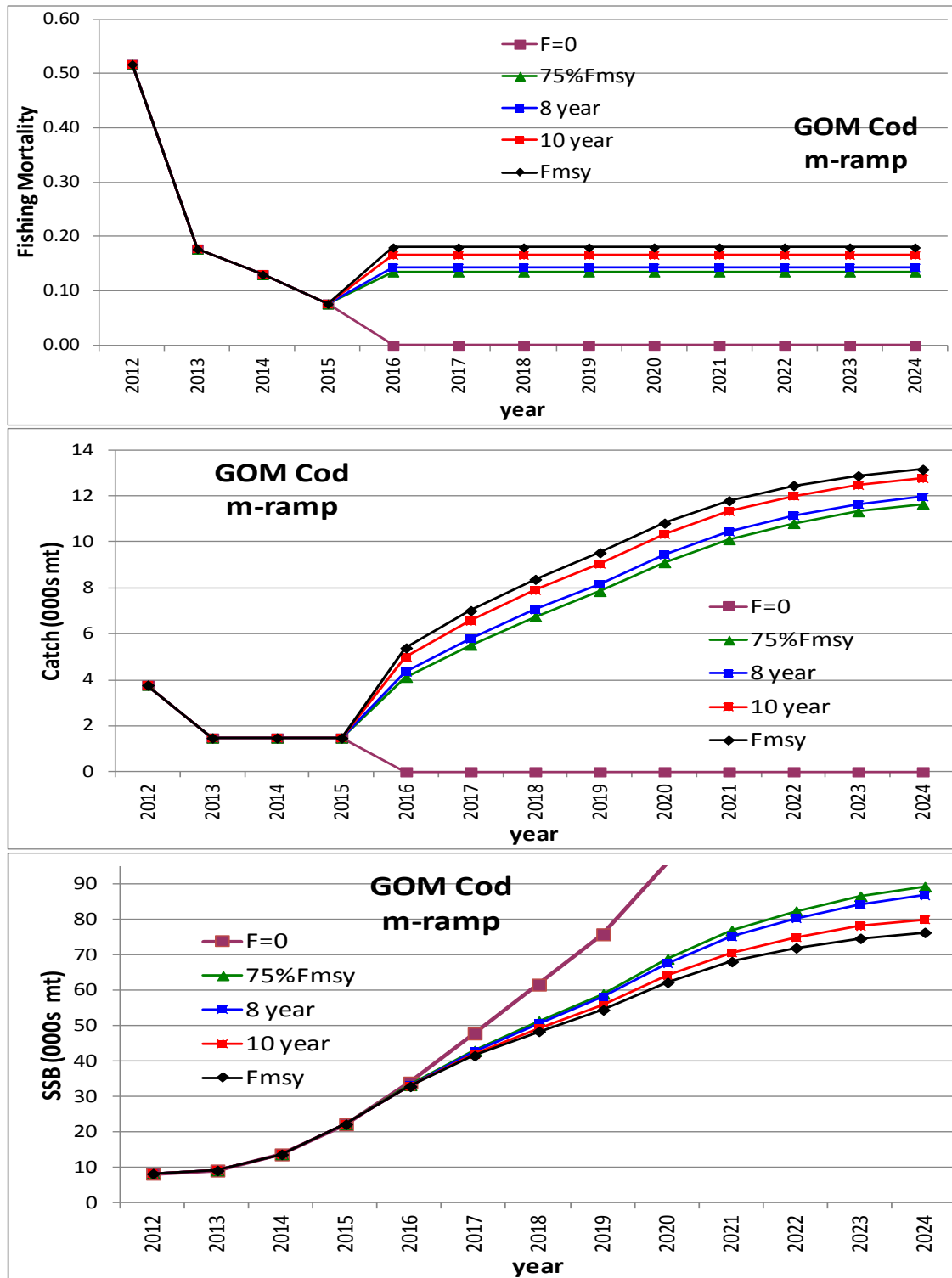
Figure 3: Gulf of Maine cod m-ramp model fishing mortality, catch, and SSB trends for F=0, 75%F_{MSY}, and F_{MSY} projections. Proposed rebuilding plans that meet the PDT requirements are shown in the 8 and 10 year projections. Bridge year catch and ACL assumptions were made from 2012-2015.

2) Georges Bank yellowtail flounder assessment

The Transboundary Resource Assessment Committee (TRAC) met June 25-27 in St. Andrews, NB to conduct assessments for Eastern Georges Bank (EGB) cod, EGB haddock, and GB yellowtail flounder. TRAC status reports (TSRs) were drafted at the meeting and available at www.nefsc.noaa.gov/saw/trac. An overview of the results for GB yellowtail flounder is provided here:

Overview of the Assessment

The Split Series VPA, which splits the survey indices between 1994 and 1995, was used for the stock assessment, but a retrospective adjustment (denoted rho adjustment) was applied to the terminal year estimates for both status determination and when providing catch advice. The TRAC acknowledges that the assumptions made about population dynamics in the model do not fully capture the trends in the data. However, the model's conclusion that stock conditions are poor is valid. Adult population biomass (age 3+) at the start of 2013 and spawning stock biomass in 2012 are both estimated to be the lowest values in their time series when the rho adjustment is applied. Recruitment of the three most recent cohorts is estimated to be the lowest in the time series. Fishing mortality for fully recruited ages 4+ is estimated to be above the reference point of Fref = 0.25 for the entire assessment time series. To achieve a high probability that F in 2014 will be less than Fref, a 2014 quota of less than 200 mt would be required. In order to achieve high probability that adult biomass will increase from 2014 to 2015, a 2014 quota of less than 500 mt would be required. Due to the assumption used for the 2012 year class in the projections, the increase in adult biomass will be optimistic if the 2012 year class is as poor as the recent year classes. Catches well below 500 mt are likely needed to achieve the harvest strategy. The TRAC considered but did not recommend a benchmark assessment for yellowtail flounder.

PDT Discussion

The PDT discussed the findings from the TRAC's recent 2013 Georges Bank yellowtail flounder assessment (see above for summary of the assessment). They discussed the catch advice and whether or not it could be trusted considering recognized model uncertainties (e.g., model assumptions do not capture stock dynamics, accuracy of the SSB estimate, retrospective pattern in SSB, need for the Rho adjustment in the terminal year SSB). The PDT was also concerned that the conflicting advice coming out of the assessment that seemed to be very precise (e.g., F_{ref} = 123 mt; e.g., catches less than 200 mt to achieve F_{ref} or well below 500 mt to increase adult biomass from 2014 to 2015), given the caveats about the model[1]. Some PDT members wondered if there is much of a difference in providing catch advice between 100 mt and 500 mt, since such advice compared to past catch advice is so low. The PDT agreed with the assessment that the stock is in poor shape and discussed the past performance of trans-boundary management. Recent rebuilding has not occurred despite the stock assessment findings and subsequent management advice. The PDT discussed whether a benchmark assessment should occur for this stock, however without additional data they feel that it may not be warranted at this time.

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[1] Note: The TRAC has a harvest policy to not exceed Fref, and when stock is in poor condition to further reduce F to promote rebuilding.   The 500 mt is mentioned here, relative to risk to biomass increase as quota is increased. To meet the Fref policy, the quota would need to be123 mt to not exceed Fref and if there is to be any growth in the stock, catches would need to be 300 mt or less. The TRAC does not have a biomass reference target, just the Fref.

However, the PDT did discuss whether or not data poor approaches might be a better choice for this stock (e.g., an index-based method). They did not make any conclusions on such an approach for Georges Bank yellowtail flounder.

The PDT was concerned about the scale of the assessment and catch advice from the assessment, considering the poor performance of past assessments. The PDT also questioned what the potential stock implications were for catch at or above 500 mt, based on the TRAC assessment. The TRAC found that based on the assessment findings, coupled with the survey trends, truncated survey and fishery age structure, poor condition factors, and poor recruitment, quotas higher than 500 mt was not recommended. Some on the PDT commented that the Fref value (123 mt) from the assessment model could be the upper bound, and serve as the OFL[2]. However, the PDT discussed that this Fref quota advice (123 mt) is a very precise value from an assessment with a large retrospective pattern and poor model performance. The PDT did not recommend an OFL or ABC.

ICES WCSAM

The first World Conference on Stock Assessment Methods (WCSAM) was held in Boston in July, 2013. One component of WCSAM was a workshop that focused on simulation studies for a number of fish stocks, including GB YTF. The GB YTF assessment has a retrospective pattern; the most recent updated assessment recommends the lowest quota ever (123 mt).

A number of models were run, prior to the workshop, on the original GB YTF data with varying results. The catch advice ranged from -3,000 t to 12,000 t. The time varying natural mortality (M) model reached 1.8 in recent years and had no retrospective pattern. The random walk models corresponded with each other early in the time period, but showed more spread after the mid-1990s. The M walk model did better when the survey catchability (Q) was generated in random walk than when it was generated from M. A catastrophe term (high brief M) was not investigated to see what happened to the large 2005 year class, but the retrospective pattern appeared before 2005. Spatial aggregation could affect availability to surveys and is suggested by the occurrence of large deck tows of YTF in the Canadian survey. The changes in the Q model were large and would require a major behavioral shift, which was not considered likely. YTF lack a swim bladder, reducing the applicability of acoustic surveys. The survey/exploitation vector autoregressive model (SEVAR) model behaved well when only observation error was included; process error resulted in more divergence.

Overall, none of the models performed well. Random walk models performed poorly against themselves and other random walk models. SEVAR did well against itself with observation error only. SEVAR performed poorly against random walk or step change. Biological characteristics, such as sexual dimorphism, as causes of the assessment issues were briefly discussed; however, the stock assessment of winter flounder does not have the same issues despite having a similar

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[2] Fref is currently 0.25, which is a US/Canada negotiated value. The F_{MSY} proxy was F40%, which was evaluated at GARM III to be 0.25. When the F_{MSY} proxy (F40%= 0.25) was applied to the approved benchmark assessment model, it gave the same answer as if Fref=0.25 was applied to the approved model. In addition, the approved benchmark split series model is not rho adjusted. In the past, the rho adjusted model has not been used to determine the GB yellowtail flounder OFL. Although, it has been suggested in the past to use the rho adjusted values when setting the ABC or TMGC quota.

life history and distribution. A solution to the yellowtail modeling issues (retrospective) was not solved with an alternative model at the workshop.

3. White hake ABCs

Recent assessment and assumptions
White hake was assessed in February 2013 at SARC 56 using a statistical catch-at-age model (ASAP). White hake is not overfished and overfishing is not occurring. SSB was at 83% of the SSB_{MSY} proxy, but SSB is projected to be at SSB_{MSY} in 2013. Biological reference points were based on an F_{MSY} proxy of $F_{40\%}$ with re-sampling from a cumulative distribution function (CDF) of 1963-2009 recruitment.

The recent assessment indicates that recruitment seem to be very stable, as long as catches do not fluctuate. LPUE from the otter-trawl fishery shows recent increase in white hake catches in the eastern Gulf of Maine (matching anecdotal information from fishermen).

The SARC panel recommended using the short term recruitment series (1995-2009) for short term projections through 2016 (Figure 4). However, there was very little difference in projected catches between the projections using the short term and the long term recruitment series in the short term (2014-2016), since it takes several years for recruitment assumption effects to enter the catch. Differences between the projected catches start diverging after 2016. Projections that assume no increase in recruitment from what was observed during the last 15 years show that catches will decline after 2016. PDT projections assume the same estimated catch in 2012 as the recent 2013 assessment.

Methods to estimate catch in 2013
The PDT considered several methods to estimate catch in 2013:

1) Assume the emergency action ABC or ACL (**4,177** mt and **3,974** mt, respectively) which was based on the SARC assessment's 75%F_{MSY} projection.
2) Assume that the catch for the second half of the calendar year (July-December) is the same as the first (January-June) from the DMIS quota monitoring database (1296.7 * 2 = **2594** mt). Recent landings are distributed relatively evenly across the year. It was about 50/50 for each half year in 2011 (Table B7, white hake assessment report http://nefsc.noaa.gov/publications/crd/crd1310/partb.pdf).
3) Estimate catch that assumes the declining trend in catch will continue in 2013 (Jul-Dec CY13 catch = (Jul-Dec CY12 catch)*(May-Jun CY13 catch / May-Jun CY12 catch)). This estimated Jul-Dec 2013 catch at 1,041 to give a total catch estimate of **2,338** mt.

Trends in catch and effort
The PDT discussed possible reasons why the white hake catch trends appear to be declining, since the terminal year of the model (2011), given the recent increases in biomass in the stock assessment and projections. Comments from industry in the past indicated that white hake was constraining in 2011 and quota monitoring also suggests that most of the white hake quota was caught in 2011.

The PDT speculated that knowing the reason for the decline might be important when making assumptions in the calculation of the ABCs. If the decline is due to fishing constraints by another

stock, perhaps fishing mortality reductions and stock increases should be appropriately estimated in the projections. If the declines in the catch are due to CPUE and stock reductions, perhaps the ABC will be increased erroneously.

In general, the PDT discussed which stocks were limiting fishing in 2012, since many of the groundfish stocks' ACLs were not fully utilized. Cape Cod/GOM yellowtail flounder was the only stock that appeared to be limiting (Table 1). The PDT questioned how Cape Cod/GOM yellowtail flounder constraints could limit the targeting of white hake in the central Gulf of Maine. The estimated decline in white hake catch remains a source of concern for the projections.

The PDT also discussed whether or not white hake catch and effort would continue to decline, given the 2013 increase in the ACL for white hake and the 2013 changes in the ACLs for many of the groundfish stocks.

Given these issues, the PDT decided to use the simple 2013 catch estimate (Method 2) which assumes the catch in that the second half of the year would be similar to the first half (2,594 mt) as the best estimate of 2013 catch to be used for the white hake projections. This assumes that the 2013 emergency action ABC is not limiting white hake catch and that other stocks have been limiting in the past and will continue to limit the white hake catch in 2013. The PDT raised concerns that white hake projections might be optimistic; since it appears that no other stock limited the white hake catch in 2012.

Below is a summary of catch and ABC assumptions used in the projections.

Year	Catch (mt)	ABC	Percent ABC caught
2008	1,545	(effort controls)	-
2009	1,872	(effort controls)	-
2010	2,014	2,832	71%
2011 (terminal yr)	3,039	3,295	92%
2012	2,900	3,638	80%
2013	2,594	4,177	62%

Candidate white hake ABCs
The PDT developed several candidate ABCs for 2014-2016 all based on the recommended short term recruitment series suggested by the SARC. The PDT developed candidate ABCs ranging from the straight 75%F_{MSY} ABC control rule to ABC's that consider higher uncertainty buffers based on past PDT work (enhanced PDT projection simulation work and comparisons of resulting Fs from ABCs in the 2012 groundfish update assessments) which showed that the 75% control rule ABCs did not adequately cover the uncertainty in most of the groundfish assessments. The enhanced PDT and 2012 groundfish updates showed that projections tend to be overly optimistic and the ABCs that were set from the 75%F_{MSY} control rule resulted in overfishing for most of the groundfish stocks.

Results

Projections are summarized in Tables 2-4 and Figures 5-7. All projections assume 2,900 mt in 2012 and 2,594 mt in 2013, the candidate ABC or F_{MSY} from 2014-2016 and 75%F_{MSY} or F_{MSY} from 2017 to 2025. Projections are done to 2025 to show the longer term trends and effects of the recruitment assumption.

Five candidate white hake 2014-2016 ABCs were developed by the PDT for SSC consideration:

1) The straight 75%F_{MSY} ABCs from the projections (4,642 mt in 2014, 4,713 mt in 2015 and 4,645 mt in 2016).
2) The 2014-2016 ABCs are held constant at the 2014 75%F_{msy} estimate (4,642 mt). This approach assumes that the small changes in the projections from 2014-2016 are within the error of the projections. These ABC estimates admit that the small changes are not justified and are within the error of the projections. This has negligible effects on the projections and the uncertainty buffers. Like the straight 75%F_{msy} projection this constant ABC does not result in a meaningful increase in the uncertainty buffer.
3) The 2014-2016 ABCs are held constant at the 2013 75%F_{msy} estimate (4,177 mt). This ABC does not result in a decrease from the 2013 ABC but does provide a larger uncertainty buffer relative to the 75%F_{MSY} control rule. However, this catch is slightly higher than long term catches supported by the recent recruitment over the last 15 years. These candidate ABCs are similar to the SSC's setting of the constant harvest ABC's used for other groundfish stocks (e.g., Cape Cod/GOM yellowtail flounder, witch flounder, GOM cod, and GB cod) that create a larger buffer in the out years when projections become more uncertain.
4) The 2014-2015 ABCs are held constant at the estimated long term (100 year projection) sustainable catch from fishing at F_{MSY} (3,997 mt), assuming recruitment does not increase from what was observed over that last 15 years. This approach is similar to the SSC's setting of ABCs for SNE winter flounder and SNE yellowtail founder. However for SNE winter flounder and SNE yellowtail, the long term 75%F_{MSY} estimate was used, and here, the PDT proposes using the long term catch from F_{MSY}. The resulting ABCs have a larger uncertainty buffer that avoids possible large reductions in future ABCs if recruitment does not improve (from the observed recruitment in the last 15 years).
5) The 2014-2015 ABCs are held constant at the estimated long term (100 year projection) sustainable catch from fishing at 75%F_{msy} (3,659 mt) assuming recruitment does not increase from what was observed over that last 15 years. This approach is similar to the SSC's setting of ABCs for SNE winter flounder and SNE yellowtail flounder. The resulting ABCs have the largest uncertainty buffer (from the list of PDT candidate ABCs). This approach may avoid a possible future reduction in the ABCs, if recruitment does not improve from the observed recruitment in the last 15 years. This ABC is a reduction from the 2013 emergency action 75%F_{MSY} ABC (4,177 mt), but it still is above the PDT's estimated catch for 2013 (2,594 mt).

Summary of candidate ABCs developed by the PDT:

year	(1) ABC	(2) ABC	(3) ABC	(4) ABC	(5) ABC
2014	4,642 mt	4,642 mt	4,177 mt	3,997 mt	3,659 mt
2015	4,713 mt	4,642 mt	4,177 mt	3,997 mt	3,659 mt
2016	4,645 mt	4,642 mt	4,177 mt	3,997 mt	3,659 mt

Comparison of ABCs

PDT candidate ABC (1) and (2) do not provide larger uncertainty buffers relative to the 75%FMSY control rule, which have been shown not to provide adequate buffers for preventing overfishing for most groundfish stocks in the past. PDT candidate ABCs (3) and (4) only differ from each other by 180 mt, and judging from past projection performance, this difference is likely within the error of the projections. OFL have not yet been calculated for each candidate ABC scenario but can be quickly done once an ABC had been set by the SSC. OFL calculations are relatively straight forward but time consuming due to the number of projections needed.

Stock	Cumulative Kept (mt)	Cumulative Discard (mt)	Cumulative Catch (mt)	Sub-ACL (mt)	Percent Caught
GB Cod East	37	30	68	162	42
GB Cod	1,489	133	1,622	4,605	35
GOM Cod	2,084	127	2,211	3,699	60
GB Haddock East	288	78	366	6,880	5
GB Haddock	927	271	1,198	27,438	4
GOM Haddock	213	33	246	653	38
GB Yellowtail Flounder	202	13	216	368	59
SNE/MA Yellowtail Flounder	419	44	463	760	61
CC/GOM Yellowtail Flounder	845	113	958	1,046	92
Plaice	1,368	237	1,605	3,278	49
Witch Flounder	917	66	983	1,448	68
GB Winter Flounder	1,927	5	1,932	3,387	57
GOM Winter Flounder	251	9	260	715	36
SNE Winter Flounder	1	105	106	303	35
Redfish	4,108	321	4,429	8,325	53
White Hake	2,432	38	2,471	3,283	75
Pollock	6,360	103	6,463	12,612	51
Northern Windowpane	0	130	130	129	101
Southern Windowpane	0	106	107	72	148
Ocean Pout	0	39	39	214	18
Halibut	16	45	61	36	169
Wolffish	0	30	30	73	41

Table 1: Fishing year 2012 commercial (sector and common pool catch monitoring) summary from June 14, 2013.

| year	(1) short R 75%Fmsy	Short R Fmsy	long R 75%Fmsy	long R Fmsy	(2) short R 75%Fmsy constant 2014	(3) short R 75%Fmsy constant 2013	(4) short R Fmsy constant long term	(5) short R 75%Fmsy constant long term
2012	0.116	0.116	0.116	0.116	0.116	0.116	0.116	0.116
2013	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091
2014	0.150	0.200	0.150	0.200	0.150	0.134	0.128	0.117
2015	0.150	0.200	0.150	0.200	0.148	0.130	0.124	0.112
2016	0.150	0.200	0.150	0.200	0.150	0.130	0.123	0.110
2017	0.150	0.200	0.150	0.200	0.150	0.150	0.150	0.150
2018	0.150	0.200	0.150	0.200	0.150	0.150	0.150	0.150
2019	0.150	0.200	0.150	0.200	0.150	0.150	0.150	0.150
2020	0.150	0.200	0.150	0.200	0.150	0.150	0.150	0.150
2021	0.150	0.200	0.150	0.200	0.150	0.150	0.150	0.150
2022	0.150	0.200	0.150	0.200	0.150	0.150	0.150	0.150
2023	0.150	0.200	0.150	0.200	0.150	0.150	0.150	0.150
2024	0.150	0.200	0.150	0.200	0.150	0.150	0.150	0.150
2025	0.150	0.200	0.150	0.200	0.150	0.150	0.150	0.150

Table 2: Fishing mortality from SARC 56 white hake AGEPO projections. Numbers in parentheses are candidate ABC projections described in the text above. "Short R" is a projection using short term recruitment (1995-2009) in the CDF. "Long R" is a projection using the entire (1963-2009) recruitment series. $F_{MSY} = 0.2$ and $75\%F_{MSY} = 0.15$.

| year	(1) short R 75%Fmsy	Short R Fmsy	long R 75%Fmsy	long R Fmsy	(2) short R 75%Fmsy constant 2014	(3) short R 75%Fmsy constant 2013	(4) short R Fmsy constant long term	(5) short R 75%Fmsy constant long term
2012	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900
2013	2,594	2,594	2,594	2,594	2,594	2,594	2,594	2,594
2014	4,642	6,062	4,657	6,082	4,642	4,177	3,997	3,659
2015	4,713	5,913	4,775	5,995	4,642	4,177	3,997	3,659
2016	4,645	5,623	4,829	5,859	4,642	4,177	3,997	3,659
2017	4,573	5,366	4,912	5,797	4,581	4,760	4,830	4,960
2018	4,420	5,055	4,979	5,747	4,426	4,575	4,633	4,741
2019	4,226	4,741	4,971	5,648	4,234	4,352	4,399	4,484
2020	4,098	4,538	4,998	5,613	4,107	4,198	4,233	4,298
2021	3,968	4,360	5,038	5,609	3,976	4,043	4,069	4,118
2022	3,877	4,238	5,061	5,604	3,880	3,931	3,949	3,985
2023	3,811	4,159	5,084	5,605	3,811	3,848	3,862	3,887
2024	3,767	4,105	5,094	5,602	3,768	3,794	3,803	3,822
2025	3,733	4,066	5,106	5,605	3,734	3,752	3,759	3,772

Table 3: Catch from SARC 56 white hake AGEPO projections. Numbers in parentheses are candidate ABC projections described in the text above. "Short R" is a projection using short term recruitment (1995-2009) in the CDF. "Long R" is a projection using the entire (1963-2009) recruitment series.

year	(1) short R 75%Fmsy	Short R Fmsy	long R 75%Fmsy	long R Fmsy	(2) short R 75%Fmsy constant 2014	(3) short R 75%Fmsy constant 2013	(4) short R Fmsy constant long term	(5) short R 75%Fmsy constant long term
2012	28,886	28,886	28,886	28,886	28,886	28,886	28,886	28,886
2013	32,384	32,384	32,397	32,397	32,384	32,384	32,384	32,384
2014	35,043	34,673	35,158	34,785	35,040	35,160	35,206	35,292
2015	35,204	33,521	35,766	34,073	35,214	35,784	36,005	36,418
2016	34,790	31,999	36,514	33,667	34,873	35,891	36,287	37,026
2017	34,017	30,359	37,153	33,362	34,086	35,371	35,870	36,805
2018	33,049	28,784	37,665	33,115	33,089	34,164	34,578	35,361
2019	31,652	27,088	37,581	32,571	31,764	32,622	32,950	33,561
2020	30,821	26,047	37,784	32,373	30,884	31,541	31,795	32,270
2021	29,880	25,047	38,076	32,384	29,936	30,420	30,608	30,958
2022	29,190	24,381	38,278	32,357	29,236	29,590	29,724	29,980
2023	28,719	23,953	38,393	32,313	28,725	28,981	29,081	29,268
2024	28,389	23,646	38,447	32,323	28,403	28,589	28,659	28,791
2025	28,152	23,444	38,584	32,316	28,160	28,290	28,338	28,433

Table 4: SSB from SARC 56 white hake AGEPO projections. Numbers in parentheses are candidate ABC projections described in the text above "Short R" is a projection using short term recruitment (1995-2009) in the CDF. "Long R" is a projection using the entire (1963-2009) recruitment series.
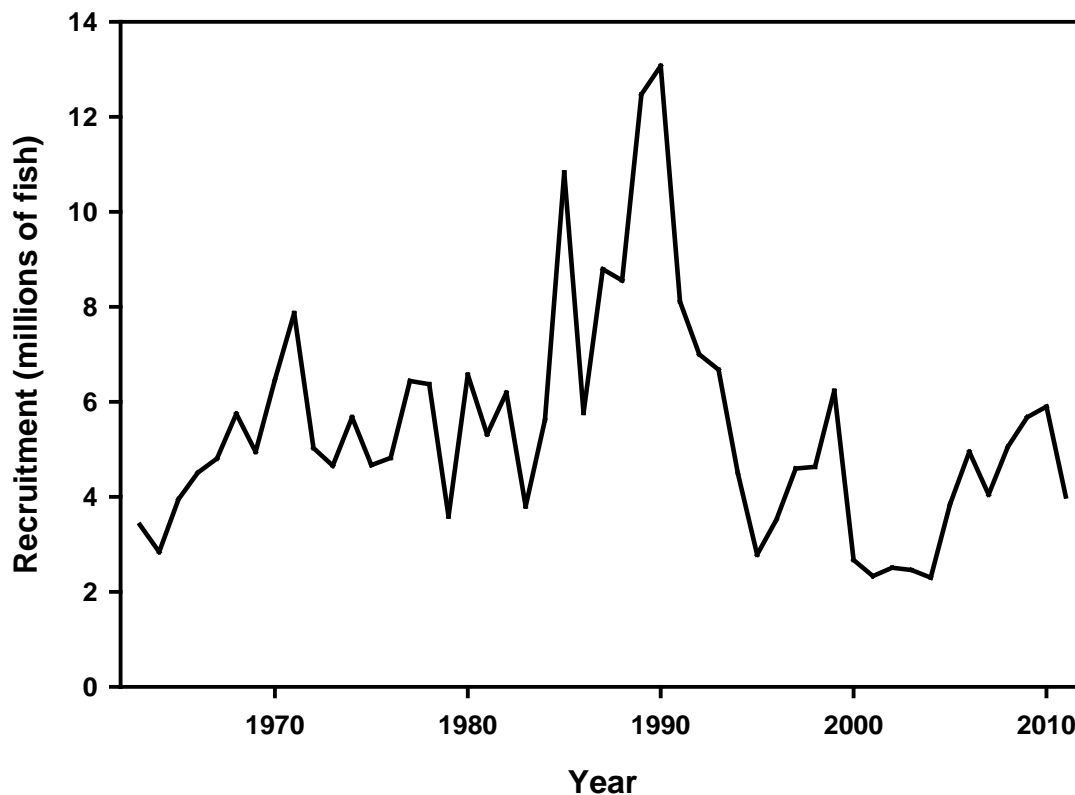
Figure 4: The time series of Gulf of Maine-Georges Bank white hake recruitment at age-1. Long term recruitment series is drawn from this series , 1963 to 2009, and the short term recruitment series is also, 1995-2009.
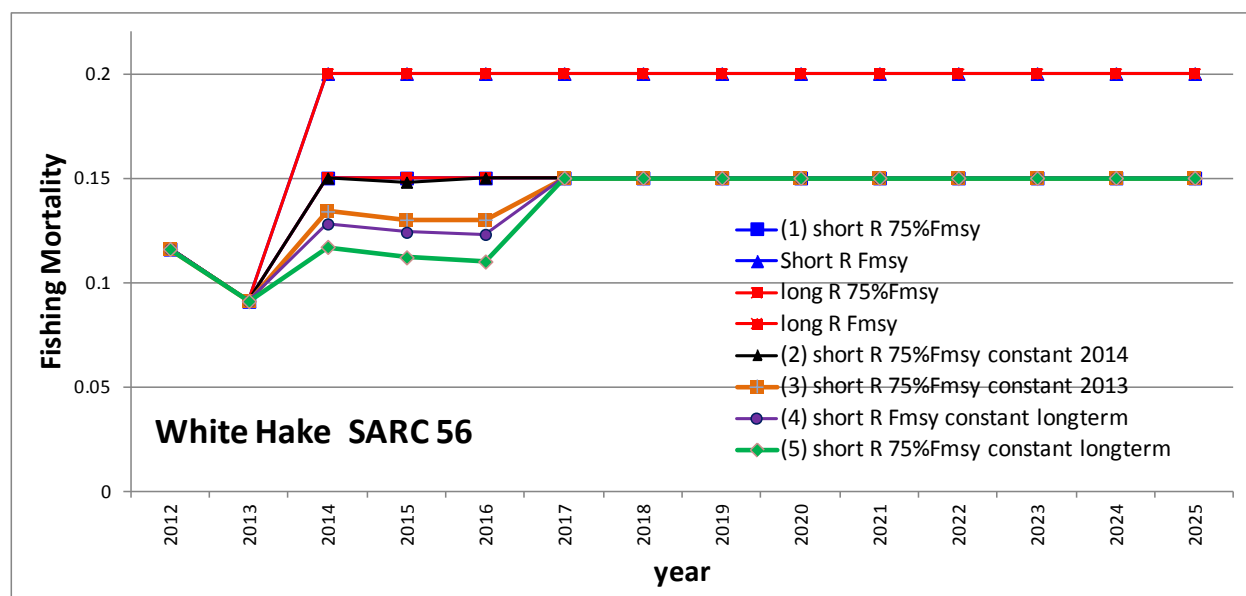
Figure 5: Fishing mortality from SARC 56 white hake AGEPO projections. Numbers in parentheses are candidate ABC projections described in the text above. "Short R" is a projection using short term recruitment (1995-2009) in the CDF. "Long R" is a projection using the entire (1963-2009) recruitment series. . $F_{MSY} = 0.2$ and $75\%F_{MSY} = 0.15$.

Figure 6: Catch from SARC 56 white hake AGEPO projections. Numbers in parentheses are candidate ABC projections described in the text above. "Short R" is a projection using short term recruitment (1995-2009) in the CDF. "Long R" is a projection using the entire (1963-2009) recruitment series.
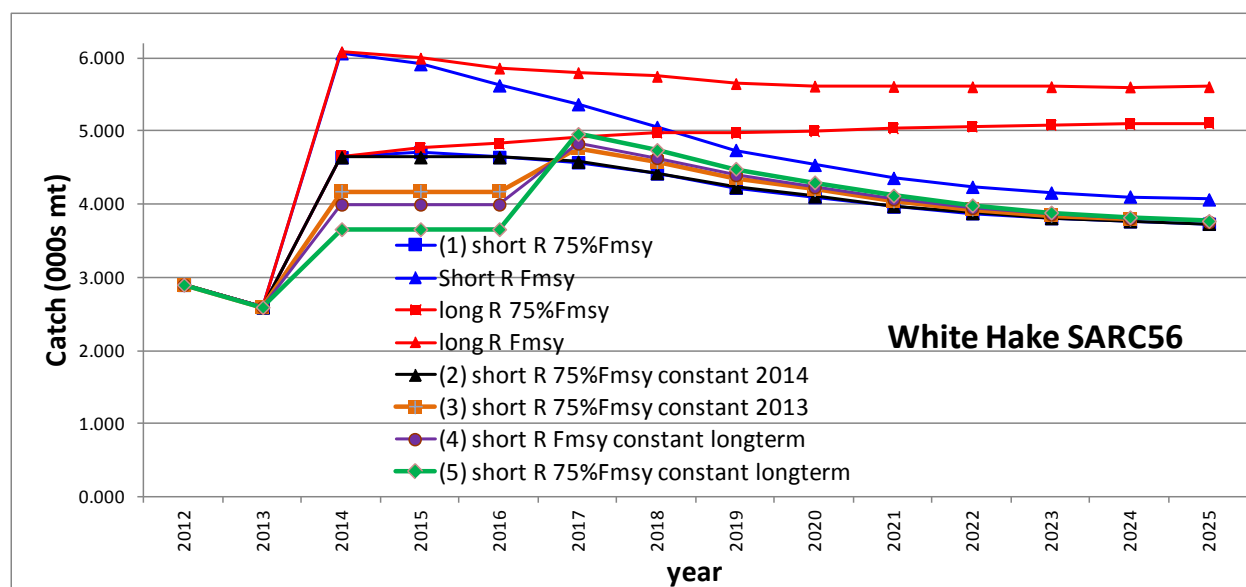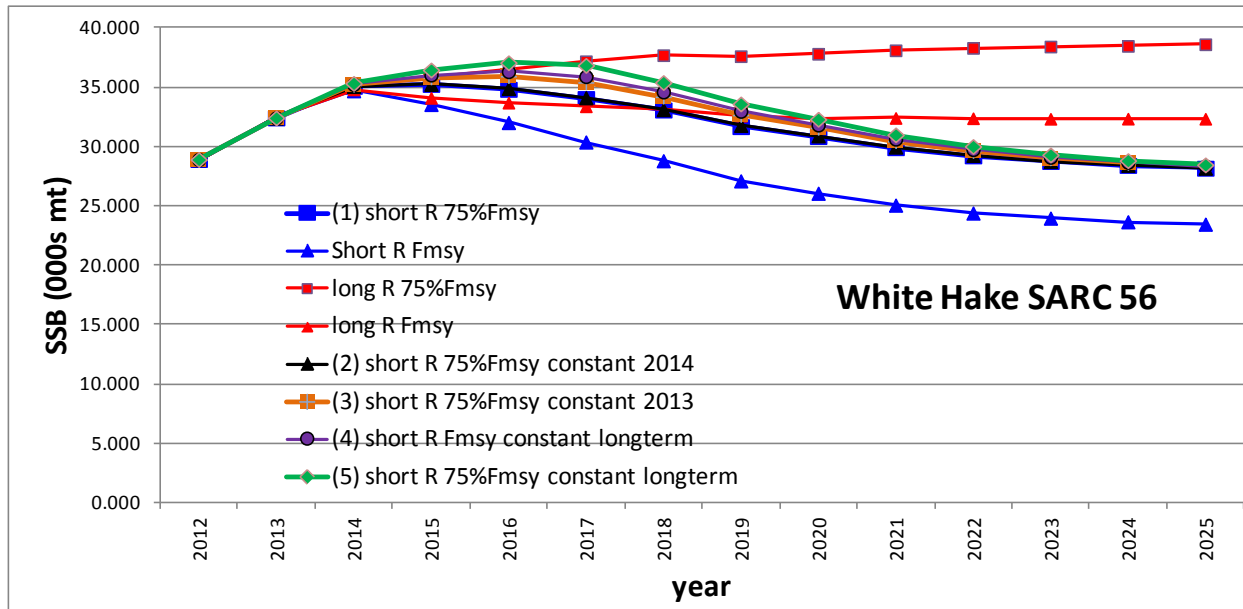
Figure 7: SSB from SARC 56 white Hake AGEPO projections. Numbers in parentheses are candidate ABC projections described in the text above. "Short R" is a projection using short term recruitment (1995-2009) in the CDF. "Long R" is a projection using the entire (1963-2009) recruitment series.

Appendix A

year	F=0	75%Fmsy	7 year	8 year	10 year	Fmsy
2011	0.143	0.143	0.143	0.143	0.143	0.143
2012	0.164	0.164	0.164	0.164	0.164	0.164
2013	0.128	0.128	0.128	0.128	0.128	0.128
2014	0.127	0.127	0.127	0.127	0.127	0.127
2015	0.127	0.127	0.127	0.127	0.127	0.127
2016	0.000	0.135	0.147	0.160	0.171	0.180
2017	0.000	0.135	0.147	0.160	0.171	0.180
2018	0.000	0.135	0.147	0.160	0.171	0.180
2019	0.000	0.135	0.147	0.160	0.171	0.180
2020	0.000	0.135	0.147	0.160	0.171	0.180
2021	0.000	0.135	0.147	0.160	0.171	0.180
2022	0.000	0.135	0.147	0.160	0.171	0.180
2023	0.000	0.135	0.147	0.160	0.171	0.180
2024	0.000	0.135	0.147	0.160	0.171	0.180

Table A1. Fishing mortality from 2012 groundfish update American plaice AGEPRO projections. Original bridge year catch (2011-2012) and ACLs (2013-2015) catch were assumed in all projections. Rebuilding projections that rebuild the stock in 7, 8 and 10 years that meet the PDT requirements are shown. Projections at F=0, 75%Fmsy, and Fmsy are also shown for comparison.

year	F=0	75%Fmsy	7 year	8 year	10 year	Fmsy
2011	1,624	1,624	1,624	1,624	1,624	1,624
2012	1,922	1,922	1,922	1,922	1,922	1,922
2013	1,482	1,482	1,482	1,482	1,482	1,482
2014	1,442	1,442	1,442	1,442	1,442	1,442
2015	1,470	1,470	1,470	1,470	1,470	1,470
2016	0	1,742	1,887	2,043	2,174	2,280
2017	0	1,927	2,069	2,219	2,342	2,440
2018	0	2,108	2,247	2,391	2,506	2,597
2019	0	2,259	2,393	2,529	2,636	2,719
2020	0	2,382	2,510	2,638	2,738	2,815
2021	0	2,493	2,617	2,738	2,831	2,902
2022	0	2,604	2,723	2,839	2,927	2,993
2023	0	2,683	2,799	2,909	2,990	3,053
2024	0	2,738	2,847	2,954	3,029	3,088

Table A2. Catch from 2012 groundfish update American plaice AGEPRO projections. Original bridge year catch (2011-2012) and ACLs (2013-2015) catch were assumed in all projections. Rebuilding projections that rebuild the stock in 7, 8 and 10 years that meet the PDT requirements are shown. Projections at F=0, 75%Fmsy, and Fmsy are also shown for comparison.

year	F=0	75%Fmsy	7 year	8 year	10 year	Fmsy
2011	11,631	11,631	11,631	11,631	11,631	11,631
2012	12,171	12,171	12,171	12,171	12,171	12,171
2013	11,961	11,961	11,961	11,961	11,961	11,961
2014	11,733	11,733	11,733	11,733	11,733	11,733
2015	12,031	12,031	12,031	12,031	12,031	12,031
2016	13,759	13,356	13,321	13,285	13,254	13,227
2017	16,760	14,681	14,511	14,327	14,174	14,052
2018	20,009	16,033	15,723	15,400	15,133	14,920
2019	23,207	17,178	16,746	16,288	15,914	15,624
2020	26,134	18,150	17,601	17,029	16,562	16,186
2021	29,102	19,047	18,386	17,717	17,163	16,729
2022	32,165	19,944	19,179	18,404	17,775	17,276
2023	34,778	20,578	19,737	18,872	18,192	17,649
2024	36,862	21,016	20,098	19,175	18,430	17,858

Table A3. Spawning stock biomass from 2012 groundfish update American plaice AGEPRO projections. Original bridge year catch (2011-2012) and ACLs (2013-2015) catch were assumed in all projections. Rebuilding projections that rebuild the stock in 7, 8 and 10 years that meet the PDT requirements are shown. Projections at F=0, 75%Fmsy, and Fmsy are also shown for comparison.

year	F=0	75%Fmsy	8 year	10 year	Fmsy
2012	0.459	0.459	0.459	0.459	0.459
2013	0.161	0.161	0.161	0.161	0.161
2014	0.135	0.135	0.135	0.135	0.135
2015	0.098	0.098	0.098	0.098	0.098
2016	0.000	0.135	0.139	0.165	0.180
2017	0.000	0.135	0.139	0.165	0.180
2018	0.000	0.135	0.139	0.165	0.180
2019	0.000	0.135	0.139	0.165	0.180
2020	0.000	0.135	0.139	0.165	0.180
2021	0.000	0.135	0.139	0.165	0.180
2022	0.000	0.135	0.139	0.165	0.180
2023	0.000	0.135	0.139	0.165	0.180
2024	0.000	0.135	0.139	0.165	0.180

Table A4. Fishing mortality from SARC 55 gulf of Maine cod base run AGEPRO projections. Original bridge year catch (2012) and ACLs (2013-2015) catch were assumed in all projections. Rebuilding projections that rebuild the stock in 8 and 10 years that meet the PDT requirements are shown. Projections at F=0, 75%Fmsy, and Fmsy are also shown for comparison.

year	F=0	75%Fmsy	8 year	10 year	Fmsy
2012	3,767	3,767	3,767	3,767	3,767
2013	1,470	1,470	1,470	1,470	1,470
2014	1,470	1,470	1,470	1,470	1,470
2015	1,470	1,470	1,470	1,470	1,470
2016	0	2,911	2,993	3,517	3,814
2017	0	3,818	3,915	4,522	4,854
2018	0	4,594	4,700	5,350	5,702
2019	0	5,283	5,394	6,064	6,417
2020	0	6,037	6,151	6,829	7,179
2021	0	6,733	6,851	7,534	7,872
2022	0	7,263	7,378	8,046	8,375
2023	0	7,631	7,749	8,404	8,706
2024	0	7,908	8,016	8,641	8,928

Table A5. Catch from SARC 55 gulf of Maine cod base run AGEPRO projections. Original bridge year catch (2012) and ACLs (2013-2015) catch were assumed in all projections. Rebuilding projections that rebuild the stock in 8 and 10 years that meet the PDT requirements are shown. Projections at F=0, 75%Fmsy, and Fmsy are also shown for comparison.

year	F=0	75%Fmsy	8 year	10 year	Fmsy
2012	8,995	8,995	8,995	8,995	8,995
2013	9,355	9,355	9,355	9,355	9,355
2014	11,949	11,949	11,949	11,949	11,949
2015	16,795	16,795	16,795	16,795	16,795
2016	24,175	23,567	23,550	23,435	23,372
2017	33,584	30,077	29,983	29,363	29,016
2018	42,760	35,449	35,273	34,074	33,398
2019	51,697	40,043	39,756	38,001	37,003
2020	63,228	45,603	45,192	42,662	41,287
2021	76,173	51,292	50,773	47,332	45,543
2022	87,114	55,489	54,800	50,697	48,536
2023	96,531	58,494	57,710	53,025	50,574
2024	104,039	60,772	59,909	54,727	52,017

Table A6. Spawning stock biomass from SARC 55 gulf of Maine cod base run AGEPRO projections. Original bridge year catch (2012) and ACLs (2013-2015) catch were assumed in all projections. Rebuilding projections that rebuild the stock in 8 and 10 years that meet the PDT requirements are shown. Projections at F=0, 75%Fmsy, and Fmsy are also shown for comparison.

year	F=0	75%Fmsy	8 year	10 year	Fmsy
2012	0.517	0.517	0.517	0.517	0.517
2013	0.177	0.177	0.177	0.177	0.177
2014	0.130	0.130	0.130	0.130	0.130
2015	0.076	0.076	0.076	0.076	0.076
2016	0.000	0.135	0.143	0.166	0.180
2017	0.000	0.135	0.143	0.166	0.180
2018	0.000	0.135	0.143	0.166	0.180
2019	0.000	0.135	0.143	0.166	0.180
2020	0.000	0.135	0.143	0.166	0.180
2021	0.000	0.135	0.143	0.166	0.180
2022	0.000	0.135	0.143	0.166	0.180
2023	0.000	0.135	0.143	0.166	0.180
2024	0.000	0.135	0.143	0.166	0.180

Table A7. Fishing mortality from SARC 55 gulf of Maine m-ramp run (m=0.2) AGEPRO projections. Original bridge year catch (2012) and ACLs (2013-2015) catch were assumed in all projections. Rebuilding projections that rebuild the stock in 8 and 10 years that meet the PDT requirements are shown. Projections at F=0, 75%Fmsy, and Fmsy are also shown for comparison.

year	F=0	75%Fmsy	8 year	10 year	Fmsy
2012	3,767	3,767	3,767	3,767	3,767
2013	1,470	1,470	1,470	1,470	1,470
2014	1,470	1,470	1,470	1,470	1,470
2015	1,470	1,470	1,470	1,470	1,470
2016	0	4,110	4,341	4,996	5,390
2017	0	5,507	5,785	6,560	7,010
2018	0	6,747	7,055	7,895	8,372
2019	0	7,846	8,172	9,043	9,532
2020	0	9,099	9,440	10,337	10,818
2021	0	10,100	10,443	11,330	11,791
2022	0	10,804	11,148	12,006	12,452
2023	0	11,316	11,644	12,466	12,879
2024	0	11,649	11,969	12,762	13,155

Table A8 Catch from SARC 55 gulf of Maine cod m-ramp run (m=0.2) AGEPRO projections. Original bridge year catch (2012) and ACLs (2013-2015) catch were assumed in all projections. Rebuilding projections that rebuild the stock in 8 and 10 years that meet the PDT requirements are shown. Projections at F=0, 75%Fmsy, and Fmsy are also shown for comparison.

year	F=0	75%Fmsy	8 year	10 year	Fmsy
2012	8,196	8,196	8,196	8,196	8,196
2013	9,094	9,094	9,094	9,094	9,094
2014	13,649	13,649	13,649	13,649	13,649
2015	22,156	22,156	22,156	22,156	22,156
2016	33,951	33,136	33,089	32,950	32,862
2017	47,825	42,975	42,713	41,963	41,522
2018	61,633	51,296	50,774	49,286	48,419
2019	75,841	58,971	58,150	55,829	54,483
2020	95,799	68,889	67,648	64,239	62,248
2021	114,755	76,902	75,240	70,707	68,130
2022	130,536	82,387	80,376	75,016	72,010
2023	143,324	86,602	84,290	78,162	74,689
2024	154,005	89,281	86,809	80,067	76,358

Table A9. Spawning stock biomass from SARC 55 gulf of Maine cod m-ramp run (m=0.2) AGEPRO projections. Original bridge year catch (2012) and ACLs (2013-2015) catch were assumed in all projections. Rebuilding projections that rebuild the stock in 8 and 10 years that meet the PDT requirements are shown. Projections at F=0, 75%Fmsy, and Fmsy are also shown for comparison.

Appendix B

Estimated CY 2011, 2012 and 2013 NE Multispecies American Plaice Catch (mt)

Stock	Total Groundfish	Commercial Groundfish*	ACLs and sub-ACLs: (with accountability measures (AMs))					sub-components: No AMs	
	A to G	A+B+C	Landings	Discard	Recreational	Herring Fishery	Scallop Fishery	State Water	Other
			A	B	C	D	E	F	G
Plaice									
2011	1,615.1	1,574.8	1,383.4	191.5				16.4	23.8
Jan - Jun 2011	733.7	705.8	601.1	104.7				10.4	17.5
Jul - Dec 2011	881.4	869.0	782.3	86.7				6.1	6.3
2012	1,838.2	1,709.3	1,467.5	241.7				28.0	100.9
Jan - Jun 2012	882.5	844.1	713.0	131.1				10.0	28.4
Jul - Dec 2012	955.6	865.1	754.5	110.6				18.0	72.5
2013	1,574.2	1,472.5						32.7	69.0
Jan - Jun 2013	773.5	702.8	597.4	105.4				17.2	53.5
Jul - Dec 2013 (est)	800.7	769.7						15.5	15.5

Values in live weight

*Includes estimate of missing dealer reports

Source: NMFS Northeast Regional Office

August 5, 2013: Data Dates: May 28 2013, July 31, 2013

These data are the best available to NOAA's National Marine Fisheries Service (NMFS). Data sources for this report include: (1) Vessels via VMS; (2) Vessels via vessel logbook reports; (3) Dealers via Dealer Electronic reporting. Differences with previous reports are due to corrections made to the database.

Sector/Common Pool:
Jan 2011 -Jun CY13 commercial data from Data Matching and Imputation System
Jul-Dec CY13 value = (Jul-Dec CY12 value)*(May-Jun CY13 value / May-Jun CY12 value)

State Water, Other Subcomponent - CY sum of monthly average FY10 and FY11 actual catch plus monthly average of FY12 and FY13 catch limit

Estimated CY 2012 and 2013 NE Multispecies GOM Cod Catch (mt)

Stock	Total Groundfish A to G	Groundfish* A+B+C	ACLs and sub-ACLs; (with accountability measures (AMs))					sub-components: No AMs	
			Landings A	Discard B	Recreational C	Herring Fishery D	Scallop Fishery E	State Water F	Other G
GOM Cod									
2012	3,636.7	3,345.0	2,669.5	143.5	531.9			240.8	50.9
Jan - Jun 2012	1,860.4	1,726.2	1,317.3	79.0	329.9			114.3	19.9
Jul - Dec 2012	1,776.3	1,618.8	1,352.2	64.6	202.0			126.5	31.0
2013	2,237.6	2,030.0			1,062.3			153.0	54.7
Jan - Jun 2013	1,505.7	1,375.0	514.3	41.4	819.3			101.5	29.2
Jul - Dec 2013 (est)	732.0	655.0			243.0			51.5	25.5

Values in live weight
*Includes estimate of missing dealer reports
Source: NMFS Northeast Regional Office
August 8, 2013: Data Dates: May 28 2013, July 31, 2013

These data are the best available to NOAA's National Marine Fisheries Service (NMFS). Data sources for this report include: (1) Vessels via VMS; (2) Vessels via vessel logbook reports; (3) Dealers via Dealer Electronic reporting. Differences with previous reports are due to corrections made to the database

Sector/Common Pool:
Jan 2012 - Jun 2013 commercial data from Data Matching and Imputation System
Jul-Dec CY13 value = (Jul-Dec CY12 value)*(May–Jun CY13 value / May–Jun CY12 value)

Recreational
- CY12: wave 6, 2011 - wave 5, 2012 landings only
- CY13: sum of monthly average FY11 actual catch plus monthly average of FY12 and FY13 catch limit

State Water and Other Subcomponent
- CY sum of monthly average FY11 actual catch plus monthly average of FY12 and FY13 catch limit