New England Fishery Management Council
50 WATER STREET | NEWBURYPORT, MASSACHUSETTS 01950 | PHONE 978 465 0492 | FAX 978 465 3116
E.F. "Terry" Stockwell, Chairman | Thomas A. Nies, *Executive Director*

MEMORANDUM

DATE: November 10, 2014

TO: Groundfish Committee

FROM: Jamie M. Cournane, PhD, Groundfish Plan Coordinator

SUBJECT: **Biological and Economic Impacts Analysis for Framework Adjustment 53 (FW 53) to the Multispecies (Groundfish) Fishery Management Plan**

In preparation for the Groundfish Committee meeting on November 12-13, 2014, this memo includes biological and economic impacts analysis for Framework Adjustment 53 (FW 53) to the Multispecies (Groundfish) Fishery Management Plan.

Attached you will find:

- Biological Impacts- remaining analysis in Section 7.1
- Recreational Fishery - *Gulf of Maine Cod and Haddock: Review of Recreational Bioeconomic Model, Potential AMs for FY 2015, and Recreational Fishery Economic Impacts of Measures in FW 53*

Additional economic impact analysis will be brought to the Committee meeting. An addendum to draft FW 53 (section 7.4 *Economic Impacts*) will be provided for the November Council meeting incorporating the economic information.

ADDENDUM TO DRAFT FRAMEWORK ADJUSTMENT 53

7.0 Environmental Consequences – Analysis of Impacts

7.1 Biological Impacts

7.1.1 Updates to Status Determination Criteria, Formal Rebuilding Programs and Annual Catch Limits

Already provided.

7.1.2 Commercial and Recreational Fishery Measures

7.1.2.1 GOM Cod Spawning Area Closures

The GOM stock of Atlantic cod is comprised of two genetically distinct groups whose spawning activity overlaps in space, but not in time (i.e., "winter" and "spring" spawners) (Kovach et al., 2010; Zemeckis et al., 2014). Within these broad groups are several smaller sub-components that form spawning aggregations at predictable times and locations. At one time, numerous aggregations of spawning cod could be found all along the GOM coast (Ames 2004). Unfortunately, most of these spawning grounds are now vacant, and current cod spawning activity appears restricted to a narrow range of coastline from NH to MA. Cod exhibit high fidelity to their spawning sites, and recent studies on spring spawning GOM cod have shown that tagged females are capable of returning to the same precise spawning location (within <10m) over multiple years (Dean et al., 2014; Zemeckis et al., 2014b). This spatial and temporal predictability makes individual spawning groups particularly vulnerable to depletion, and there is little indication that once a site-specific spawning component is lost that the area can be recolonized.

Some of the remaining GOM cod spawning aggregations are well documented and small seasonal fishery closures have been implemented in an attempt to protect them from disruption and depletion (Armstrong et al., 2013). However, these examples as well as similar experiences in other cod stocks have pointed to a need for broader-scale measures (i.e., at the scale of 30-min blocks) to prevent further loss of population structure and enhance the potential for recruitment success in the future (Zemeckis et al., 2014a).

7.1.2.1.1 Option 1: No Action

Impacts on regulated groundfish

Option 1\No Action would maintain the existing GOM cod spawning closure area (Whaleback) implemented in Framework Adjustment 45. It is reasonable to expect that this area would continue to result in positive impacts to GOM cod and other regulated groundfish as it limits commercial and recreational fishing during the designated timeframes of the closure (i.e., June 1-June 30:Commercial vessels; April 1-June 30: recreational vessels). Specifically, use of gear capable of catching groundfish is prohibited in this area during the closure. Although Option 1\No Action is likely to continue to provide positive impacts to GOM cod and regulated groundfish species, as the Option 1\No Action area closure is shorter in duration and encompasses a smaller area than the areas proposed in Sub-Options A and B, Option 1\No Action would have less of a positive impact on GOM cod and other regulated groundfish than either option. As a result, Option 1\No Action is likely to have positive impacts on regulated groundfish species.

Impacts on other species

It is reasonable to expect that this area would continue to result in positive impacts to other species that may be co-caught with other regulated groundfish as it limits commercial and recreational fishing during the designated timeframes of the closure (i.e., June-June 30:Commercial vessels; April-June: recreational vessels). Although Option 1\No Action is likely to continue to provide positive impacts to other species, as the Option 1\No Action area closure is shorter in duration and encompasses a smaller area than the areas proposed in Sub-Options A and B, Option1\No Action would have less of a positive impact on other species than either option. As a result, Option 1\No Action Alternative is likely to have a positive impact on other species.

7.1.2.1.2 Option 2: Additional GOM cod Spawning Protection Measures

The Council may select Sub-Option A or Sub-Option B.

During particular months, Sub-Options A and B would provide protection for both remaining spawning components (winter and spring) for the GOM cod stock. Protection of spawning is needed to ensure that the low SSB of this stock has the opportunity for successful spawning events which is essential to prevent failures in future year classes through recruitment success. Spawning success from a low stock biomass does have the potential for rapid stock rebuilding. However further declines in SSB and disruption of spawning behavior will further reduce the probability of rebuilding an important future cod resource.

Sub-Options A and B include 30 minute blocks that would be closed for specific months throughout the year to protect spawning cod. Appendix II (*Analytic Techniques: Identifying location and times of spawning for Gulf of Maine cod*) summarizes the analysis to examine GOM cod spawning.

Multiple independent data sources and analytical approaches were used to identify the areas important to spawning cod in the GOM, at the scale of the 30-min month-block. Notable discrepancies exist between these analyses and the FW53 closure Sub-Options A and Sub-Option B, including:

1) Significant spawning occurs in February and July, both of which are absent from Sub-Option A and Sub-Option B
2) March appears to be a time with limited spawning, yet is included in both Sub-Option A and Sub-Option B
3) The northward shift in closure areas (from May to June) under both Sub-Option A and Sub-Option B does not match existing data on the latitudinal progression of spawning. Blocks 124 and 125 continue to be important in June.
4) Sub-Option B would protect a small fraction of the area that is import to spring spawning cod.

Analysis suggests that to more fully protect spawning cod, while at the same time allow access to areas that do not support aggregations of spawning cod these times/areas are important: blocks 124, 125, 132, 133 for the months of November through February, and blocks 124, 125, 132, 133, 139, 140 for the months of April through July.

<u>Sub-Option A:</u>

Sub-Option A would create discreet GOM cod closure areas in May, June, November through January, and March through April. The May spawning closure restricts commercial and recreational fishing in areas of the Western Gulf of Maine (WGOM). This spawning area overlaps with the WGOM closed area, and includes all of Ipswich Bay, and Massachusetts Bay, including Stellwagen Bank National Marine Sanctuary. The April spawning area covers the northern portion of the WGOM, and overlaps with the

WGOM closed area. The November through January closure restricts fishing from Massachusetts Bay east to Stellwagen Bank, and the southern extent of the WGOM closed area. The March to April spawning closure area would prohibit fishing in Ipswich Bay, Massachusetts Bay, including Stellwagen Bank, and overlaps with the western GOM closed area. Furthermore, CATT analysis suggests that spawning activity for haddock and yellowtail flounder occur in the spring closure areas (NEFMC 2013).

Impacts on regulated groundfish

Sub-Option A would likely reduce fishing effort, and subsequently reduce fishing mortality. It is expected that effort shifts may occur as result of Sub-Option A's seasonal closures. Sub-Option A is likely to reduce fishing effort, and ultimately fishing mortality more than Sub-Option B because Sub-Option B closes a smaller overall area than Sub-Option A during the same months. Therefore, Sub-Option A would have a greater positive impact on GOM cod and other regulated groundfish species when compared to Sub-Option B. Both sub-options could be expected to positively impact regulated groundfish species when compared to the No Action alternative.

Impacts on other species

Sub-Option A would likely reduce fishing effort, and subsequently reduce fishing mortality. It is expected that effort shifts may occur as result of Sub-Option A's seasonal closures. Sub-Option A is likely to reduce fishing effort, and ultimately fishing mortality more than Sub-Option B because Sub-Option B closes a smaller overall area than Sub-Option A during the same months. Therefore, Sub-Option A would have a greater positive impact on other species co-caught with regulated groundfish species when compared to Sub-Option B. Both sub-options could be expected to positively impact other species when compared to the No Action alternative.

<u>Sub-Option B:</u>

Sub-Option B would create discreet GOM cod closure areas in May, June, November through January, and March through April. The May spawning closure is smaller than the Option A May closure, and restricts commercial and recreational fishing in Massachusetts Bay and Ipswich Bay. The April spawning closure area covers a portion of the inshore GOM, including Ipswich Bay, and overlaps with the existing GOM cod spawning closure area. The November through January closure restricts fishing in Massachusetts Bay, and on Stellwagen Bank. The March to April spawning closure area covers the same inshore area as the May closure. Furthermore, CATT analysis suggests that spawning activity for haddock and yellowtail flounder occur in the spring closure areas (NEFMC 2013).

Impacts on regulated groundfish

Sub-Option B would likely reduce fishing effort, and subsequently reduce fishing mortality. It is expected that effort shifts may occur as result of Sub-Option B's seasonal closures. When compared to the No Action/Option 1, Sub-Option B would likely positively affect multispecies stocks by reducing fishing effort in inshore areas at times of the year when cod are particularly vulnerable Both sub-options could be expected to positively impact regulated groundfish species when compared to the No Action alternative.

Impacts on other species

Sub-Option B would likely reduce fishing effort, and subsequently reduce fishing mortality. It is expected that effort shifts may occur as result of Sub-Option B's seasonal closures. When compared to the No Action/Option 1, Sub-Option B would likely positively affect multispecies stocks by reducing fishing

effort in inshore areas at times of the year when cod are particularly vulnerable Both sub-options could be expected to positively impact other species when compared to the No Action alternative.

References

Ames, T. 2004. Atlantic cod stock structure in the Gulf of Maine. Fisheries 29 (1): 10-28.

Armstrong, M. P., M. J. Dean, W. S. Hoffman, D. R. Zemeckis, T. A. Nies, D. E. Pierce, P. J. Diodati, and D. J. Mckiernan. 2013. The application of small scale fishery closures to protect Atlantic cod spawning aggregations in the inshore Gulf of Maine. Fisheries Research 141:62-69.

Kovach, Adrienne I, Timothy S. Breton, David L. Berlinsky, Lorraine Maceda, Isaac Wirgin. 2010. Fine-scale spatial and temporal genetic structure of Atlantic cod off the Atlantic coast of the USA. *Marine Ecology Progress Series* 410:177-195.

New England Fishery Management Council (NEFMC). 2013. *Omnibus Essential Fish Habitat Amendment 2: Draft Environmental Impact Statement; Appendix E- Synopsis of Closed Area Technical Team analysis of juvenile groundfish habitats and groundfish spawning areas*. Available at: <http://www.nefmc.org/library/omnibus-habitat-amendment-2>

Zemeckis, D., Dean, M., Cadrin, S. 2014a. Spawning dynamics and associated management implications for Atlantic cod (Gadus morhua). *North American Journal of Fisheries Management*. 34:424-442.
Zemeckis, D., Hoffman, W., Dean, M., Armstrong, M. 2014b. Spawning site fidelity by Atlantic cod (Gadus morhua) in the Gulf of Maine: implications for population structure and rebuilding. *ICES Journal of Marine Science*. 71: 1356-1365.

7.1.2.2 Prohibition on the Possession of GOM cod

7.1.2.2.1 Option 1: No Action

Impacts on regulated groundfish

Under the No Action, there would be no revision to the retention regulations of GOM cod. This would continue to require sector vessels to retain and land all legal sized cod, and common-pool and recreational fishermen to retain and land all legal sized cod up to a trip or bag limit, respectively. Each component of the fishery would continue to operate under strict catch limits and AMs. Option 1 is not expected to change behavior in the fishery, in and of itself, and therefore is expected to have a neutral impact on regulated groundfish.

Impacts on other species

This option would not be expected to have any direct impacts on other species. This option would not be expected to lead to any changes in catches of other species, and would not affect the management of those species.

7.1.2.2.2 Option 2: Prohibition on the possession of GOM cod

Impacts on regulated groundfish

This option would prohibit possession of GOM cod by all commercial and recreational vessels (i.e. all vessels would be required to discard all GOM cod). Option 2 retains allocations of GOM cod for the groundfish fishery, and fishing effort is expected to be a function of the allocated ACL. In theory, this measure would not allow fishing effort to increase because commercial and recreational fisheries would continue to operate under strict catch limits and AMs. While landings and possession would be prohibited, all catch, in theory, would be accounted for, however there are additional considerations.

The prohibition on the possession of GOM cod is likely to have differing effects for commercial and recreational fisheries (see Economic Impacts section XXX). Under Option 2, there is a potential loss of information on GOM cod (i.e., collection of biological samples from landed fish) and zero possession could increase uncertainty of catch estimates. The general lack of biological data and increases in the discards could result in higher uncertainty with the removals and degrade the stock assessment and knowledge with regards to potential changes in future stock status. No possession will likely further increase the concerns with observer effects and unaccounted for mortality. In addition, previous work on the discard monitoring showed that trimming of large tows from the estimator will result in a large bias in the discard estimate (http://nefsc.noaa.gov/groundfish/discard/). The discard estimation methodology review did not recommend omitting observed large or low discard tow information from the data stream in the discard estimator when monitoring the discards. The biological impacts may be similar on paper between Option 1\No Action and Option 2 since the theoretical catch limit is the same, but under no possession as in Option 2 the uncertainty on whether the mortality target will be achieved increases since there are increases in the uncertainty associated with the estimated catch. Uncertainty increases in Option 2, because what would have been known landings under Option 1\No Action are now being converted into a discard estimate. In addition, there is uncertainty in the assumed discard mortality rates associated with the different gear types. The true mortality associated with discarding from different gear types is not well known since there are very few survival rate studies on GOM cod. Uncertainty with regards to the true mortality on GOM cod will be higher in Option 2 relative to Option 1\No Action. Therefore, Option 2 would have negative impacts on GOM cod when compared to Option 1\No Action.

However, it is possible that Option 2 may deter fishing on the GOM cod stock by both commercial and recreational fishermen in federal waters. If fishermen and anglers are able to adjust their behavior and move to areas with lower concentrations of GOM cod, fishing mortality would be reduced. If that occurs, Option 2 would be expected to have low positive impacts on GOM cod when compared with Option 1/No Action. Likewise if fishermen and angler avoid GOM cod, Option 2 is expected to have low positive impacts on other regulated groundfish species co-caught with GOM cod when compared to Option 1/No Action.

Impacts on other species

This option would not be expected to have any direct impacts on other species. This option would not be expected to lead to any changes in catches of other species, and would not affect the management of those species.

7.1.2.3 Observer Requirements in the Gulf of Maine

7.1.2.3.1 Option 1: No Action

Impacts on regulated groundfish

The No Action alternative would make no changes to regulations, and reporting requirements that are currently in place for all limited access groundfish vessels. Option 1 is not expected to change behavior in the fishery, in and of itself, and therefore is expected to have a neutral impact on regulated groundfish.

Impacts on other species

This option would not be expected to have any direct impacts on other species. This option would not be expected to lead to any changes in catches of other species, and would not affect the management of those species.

7.1.2.3.2 Option 2: Revised Observer Requirements on trips in the GOM

Impacts on regulated groundfish

The Option 2 would prohibit all limited access groundfish vessels that conduct fishing activity west of 70 15 W longitude in the GOM broad stock reporting area (BSA 1) from fishing in multiple broad stock reporting areas with the intent of improving accountability of catches of GOM cod. Option 2 would add an additional VMS reporting requirement and would prohibit vessels that fish to the west of 70 15 W longitude from fishing in multiple broad stock reporting areas unless carrying and observer.

Analysis of commercial cod catch in the GOM using VTRs suggests that the majority of that catch comes from 30 minute blocks 124 and 132 (Michael Palmer personal communication; Palmer 2014; Richardson et al. 2014). More recently there is some evidence for higher relative cod catch coming from the eastern edge of the GOM closure in blocks 132 and 138 as the fleet moved further offshore to avoid cod with the reductions in the GOM cod ACL). However the highest catch rates still show that the heart of the GOM cod population is still within blocks 124 and 132. For comparison, the 70 15 W line bisects blocks 124 and 132. The significance of 70 15 W is that it is the western boundary of the WGOM closure. While 70 15 W bisects 124 and 132, it only really affects a small portion in the southeastern quadrant of 124, and historically, there has not been a substantial removal of GOM cod from this area.

To the extent that there will be additional reporting requirements for vessel's conducting fishing activity without at-sea observers on board, there may be improved information regarding GOM cod and other regulated groundfish species. However, Option 2 has the capability to invalidate the unbiased nature of the discard estimation procedures currently in use. The provision increases the likelihood that the sample of vessels covered by observers will have a different spatial distribution from unobserved vessels. For example, consider a sector that traditionally fishes broadly throughout the Gulf of Maine and Georges Bank regions (i.e., many of the trips declare into multiple BSAs). If high discards of GOM cod occur west of 70°15' W, then the discards rates from observed trips will be higher than those of unobserved trips, resulting in the sample not being representative of the population.

This provision it is intended to reduce the misreporting of inshore GOM cod catches. Unfortunately, it will potentially bias discard estimates for trips that intend to fish in multiple BSAs. Option 2 would result in an increased potential for observer bias, thus having a negative impact on all groundfish species when compared with Option 1\No Action.

Impacts on other species

This option would not be expected to have any direct impacts on other species. This option would not be expected to lead to any changes in catches of other species, and would not affect the management of those species.

References

Palmer MC. 2014. 2014 Assessment update report of the Gulf of Maine Atlantic cod stock. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 14-14; 119 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://nefsc.noaa.gov/publications/

Richardson, D.E., M. C. Palmer, and B. E. Smith. 2014 The influence of forage fish abundance on the aggregation of Gulf of Maine Atlantic cod (*Gadus morhua*) and their catchability in the fishery. *Canadian Journal of Fisheries and Aquatic Sciences*, 71 (9), 1349-1362.

7.1.2.4 Rollover of Groundfish Specifications

7.1.2.4.1 Option 1: No Action

Impacts on regulated groundfish

In the absence of specifications for a stock due to a delay in rulemaking, fishing would not be allowed in the broad stock area for that stock. There are currently no provisions within the Northeast Multispecies FMP that allow for specifications to be rolled forward into the next fishing year to enable fishing to begin of time at the start of the fishing year (e.g. from FY 2014 to FY 2015). In the event of a delay in rulemaking, the No Action would decrease fishing effort in all broad stock reporting areas (GOM, GB, SNE) at the start of the fishing year, which is expected to reduce overall fishing morality on regulated groundfish, and would have a positive impact on the resource.

Impacts on other species

In the event of a delay in rulemaking, the No Action would decrease fishing effort in all broad stock reporting areas (GOM, GB, SNE) at the start of the fishing year, , which is expected to reduce overall fishing morality on regulated groundfish, and would have a positive impact on other species co-caught with regulated groundfish.

7.1.2.4.2 Option 2: Percentage Rollover Provisions for Specifications

The Council may select either sub-option A, B, or C.

Option 2 would allow the FY to begin on time in the event of a delay in rulemaking by rolling forward specification values from one fishing year into the next (e.g. from FY 2014 to FY 2015). Sub-options A, B, and C would roll forward a percentage of the prior year's stock specific ACL up to a value that may not exceed the stock's acceptable biological catch (ABC) for the upcoming fishing year. The default rollover ACL would be replaced by new, updated specifications upon rulemaking. This is an administrative measure that, in and of itself, is not expected to impact fishing effort or behavior over the course of an entire fishing year. However, varying percentages would allow varying levels of fishing effort – and subsequent fishing mortality – in the event of a major delay in rulemaking.

Sub-Option A: Rollover 35% of all groundfish stocks to the following FY.

Impacts on regulated groundfish

Sub-Option A is less conservative than Sub-Options B and C. These default rollover measures would have may have slightly negative impact on regulated groundfish species when compared to Sub-Options B and C because this option would allow the fishery to catch up to 35% of the prior year's ACL before new specifications are adopted.

Sub-Option A would have a slightly negative impact on regulated groundfish species when compared to Option 1\No Action because the No Action would reduce significantly reduce fishing effort and therefore reduce fishing mortality.

Impacts on other species

Sub-Option A is less conservative than Sub-Options B and C. These default rollover measures may have slightly negative impact on other species co-caught with regulated groundfish when compared to Sub-Options B and C because this option would allow the groundfish fishery to catch up to 35% of the prior year's ACL before new specifications are adopted. Sub-Option A would have a slightly negative impact on other species co-caught with regulated groundfish when compared to Option 1\No Action.

Sub-Option B: Rollover 20% of all groundfish stocks to the following FY.

Impacts on regulated groundfish

Sub-Option B is the more conservative than Sub-Option A, but less conservative than Sub-Option C. These default rollover measures would have slightly positive impacts on regulated groundfish species when compared to Sub-Option A, and a slightly negative impact when compared to Sub-Option C because this would allow the fishery to catch up to 20% of the prior year's ACL before new specifications are adopted. Sub-Option B would have a slightly negative impact on groundfish species when compared to Option1\No Action because the No Action would reduce significantly reduce fishing effort and therefore reduce fishing mortality. .

Impacts on other species

Sub-Option B is the more conservative than Sub-Option A, but less conservative than Sub-Option C. These default rollover measures would have slightly positive impacts on other species co-caught with regulated groundfish when compared to Sub-Option A, and a slightly negative impact when compared to Sub-Option C because this would allow the groundfish fishery to catch up to 20% of the prior year's ACL before new specifications are adopted. Sub-Option B would have a slightly negative impact on other species co-caught with regulated groundfish when compared to Option1\No Action.

Sub-Option C: Rollover 10% of all groundfish stocks to the following FY.

Impacts on regulated groundfish

Sub-Option C is the most conservative of the default rollover measures under consideration, and would have may have slightly positive impacts on regulated groundfish species when compared to Sub-Options A or B because this would only allow the fishery to catch up to 10% of the prior year's ACL before new specifications are adopted. Sub-Option C would have a slightly negative impact on regulated groundfish species when compared to the Option 1\No Action because the No Action would reduce significantly reduce fishing effort and therefore reduce fishing mortality. .

Impacts on other species

Sub-Option C is the most conservative of the default rollover measures under consideration, and would have may have slightly positive impacts on other species co-caught with regulated groundfish when compared to Sub-Options A or B because this would only allow the groundfish fishery to catch up to 10% of the prior year's ACL before new specifications are adopted. Sub-Option C would have a slightly negative impact on other species co-caught with regulated groundfish when compared to the Option 1\No Action.

7.1.2.5 Sector ACE Carryover

7.1.2.5.1 Option 1: No Action

Impacts on regulated groundfish

The No Action alternative would continue to allow groundfish sectors to carry over up to 10% of their unused sector ACE, as outline in Amendment 16. However, the 10% could not be implemented based on the U.S. District Court for the District of Columbia's April 4, 2014 ruling on NMFS' carryover-related measures included in the Framework Adjustment 50 rulemaking, which invalidated and vacated the FY 2013 carryover measures. The ruling also specified that a 'total potential catch' (the total ACL plus 10% unused ACE carryover) cannot exceed the ABC for any stock. This revision is necessary to cap the amount of carryover that can be harvested to ensure that the 'total potential catch' (i.e., total ACL + max. carryover) does not exceed the ABC for the fishing year in which the carried over ACE may be harvested. Option 1/No Action may lead to changes in catches of regulated groundfish species if carryover on regulated groundfish stocks is not implemented and fishing is reduced as a consequence. Therefore, No Action would have low positive impacts on regulated groundfish stocks when compared with Option 2.

Impacts on other species

This option would not be expected to have any direct impacts on other species. This option may lead to any changes in catches of other species if carryover on regulated groundfish stocks is not implemented and fishing is reduced as a consequence. Therefore, No Action would have low positive impacts on other species when compared with Option 2.

7.1.2.5.2 Option 2: Modification to Sector ACE carryover

Impacts on regulated groundfish

Option 2 would modify Sector carryover provisions in Amendment 16. Carryover effectively increases the total amount of allocation a sector can catch in the following fishing year.

Option 2 would allow groundfish sectors to carry forward up to 10% of unused ACE provided that the total unused sector ACE carried forward for all sectors from the previous FY does not exceed the ABC level minus the ACL for the fishing year in which the carryover would be landed. This provision keeps catches within the prescribed acceptable biological catch, and in and of itself, is not expected to change fishing effort or behavior. This is an administrative alternative and is not expected to have an impact regulated groundfish species. With a reduced, and unknown (will it be 10% or less this year?), possibility to carry over quota, sectors may be more inclined to attempt to fully fish their ACE, including any reserve, to avoid the risk of losing quota.

Impacts on other species

Option 2 reduces the overall amount of ACE that may be carried over from one fishing year to the next, and may lead to reductions in fishing effort, and therefore may reducing impacts on other species. Therefore, No Action would have low negative impacts on other species when compared with Option 2.

Gulf of Maine Cod and Haddock: Review of Recreational Bioeconomic Model, Potential AMs for FY 2015, and Recreational Fishery Economic Impacts of Measures in FW 53

Analysis of Potential Recreational Fishing Accountability Measures for FY 2015

A bioeconomic model, developed by the Northeast Fisheries Science Center's Social Sciences Branch, was used to estimate FY 2015 recreational Gulf of Maine cod and haddock mortality under alternative size and possession limit accountability measures (AMs). The model predicts that under a zero possession limit Gulf of Maine (GOM) cod mortality will exceed the recreational sub-ACL under consideration in Option 2 (121 mt), section 4.1.2.2 (*Revised Annual Catch Limit Specifications*) of Framework Adjustment 53 (FW 53) in FY 2015. Discard mortality is estimated to account for approximately 85-90% of total GOM cod mortality, with the remainder attributed to noncompliance. Model results are shown for four potential combinations of size and possession limit AMs for both GOM cod and haddock. AMs for both GOM cod and haddock are considered simultaneously in the model because both species are often caught on a given recreational fishing trip. Model results also indicate that status quo recreational GOM haddock AMs would need to be adjusted to keep mortality from exceeding the haddock recreational sub-ACL under consideration in Option 2 (372 mt). A quantitative assessment of the proposed GOM cod spawning protective measures on the recreational fishing industry, section 4.2.1.2 (*Additional GOM Cod Spawning Protection Measures*), is not possible given data limitations, so the effect of the spawning protective measures is discussed qualitatively as well as ideas for different AMs that could potentially be implemented in FY 2015 to further reduce recreational discard mortality of both GOM cod and haddock.

Bioeconomic Model Overview

The recreational bioeconomic model used for the analysis was reviewed by a panel consisting of SSC members representing both the NEFMC and the MAFMC and outside experts in September, 2012. Following the review, the model has been used by NMFS to develop AMs for GOM cod and haddock in FY 2013 and FY 2014.

The bioeconomic model takes into account how changes in the biophysical and regulatory environments reflect changes in angler behavior and fishing mortality. The model uses angler behavioral data collected from an angler stated preference conjoint survey, biological information about the current and projected stock structures of Gulf of Maine cod and haddock, and historical recreational catch and effort data. The model accounts for length-based selectivity by anglers, is dynamic, and is characterized by feedback loops between stock structures and angler participation. Monte Carlo simulations are conducted and the model aggregates from the micro-level choice occasion up to the fishing year level to estimate the costs and benefits of alternative fisheries policies and the probability that those policies will achieve short-run conservation objectives (meeting ACLs) and long-run conservation objectives (rebuilding depleted fish stocks). For this assessment, the model was used to estimate how alternative size limits, possession limits, and/or closed seasons will affect recreational fishing mortality and angler effort during FY 2015 for both GOM cod and haddock.

Evaluation of Model Predictions

Final FY 2013 recreational mortality of GOM cod was estimated by the NEFSC to be 639 mt and recreational mortality in FY 2014 is estimated at 422 mt (Table 1). The model-generated predictions of recreational mortality were 36% lower for FY 2013 and 31% lower for FY 2014. Although the reasons for the disparities are still being evaluated, several modifications were recently made to the model which should reduce the discrepancies in FY 2015. First, the model now incorporates both size limit and bag limit noncompliance according to historical noncompliance rates developed from MRIP data. These data were derived from sampled angler-trips and likely provide a lower bound estimate of noncompliance. Noncompliance varies by year, wave, mode, and species and is a function of regulations and encounter rates, among other things. For the FY 2015 assessment, noncompliance rates were derived from available FY 2014 MRIP data on GOM cod and haddock catch. Secondly, and more importantly, the algorithm for how angler trips are retained in the simulations was modified. After comparing model projections to actual MRIP effort data it was found that the simulation approach underestimated the total number of angler trips that targeted or caught GOM cod and haddock in FY 2013 and FY 2014, and hence underestimated total mortality as well. For the FY 2015 assessment, the algorithm in the simulations was adjusted to account for the rate of effort underestimation found in FY 2013 and FY 2014. In combination, these changes will result in higher model-generated estimates of angler effort and mortality and should improve the predictive capability of the model for evaluating FY 2015 AMs.

FY 2015 Mortality Projections Under Status Quo AMs

The current AMs for recreational GOM of cod and haddock are shown in Table 2. The projected effect that these measures would have on mortality of GOM cod and haddock in FY 2015 are shown in Figure 1. Recreational GOM cod mortality is estimated to be 549 mt under status quo AMs. Approximately 68% of the cod mortality is projected to be from landings and the remaining 32% from discard mortality (assumes a 30% discard mortality rate). Recreational GOM haddock mortality is estimated to be 511 mt under status quo AMs, with 42% estimated to be from landings and 58% from discards (assumes a 50% discard mortality rate). The current haddock minimum size of 21" results in a high degree of discards.

The resulting mortality estimates associated with status quo measures are considerably higher than the recreational sub-ACLs under consideration in Option 2 for GOM cod (121 mt) and haddock (372 mt), section 4.1.2.2. In fact, the model predicts that the status quo measures have a zero percent chance of keeping mortality below the Option 2 targets for both GOM cod and haddock.

FY 2015 Mortality Projections Under More Restrictive Size, Season, and Possession Limits

In addition to an assessment of status quo measures for FY 2015, more restrictive AMs were analyzed in attempt to uncover measures that would have at least a 50% probability of achieving the conservation objectives for FY 2015. Out of 25 scenarios analyzed with varying combinations of size limits, possession limits, and closed seasons for GOM of cod and haddock, only two scenarios resulted in haddock mortality below the Option 2 (section 4.1.2.2) FY 2015

haddock recreational sub-ACL. None of the 25 scenarios resulted in cod mortality below the Option 2 FY 2015 cod recreational sub-ACL, even with a possession limit of 0 cod for all of FY 2015. Table 3 shows the results of the two scenarios that have a high probability of keeping haddock mortality below the Option 2 FY 2015 recreational sub-ACL and two other scenarios that help to explain the projections.

Scenario 1 in Table 3 shows the mortality projections assuming a zero possession limit of cod for all of FY 2015 and a three fish possession limit for haddock during a 4-month open season (May 1 through August 31). These accountability measures are projected to result in 280 mt of GOM cod mortality and 480 mt of GOM haddock mortality, based on the median values from 100 model simulations. The projected probability that these accountability measures will keep mortality below the Option 2 FY 2015 recreational sub-ACLs is zero.

Scenario 2 shows the mortality projections assuming the same AMs as Scenario 1, except the haddock possession limit is reduced from three to two fish. This set of AMs is slightly more restrictive for GOM haddock, so the model predicts a small decrease in recreational fishing trips relative to Scenario 1. The small decline in recreational fishing trips causes GOM cod mortality to decline marginally to 276 mt and GOM haddock mortality to decline to 415 mt; levels that still exceed the Option 2 FY 2015 recreational sub-ACLs for both species. The projected probability that these accountability measures will keep mortality below the Option 2 FY 2015 recreational sub-ACLs is also zero according to the simulations.

Scenario 3 shows the mortality projections assuming the same AMs as Scenario 2, except the haddock minimum size is reduced from 21" to 19". The reduction in the minimum size for haddock results in a slightly higher estimates of angler effort, due to the less restrictive size limit, but haddock mortality actually declines to 357 mt due to anglers discarding fewer fish. The model predicts that these measures would have a 99% probability of keeping haddock mortality below the FY 2015 recreational sub-ACL value shown in Option 2 (372 mt). However, the measures do little to change projected GOM cod mortality and the simulated probability that the AMs would result in cod mortality below the Option 2 FY 2015 sub-ACL remains at zero.

Scenario 4 maintains the same AMs as Scenario 3, except the haddock minimum size is reduced from 19" to 17". Projected GOM haddock mortality declines even further under this reduction to 326 mt. The probability that these AMs would keep haddock mortality below the Option 2 FY 2015 recreational sub-ACL is also 99% according to the model simulations. GOM cod mortality on the other hand, under these measures, remains well above the target sub-ACL value of 121 mt.

The remaining scenarios that were analyzed, but not shown here, considered different combinations of 2-month wave openings for GOM haddock in conjunction with 21", 19", and 17" size limits. A zero possession limit for GOM cod was assumed for all model runs. None of the additional model runs had at least a 50% probability of achieving the mortality targets set for under Option 2.

In summary, the AMs analyzed under Scenario 3 and 4 have a high probability of keeping haddock mortality below the Option 2 recreational sub-ACL according to the model. The

median projected haddock mortality is lower under Scenario 3 than Scenario 4 though. In contrast, projected GOM cod mortality is considerably higher than the Option 2 recreational sub-ACL even under a zero possession policy for all of FY 2015. Therefore, in addition to a zero possession limit, further AMs may be warranted to reduce GOM cod mortality in FY 2015.

FY 2015 Model Projection Uncertainty

As with any model, the further removed from prevailing conditions the less certain the projections. The model is based on angler behavior under prevailing conditions and is designed to predict behavioral responses associated with the implementation of different AMs (i.e., increase/decrease in the number of angler trips). However, retention of cod has never been prohibited to the degree assessed in the projections. Thus, there is no way to compare the model's predictions with historical data.

Additionally, although the model predicts aggregate changes in the number of angler trips associated with varying the AMs in FY 2015, it assumes that anglers' trip taking behavior will remain constant. In other words, the model does not consider potential avoidance behavior. If anglers are able to adjust their behavior and move to areas with lower concentrations of GOM cod, discard mortality will be lower than projected.

On the other hand, mortality associated with noncompliance is likely underestimated. The projections assume noncompliance rates derived from available FY 2014 MRIP data will continue in FY 2015. During FY 2014, the possession limit for GOM cod is 9 fish. Only 12% of modeled angler trips that target or catch cod are estimated to be encountering more than 9 fish in FY 2014. That means that 88% of cod angler trips in FY 2014 are estimated to be unaffected by the 9 fish possession limit. This percentage will drop considerably if anglers are prohibited from retaining GOM cod in FY 2015. Under a zero possession limit, all anglers that encounter a GOM cod in FY 2015 will be affected by the prohibition; raising the likelihood that noncompliance will increase.

Lastly, uncertainty associated with the MRIP data, the biological projections, and the underlying behavioral model may affect the FY 2015 mortality projections as well.

Proposed GOM Spawning Closure Areas to Recreational Bottom Fishing

Potential recreational mortality savings from implementation of the proposed GOM cod spawning closure areas (section 4.2.1.2) is not quantifiable. Although the proposed spawning closures would reduce angler effort and therefore mortality, a substantial number of recreational bottom fishing trips that catch cod and/or haddock would likely continue west of 70 degrees W longitude in FY 2015.

The proposed spawning closures encompass the principal recreational bottom fishing locations in the GOM and the majority of the recreational fishing access points in the GOM. As a result, all three state management agencies will likely be unwilling to prohibit recreational fishermen from bottom fishing in their waters. A prohibition on any type of rod and reel recreational fishing

activity has never been adopted by any state fishery management agency in the U.S. to reduce mortality.

Approximately 85-90% of GOM cod and haddock mortality generally occurs in Federal waters though. If anglers only catch GOM cod and haddock in state waters during FY 2015, a mortality reduction would likely occur from the proposed spawning closures. The larger unknown, however, is the level of noncompliance that will occur in federal waters under the spawning closures. Even marginal differences in state and federal regulations increase noncompliance, so an unprecedented change of prohibiting bottom fishing in federal waters, but allowing anglers to continue to bottom fish in state waters, will almost certainly increase noncompliance in federal waters during FY 2015 – thereby reducing the conservation benefit of the spawning closures.

The proposed prohibition on recreational bottom fishing in the closed areas will also generally be unenforceable. Currently, virtually all enforcement of recreational fishing regulations is conducted in state waters by State Law Enforcement Agencies. The United States Coast Guard (USCG) has legal authority to enforce federal recreational fishing laws, but principally only performs safety checks aboard recreational fishing boats in state waters. NOAA's Office of Law Enforcement also has legal authority to enforce federal recreational fishing laws, but their focus is almost exclusively on compliance with commercial fishing regulations. Thus, since enforcement mainly occurs only in state waters, where anglers will most likely be allowed to bottom fish in FY 2015 during the proposed spawning closures, the potential for noncompliance in the closed areas will be high. Some of the noncompliance will be deliberate, but most will likely be from private boat anglers that are simply unaware of the prohibition on bottom fishing. The level of noncompliance associated with the closed areas is impossible to predict, but if it is high the conservation benefit of the closures will be further eroded.

The economic consequences of the rolling closures on the for-hire industry and businesses that support the recreational fishing industry in the GOM would be extensive. Table 4 shows the average annual percent of for-hire landings derived from the spatial and temporal proposed spawning closure areas by species. The averages are based on for-hire VTR landings from 2010 through September, 2014. Landings during the proposed closure areas accounted for approximately ¾ of annual for-hire landings of Atlantic cod, haddock, pollock, white hake, and redfish. Although possession of GOM cod could be prohibited in FY 2015, with or without implementation of the closure areas, catch of the remaining species over the past 5 years is clearly concentrated in the areas and time periods under consideration for closures. This high degree of concentration implies that it will be difficult for for-hire businesses to move to alternative areas that hold bottom fish for their customers.

The sheer size of the proposed spawning closed areas will also make it difficult for for-hire vessels, particularly the larger head boat vessels, to steam up to 60 miles through the closed areas to open water fishing sites. The travel time required to traverse through the closed areas will exceed the total time allotted for the most common type of for-hire trip offered by for-hire businesses in the GOM: 4 or 6 hour fishing trips. Thus, implementation of the proposed spawning closures would likely have a devastating effect on for-hire businesses operating in the GOM.

The impact of the closures on private boat fishing in the GOM is less certain. Spatial data on fishing locations are not available for private boat anglers, so the extent to which private boat anglers fish in the proposed closed areas to bottom fish is unknown. However, since approximately 80-85% of private boat catch of GOM cod and haddock takes place in federal waters, it is likely that the vast majority occurs in the proposed spawning closures. Although the closures would legally exclude private boat anglers from bottom fishing within the closed areas, some level of bottom fishing will likely continue by private boat anglers within the closed areas in FY 2015. Private boat anglers would also still be allowed to use pelagic gear to target bluefish, striped bass, etc. within the proposed closures, thereby exacerbating the enforcement problem. Ultimately, overall private boat fishing effort will likely decline, at least somewhat, if recreational bottom fishing is prohibited in the proposed closed areas. The magnitude of the decline though is unknown.

Businesses that support the recreational fishing industry will also be impacted if recreational fishing effort declines because of the prohibition of bottom fishing in the closed areas. Bait and tackle shops, marinas, boat repair shops, convenience stores, restaurants, hotels, and many other indirectly affected businesses would face revenue declines due to lower angler spending.

Ideas for Different AMs

The primary source of GOM cod recreational fishing mortality in FY 2015, under any of the options being proposed, will be from discards. Approximately 85% of the GOM cod mortality associated with the zero possession limit scenarios is estimated to be discard mortality (see Table 3). The discard mortality rate used in the analysis is 30%, the same rate used in the most recent updated assessment. If measures could be taken that reduce the discard mortality rate to 10% in FY 2015, the simulation model predicts that GOM cod mortality would be lower than the Option 2 recreational sub-ACL of 121 mt (section 4.1.2.2) under both Scenario 3 and 4 shown in Table 3.

The first proposed alternative AM that would help reduce cod discards is simply to increase public awareness of the FY 2015 measures. All saltwater anglers fishing in New England waters are now required to obtain a valid state-issued fishing permit. Name, mailing address, phone number, and email address are requested during sign-up. Information about current regulations could be displayed during on-line sign-ups and distributed to licensing agents across the GOM.

Monthly email blasts could also be sent to new permit holders and/or pamphlets mailed to home addresses showing current regulations in state and federal waters. To date, the permit data base has not been utilized to increase public awareness of management regulations by the three state management agencies responsible for implementing regulations in the GOM or by NMFS.

The largest source of noncompliance by recreational fishermen is likely due to misunderstood regulations. Simple email blasts, etc. sent out to permit holders would almost certainly go a long way towards minimizing noncompliance due to ignorance. This is an inexpensive measure that could have a large effect on reducing cod and haddock mortality in FY 2015, and unlike the proposed spawning closure areas, would likely garner support from all three state management agencies.

Another relatively inexpensive AM that could be implemented during FY 2015 to reduce discard mortality is to require all anglers to use circle hooks for bait rigs and j-hooks for jigs while bottom fishing in the GOM. Circle hooks have a long history of use (reviewed in Cooke and Suski 2004) and have been shown to result in a very high incidence of mouth hook-ups, which translate into higher survival rates of released fish. Since 2008, state and federal regulations in the Gulf of Mexico require all recreational anglers fishing for any reef fish species in the Gulf of Mexico to use circle hooks.

In addition to bait rigs, jigs are often used to bottom fish in the GOM. A switch from treble hooks to j-hooks while jigging could also translate into reduced discard mortality. The vast majority of studies that have investigated the effects of different hook designs on hooking injury and mortality have found that treble hooks resulted in significantly greater mortality than other hook types (for two examples see Ayvazian et al. 2002 and Diodati and Richards 1996).

Some anglers fishing in the GOM have been using circle hooks on bait rigs and j-hooks on jigs for years. Most anglers bottom fishing in the GOM, however, have not made the switch. Again, unlike the proposed measure to prohibit bottom fishing within specified time/area closures, this gear modification would also likely garner support from all three state management agencies.

The final proposed alternative AM that would decrease recreational discard mortality in FY 2015 is to encourage or require anglers to utilize barotrauma descender devices when visible signs of barotrauma are present. When fish are brought up from depth, decreasing pressure allows gas to expand in the swim bladder which may cause injury and prevent the fish from returning to depth under its own power. Visible symptoms of gas expansion include a swollen and tight belly, stomach protruding past the gullet and into the mouth, and distended and/or "crystallized" eyes. Miraculously, studies have shown that many fish can recover from barotrauma if they are properly released to their respective depths as soon as possible (see Jarvis and Lowe 2008 and Hannah and Matteson 2007). Barotrauma descender devices are inexpensive, widely available, and allow for rapid recompression of fish. These devices are utilized widely on the west coast to reduce discard mortality of Pacific rockfish, and are currently being utilized by some for-hire businesses in the GOM.

Given that all for-hire owners are familiar with the symptoms of barotrauma and some are currently using barotrauma descender devices in the GOM to reduce release mortality, this AM could be required aboard for-hire boats in FY 2015 with minimal disruption or added expense. In contrast, many private boat anglers are likely not as familiar with barotrauma or the visible signs of barotrauma so requiring private boat anglers to utilize descender devices is likely not practical in FY 2015 without at least some level of education. Private boat anglers would be encouraged, but not required, to use descender devices at least in early years of implementation.

In combination, or even in isolation, any of the inexpensive and practical AMs presented here would likely have a substantial effect on reducing discard mortality of cod and all other bottom caught fish by recreational fishermen in the GOM. Quantitatively, a decrease in the discard mortality rate of GOM cod from the assumed level of 30% to 10% translates into 117 mt of total GOM cod estimated mortality under Scenario 3 in Table 3 and 116 mt of total GOM cod estimated mortality under Scenario 4 in Table 3. If the discard mortality was reduced as such,

this means that a zero possession limit for GOM cod in combination with a 2-fish possession limit for haddock and minimum fish size of 17-19" during the months of May-Aug, results in estimated FY 2015 cod mortality that is lower than the Option 2 recreational sub-ACL of 121 mt. Model results for these scenarios, assuming a GOM cod discard mortality rate of 10% and a haddock discard mortality rate of 30% are shown in Table 5. Under the conditions shown, the AMs are estimated to have a 60-67% probability of keeping GOM cod recreational mortality below its sub-ACL of 121 mt and a 100% probability of keeping GOM haddock recreational mortality below its sub-ACL of 372 mt.

Although it is impossible to quantify the exact effect of the alternative AMs described in this section on discard mortality, adoption of one or more of the measures would reduce discards and ultimately discard mortality. Model results show that in combination with a zero possession limit, a reduction in the discard mortality rate of GOM cod from 30% to 10% would negate the need for additional time/area closures.

References

Ayvazian SG, Wise BS, Yound GC. 202. Short-term hooking mortality of tailor (*Pomatomus saltatrix*) in Western Australia and the impact on yield per recruit. Fish Res 58(2):241-248.

Cooke SJ, Suski CD. 2004. Are circle hooks effective tools for conserving freshwater and marine recreational catch-and-release fisheries? Fish Manag Ecol. 14:73-79.

Diodati PJ, Richards LA. 1996. Mortality of striped bass hooked and released in salt water. Trans AM Fish Soc 125:300-307.

Hannah RW, Matteson KM. 2007. Behavior of nine species of Pacific rockfish after hook-and-line capture, recompression, and release. Trans Am Fish Soc 136:24-33.

Jarvis ET, Lowe CG. 2008. The effects of barotraumas on the catch-and-release survival of southern California nearshore and shelf rockfish. Can J Fish Aquat Sci 65:1286-1296.

TABLES

Table 1- Evaluation of GOM Cod Mortality Projections.

GOM cod	Actual (mt)	Model (mt)
FY 2013	639	409 (36% lower)
FY 2014	609[a]	422 (31% lower)

[a] Mortality in FY 2014 was estimated from preliminary MRIP data for wave 3 (May-Jun) and wave 4 (July-Aug) and model predictions for wave 5 (Sept-Oct) and wave 2 of 2015 (April 16 – April 30). No mortality was assumed for wave 6 based on historical MRIP data.

Table 2- FY 2014 GOM Cod and Haddock AMs.

Species	Possession Limit	Minimum Size Limit	Season (Open)
GOM cod	9	21"	April 16 – Aug 31
GOM haddock	3	21"	May 1 – Aug 31, Dec 1 – Feb 28

Table 3- FY 2015 Simulation Projections Under Varying Size and Possession AMs.

Scenario	Cod Bag	Haddock Bag	Haddock Min	Haddock Season (Open)	Angler Trips (Median)	% Under Cod ACL (out of 100 trials)	% Under Haddock ACL (out of 100 trials)	Cod Mortality mt (Median)	Haddock Mortality mt (Median)
1	0	3	21	May – Aug	211,982	0	0	280	480
2	0	2	21	May – Aug	210,389	0	0	276	415
3	0	2	19	May – Aug	211,409	0	99	275	357
4	0	2	17	May – Aug	211,946	0	99	274	326

Table 4- Average Annual Percent of For-Hire Landings Derived from the Proposed Spatial and Time Area Closures by Species[a]

Species	Option 2 Proposed GOM Spawning Closure Areas and WGOM
Atlantic cod	75%
Haddock	77%
Pollock	73%
White hake	68%
Redfish	79%
Winter flounder	22%
Yellowtail flounder	12%

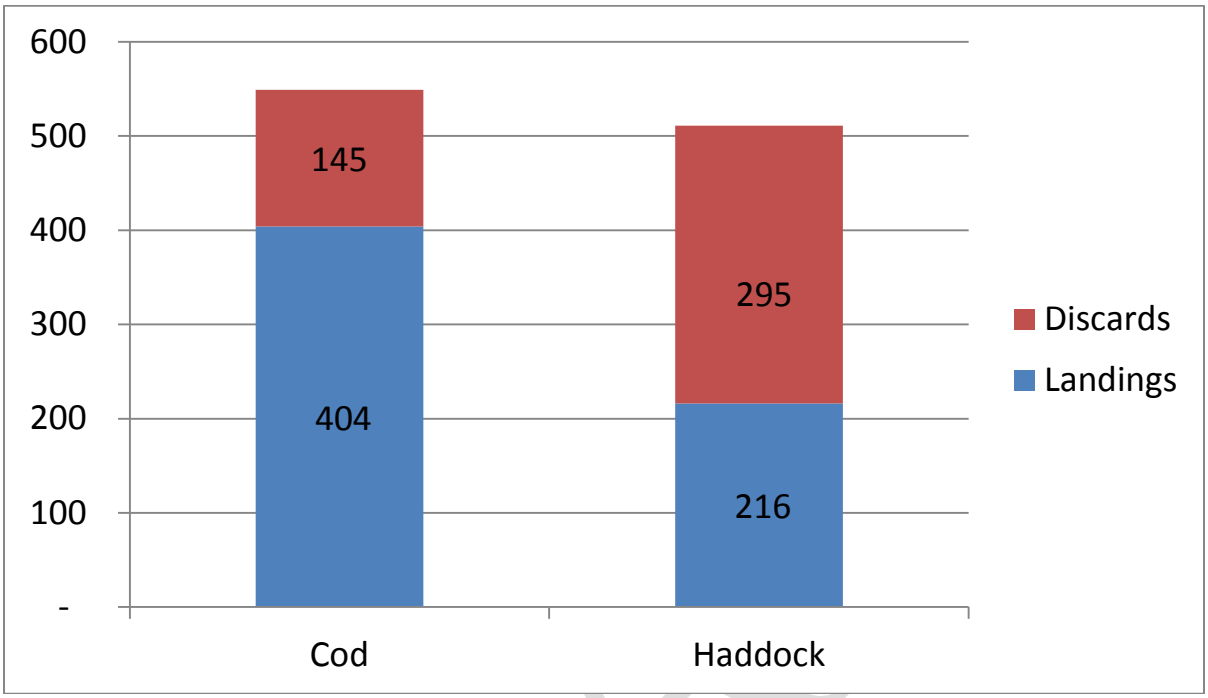
[a] Based on average annual VTR landings (numbers of fish) from 2010-2014

Table 5- FY 2015 Simulation Projections Under Varying Size and Possession AMs (assumes a 10% discard mortality rate for GOM cod and a 30% discard mortality rate for GOM haddock).

Scenario	Cod Bag	Haddock Bag	Haddock Min	Haddock Season (Open)	Angler Trips (Median)	% Under Cod ACL (out of 100 trials)	% Under Haddock ACL (out of 100 trials)	Cod Mortality mt (Median)	Haddock Mortality mt (Median)
1	0	3	19	May – Aug	211,409	60	100	117	301
2	0	2	17	May – Aug	211,946	67	100	116	285

FIGURES

Figure 1- FY 2015 Status Quo Mortality Projections.



Results are based on medians of 100 model runs