## I. Executive Summary and Introduction

### 1. Background

The Northeast Multispecies Fishery Management Plan (FMP) of the New England Fishery Management Council (NEFMC) currently comprises twenty groundfish stocks. Nineteen of the stocks were assessed and peer reviewed in 2008 in the GARM III (NEFSC 2008) and one stock, Atlantic wolffish, was reviewed in the Northeast Data Poor Stocks Working Group (DPSWG 2009a, b). Atlantic wolffish was added to the FMP after GARM III took place.

Of the twenty stocks, five were reassessed during 2010-2012, and therefore were not updated for the current report. These five stocks, which were peer reviewed in the SAW/SARC process, include pollock (NEFSC 2010a, b), three stocks of winter flounder (NEFSC 2011a, b), and Gulf of Maine cod (NEFSC 2012).

In addition to the five stocks mentioned above, two other stocks were not updated for the current report because they are scheduled for assessment and peer review in 2012. They are SNE-MidAtlantic yellowtail flounder (SAW/SARC-54) and GB yellowtail flounder (TRAC).

The current report contains updated assessment information on thirteen groundfish stocks (Table 1) from the Multispecies FMP. All are assessment updates, including a status determination, except for white hake which is a more restricted data update. White hake requires significant analytical work, beyond what can be done in an update, and is currently scheduled for a benchmark assessment in late 2012 (SAW/SARC-55).

Table 1. List of stocks, their previous assessment date and review process.

| Stock Code | Count | Stock | Previously Assessed | Previous Review Process |
|---|---|---|---|---|
| A | 1 | GB cod | 2008 | GARM III |
| B | 2 | GB haddock | 2008 | GARM III |
| C | 3 | GOM haddock | 2008 | GARM III |
| D | 4 | CC-GOM yellowtail flounder | 2008 | GARM III |
| E | 5 | American plaice | 2008 | GARM III |
| F | 6 | witch flounder | 2008 | GARM III |
| G | 7 | Acadian redfish | 2008 | GARM III |
| H | 8 | white hake | 2008 | GARM III |
| I | 9 | GOM-GB windowpane flounder | 2008 | GARM III |
| J | 10 | SNE-MAB windowpane flounder | 2008 | GARM III |
| K | 11 | ocean pout | 2008 | GARM III |
| L | 12 | Atlantic wolffish | 2008 | DPSWG |
| M | 13 | Atlantic halibut | 2008 | GARM III |

## 2. Assessment and Peer Review Process

A new assessment framework is being developed in the Northeast (NE) region for conducting and peer reviewing operational stock assessments more rapidly and at greater frequency. "Operational" assessments are similar to what are commonly called assessment "updates". This was the first time this process was put into practice in the NE region. The process is described in a white paper (see Appendix 1) that was delivered to the Northeast Regional Coordinating Committee (NRCC) on April 6, 2011.The paper was written by a subcommittee of the NRCC known as the ACL Working Group. See Appendix 1for a flow chart that describes the new process.

The flow chart (in Appendix 1) served as a guide for running the 2012 groundfish assessment update and peer review meeting. Some implementation details follow. At the October 2011 meeting of the NRCC, it was agreed that the NE groundfish stocks would be updated and reviewed according to the new process (Step 1 of flow chart). The lead assessment scientist for each stock planned the analysis (Step 2) and presented the work plan to the Assessment Oversight Panel (AOP) at an open meeting on November 22, 2011 (Step 3). The AOP meeting was attended by representatives of the NEFMC Science and Statistical Committee (SSC) and MAFMC SSC (John Boreman, Jake Kritzer, Mike Sissenwine). The operational stock assessments described in this report were conducted between November 2011 and February 2012 (Step 4). An integrated peer review of the assessments took place during a public meeting at the Northeast Fisheries Science Center (NEFSC) in Woods Hole, MA from February 13-17, 2012 (Step 5). External reviewers were selected by the NEFMC from their SSC. One external reviewer was selected from another NOAA fisheries science center located on the Pacific coast. The integrated peer review meeting was co-chaired by the chief of the NEFSC Population Dynamics Branch and by the chair of the NEFSC Stock Assessment Workshop (SAW). Each stock assessment was presented at the open meeting by the lead assessment scientist, discussed by the review panel, and comments and questions were taken from the public. The meeting was open to the public and was also accessible over the telephone and web. On the final day of the meeting, the review panel worked with the lead assessment scientists for each stock to write final conclusions about stock status and to summarize the review panel comments. These were reviewed and approved by the entire panel before the meeting ended. Every session had rapporteurs, and their notes were used throughout the meeting, especially during writing sessions. This report, which includes assessment updates and stock status determinations, is available to fishery managers in the NE region (Steps 6 and 7). Appendices 2-4 contain a list of peer reviewers, a list of meeting attendees, and the meeting agenda.

## 3. Methods

The generic Terms of Reference for the groundfish stock assessment updates were:

1. Update all fishery-dependent data (landings, discards, catch-at-age, etc.) and all fishery-independent data (research survey information) used as inputs in the baseline model or in the last operational assessment.

2. Estimate fishing mortality and stock size for the current year, and update estimates of these parameters in previous years, if these have been revised.

3. Identify and quantify data and model uncertainty that can be considered for setting Acceptable Biological Catch limits.

4. If appropriate, update the values of biological reference points (BRPs).

5. Evaluate stock status with respect to updated status determination criteria.

6. Perform short-term projections; compare results to rebuilding schedules.

7. Comment on whether assessment diagnostics—or the availability of new types of assessment input data—indicate that a new assessment approach is warranted (i.e., referral to the research track).

8. Should the baseline model fail when applied in the operational assessment, provide guidance on how stock status might be evaluated. Should an alternative assessment approach not be readily available, provide guidance on the type of scientific and management advice that can be.

An underlying premise of the assessment updates was to minimize the number of significant changes in methodology that would likely require a more detailed peer review. Slight modifications were necessary depending on the availability of data and model framework. Details on these minor changes are summarized in the individual chapters.

Commercial landings data and discard estimates for 2008 to 2010 were summarized for each stock from appropriate NEFSC databases. All assessments followed the methodologies previously applied in NEFSC (2008).

All recreational landings and discard estimates were obtained from databases developed and maintained by the Marine Recreational Fishing Statistical Survey (MRFSS) program in Silver Spring, MD. The survey methodology for recreational landings data is changing and a new database is being developed under the Marine Recreational Information Program (MRIP). Data from MRIP however, were not used in the groundfish updates because the methodology for converting the historical MRFSS data to MRIP "equivalents" has not been finalized. (A national workshop on the incorporation of MRIP data in stock assessments is planned for late March 2012.) A change in the underlying recreational data for Georges Bank haddock and cod, Gulf of

Maine haddock, and wolffish would have been too large a change to make in this meeting, and merits a more intensive review in a future benchmark assessment.

The NEFSC fall bottom trawl survey indices for 2008-2010 and spring indices for 2008-2011 were included in stock assessments as appropriate. Spring and fall survey indices for the Maine-New Hampshire and Massachusetts Division of Marine Fisheries were updated for 2008 to 2010 and 2011 (spring only). Canadian Department of Fisheries and Oceans survey data for Georges Bank cod and haddock were included in the models for these stocks. All assessments used the same sets of fishery-independent abundance indices as described in GARM III.

New age-length keys for commercial and survey samples were prepared for all age-based assessments except redfish and white hake.

One of the major changes in these assessments was the use of bottom trawl survey data from the relatively new research vessel FSV *Henry B. Bigelow*. All of the NEFSC survey indices for 2009 to 2011 were based on surveys conducted by the *Bigelow*. A large-scale comparative study (Miller et al. 2010) demonstrated that catch rates for the *Bigelow* were generally higher than catch rates for the RV *Albatross IV*, and that there were length specific differences as well. In order to maintain comparability as measures of temporal trend it was necessary to convert survey catches from the *Bigelow* into *Albatross* "equivalents" using either scalar or length-specific adjustment coefficients. The choice was based on recent experience with other stocks for the same species, e.g., Georges Bank yellowtail flounder conversion coefficients were used for Gulf of Maine/Cape Cod yellowtail flounder. For some stocks it was not possible to derive statistically reliable conversion coefficients because of lack of data on those species. For example, no calibration coefficients were estimable for halibut or wolffish. Halibut conversion coefficients were estimated as the average of 4 other flatfish species; wolffish calibration coefficients were assumed to be equal to those of ocean pout, a species with similar body form and habitat.

Owing to its deeper draft, the research survey vessel *Bigelow* cannot sample the same inshore strata as the *Albatross*. This difference was unimportant for all groundfish stocks except Southern New England/Mid-Atlantic Bight windowpane flounder, which is assessed using index methods. For this stock it was necessary to re-estimate all relative fishing mortality rates and survey indices to provide consistency between the assessment and the biological reference points for that stock.

**Modeling Issues**

By design, there were no changes to the underlying assessment models and there were minimal changes in model configuration. All assessment models used the same sets of survey indices as described in GARM III. Previous assessment models that used split survey abundance time series continued to use them for this update and there were no changes to assumed natural mortality rates or assumptions about discard mortality rates. A summary of the model configurations is provided in Table 2.

Table 2. Summary of model configuration, use of retrospective adjustments and stock recruitment relationships for updated groundfish stocks.

| | | | | *Retrospective Pattern Adjustment* | | *Basis for Terminal Year Estimates of:* | | | *Stock Recruitment Model* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Stock Code*** | ***Count*** | ***Stock*** | ***Model*** | ***Split Series?*** | ***Post hoc adjust-ment?*** | ***Bio-mass*** | ***Fish. Mort. Rate*** | ***Re-cruit-ment*** | ***Type*** | ***Fmsy proxy*** | ***Bmsy Proxy*** | ***Recruitment Time series used for BRP estimation*** |
| A | 1 | GB cod | VPA | Yes | No | 2010 | 2010 | 2004-2008 geo mean | Nonparametric (2 stage) | F40%MSP | SSB/R(F40%MSP) | Recruitment from SSB greater than 50,000 mt |
| B | 2 | GB haddock | VPA | No | No | 2010 | 2010 | 2010 | Nonparametric (2 stage) | F40%MSP | SSB/R(F40%MSP) | Recruitment from SSB greater than 75,000 mt. Excluding 1963 and 2003 year classes. |
| C | 3 | GOM haddock | VPA | No | No | 2010 | 2010 | 1977-2010 geo mean | Nonparametric (2 stage) | F40%MSP | SSB/R(F40%MSP) | Recruitment from SSB greater than 3,000 mt |
| D | 4 | GOM CC YT | VPA | No | Yes | 2010 w/ rho adjust-ment | 2010 w/ rho adjust-ment | 1985-2008 geom mean | Nonparametric (single stage) | F40%MSP | SSB/R(F40%MSP) | Recruitment from VPA time series 1977-2008 |
| E | 5 | plaice | VPA | No | Yes | 2010 w/ rho adjust-ment | 2010 w/ rho adjust-ment | 2010 | Nonparametric | F40%MSP | SSB/R(F40%MSP) | Recruitment from VPA time series 1980 to 2008 |
| F | 6 | witch | VPA | Yes | No | 2010 | 2010 | 2006-2010 geom mean | Nonparametric | F40%MSP | SSB/R(F40%MSP) | Recruitment from VPA time series 1982-2009 |
| G | 7 | redfish | ASAP | No | No | 2010 | 2010 | 2004-2008 geo mean | Nonparametric | F50%MSP | SSB/R(F50%MSP) | Recruitment from ASAP time series 1969 to 2010 |
| H | 8 | white hake | (data update only) | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| I | 9 | GOM GB windowpane | Index | NA | NA | 2008-2010 ave. | Rel F(2010) | NA | Visual Interpetation | Rel F at Replacement | External | NA |
| J | 10 | Southern windowpane | Index | NA | NA | 2008-2010 ave. | Rel F(2010) | NA | Visual Interpetation | Rel F at Replacement | External | NA |
| K | 11 | ocean pout | Index | NA | NA | 2009-2011 ave. | Rel F(2010) | NA | Visual Interpetation | Rel F at Replacement | External | NA |
| L | 12 | wolffish | SCALE | NA | NA | 2010 | 2010 | 2010 | Nonparametric | F40%MSP | SSB/R(F40%MSP) | Recruitment from SCALE |
| M | 13 | halibut | Replacement yield | NA | NA | 2010 | Catch/ Biomass (2010) | NA | Implied | F0.1 | Internal | NA |

Retrospective patterns, whereby a particular variable appears to be consistently under- or overestimated, were important for several stocks. The GARM III precedent of splitting survey abundance series to reduce retrospective patterns was followed for the updates of Georges Bank cod and witch flounder   Retrospective patterns were quantified by using a measure known as Mohn's rho. Age-specific measures of Mohn's rho were used to adjust the terminal year abundance estimates for American plaice as in GARM III. The previous assessment of redfish at GARM III used a Mohn's rho adjustment but the retrospective pattern in the current assessment was not significant. Thus, no post hoc adjustment for redfish was made. In contrast the Gulf of Maine/Cape Cod yellowtail flounder stock, which did not have a strong retrospective pattern when last assessed, could not be reduced with a split series approach in this update. As a result, the post hoc Mohn's rho adjustment approach was applied to estimate spawning stock biomass and fishing mortality in 2010.

When spawning stock biomass is consistently overestimated by the model, the use of a split abundance series in the VPA model results in a change in the catchability coefficients and can imply catch efficiencies (q) approaching unity. The change in estimated catchability is an alias for the effects of one or more factors (e.g., missing landings, underestimated discards, increased natural mortality, or true change in catch efficiency) acting individually or collectively to result in overestimation of stock biomass and underestimation of fishing mortality. The GARM III (NEFSC 2008) panel concluded "It is not possible to determine which single factor or combination of factors was responsible for the observed retrospective patterns."

**Revision of Biological Reference Points (BRPs)**

The bases for biological reference points in age-based assessments were not changed. However, the datasets that are used to estimate the biological reference points were updated which resulted in updated estimates of the BRPs. For example, updated five-year average weights at age, age-specific fishery selectivity and maturity at age were incorporated into estimates of yield per recruit (YPR) and spawning stock biomass (SSB/R) for each stock. Recruitment time series were updated with revised estimates for all years up to 2009. In most cases model based estimates of recruitment for 2010 and 2011 were not included in revising the BRP estimates (Table 2). The terminal year estimates of recruitment, as defined in Table 2, were used for estimation of stock size and served as the initial condition for stock projections. One important change from GARM III was that the estimate of recruitment in the terminal year was not always based on the model. Instead, recruitment was estimated as the geometric mean of multiple years. This method was judged to reduce the reliance of projections on the highly uncertain estimates of recruitment in the terminal year plus one.

No changes were made with respect to the bases for estimating cut points for two-stage stock recruitment relationships nor was the time series of recruitment selectively trimmed to reflect perceived trends in recent low recruitment. Such changes, while supported by some recent observations, were thought to be beyond the scope of the update process.

## 4. Results

Measures of stock biomass and fishing mortality were computed for 12 of 13 stocks. A composite snapshot of the overall stock status of these stocks (Fig. 1) reveals seven stocks that are overfished and of these, four experience overfishing. Of the five stocks that exceed ½ of the $B_{MSY}$ proxy, one stock (GOM haddock) is experiencing overfishing.

There were no changes in overfished status between the current results and GARM III. Of the 12 assessed stocks two (Acadian redfish and SNE/MAB windowpane flounder) have exceeded their $B_{MSY}$ proxy targets and are therefore newly rebuilt since GARM III (Table 3). Model-based estimates were not derived for white hake because the stock is currently scheduled for a benchmark assessment in December 2012.

Stock biomasses increased for eight of the 12 stocks between 2007 and 2010. Declines in stock biomass for Georges Bank and Gulf of Maine haddock stocks were expected owing to the reduced influence of the strong 2003 year class to the population. Decreases in biomass for American plaice and ocean pout were 12% and 13% respectively.

Comparisons between estimated stock sizes for 2007 from GARM III with the revised estimate for 2007 from the current update results revealed decreases of 46% for Georges Bank cod, 20% for Georges Bank haddock, 57% for Gulf of Maine/Cape Cod yellowtail flounder, and 21% for witch flounder (Fig. 2). Revised biomass estimates for GOM haddock, American plaice, redfish biomasses exceeded those estimated in 2007 at GARM III. The changes in abundance between assessments for the same calendar year estimate are the result of incorporation of more information into the estimate and reduced uncertainty in the stock biomass.

It is important to note that the "best" estimate of stock biomass is not always the terminal year estimate of the model output. Stock status determination for stocks with post hoc retrospective adjustments (plaice and GOM/CC yellowtail flounder) incorporate the effects of retrospective pattern. Index stocks, which rely heavily on the measurement of relative abundance in surveys, typically use a 3-year average to characterize abundance in the terminal year. Three-year averages are used for GOM/GB windowpane flounder, SNE/MAB windowpane flounder and ocean pout.

Estimates of biomass reference points (Table 3) decreased for 8 of the 12 assessed stocks. Such changes reflect a variety of causal factors including reduced recruitment, changes in average weight, changes in selectivity patterns in fisheries, and delayed maturation. It is not possible to ascribe such changes to a single factor.

Changes in fishing mortality and reference points are summarized in Table 4. All of the fishing mortality reference points are based on $F_{MSY}$ proxy values. Changes in the reference points between GARM III and this update were considered negligible. Determinations of overfishing were consistent between 2008 and 2012 with two exceptions (Table 4 and Fig. 3). Overfishing of GOM haddock was not occurring in 2007 (GARM III) but is occurring in 2010. Conversely, overfishing of SNE/MAB windowpane is no longer occurring in 2010. Overfishing was occurring for five of the 12 assessed groundfish stocks in 2010. For most stocks the trend in fishing mortality is downward but GOM haddock constitutes a notable exception. Eight of the 12 stocks demonstrated reduced fishing mortality rates between 2007 and 2010.

Projections of catches for 2012 by stock at various fishing mortality rates (status quo, $F_{rebuild}$, Fmsy and 75% of Fmsy) were typically lower than the ABCs and ACLs currently specified in Framework 47 (Table 5). The increased biomass of redfish resulted in projected catches higher than ACLs for that stock listed in Framework 47 (NEFMC Groundfish FMP). A similar result occurred for the rebuilt stock of SNE-MAB windowpane flounder. Projected catches of GB cod, GOM haddock, GOM/CC yellowtail flounder, plaice and witch flounder consistent with the current control rule of 75% Fmsy were all lower than the Annual Catch limits now set for 2012.

All catch projections is this update should be considered provisional until the NEFMC SSC has received the final report and the NEFMC Multispecies Groundfish PDT has had the opportunity to update the projections with improved or final estimates of catches in 2011. All of the projections herein are based on the assumption that catches in 2011 were equal to 2010. The presentation of alternative F scenarios in Table 5 illustrates the range of likely catches under previously used candidate F scenarios.

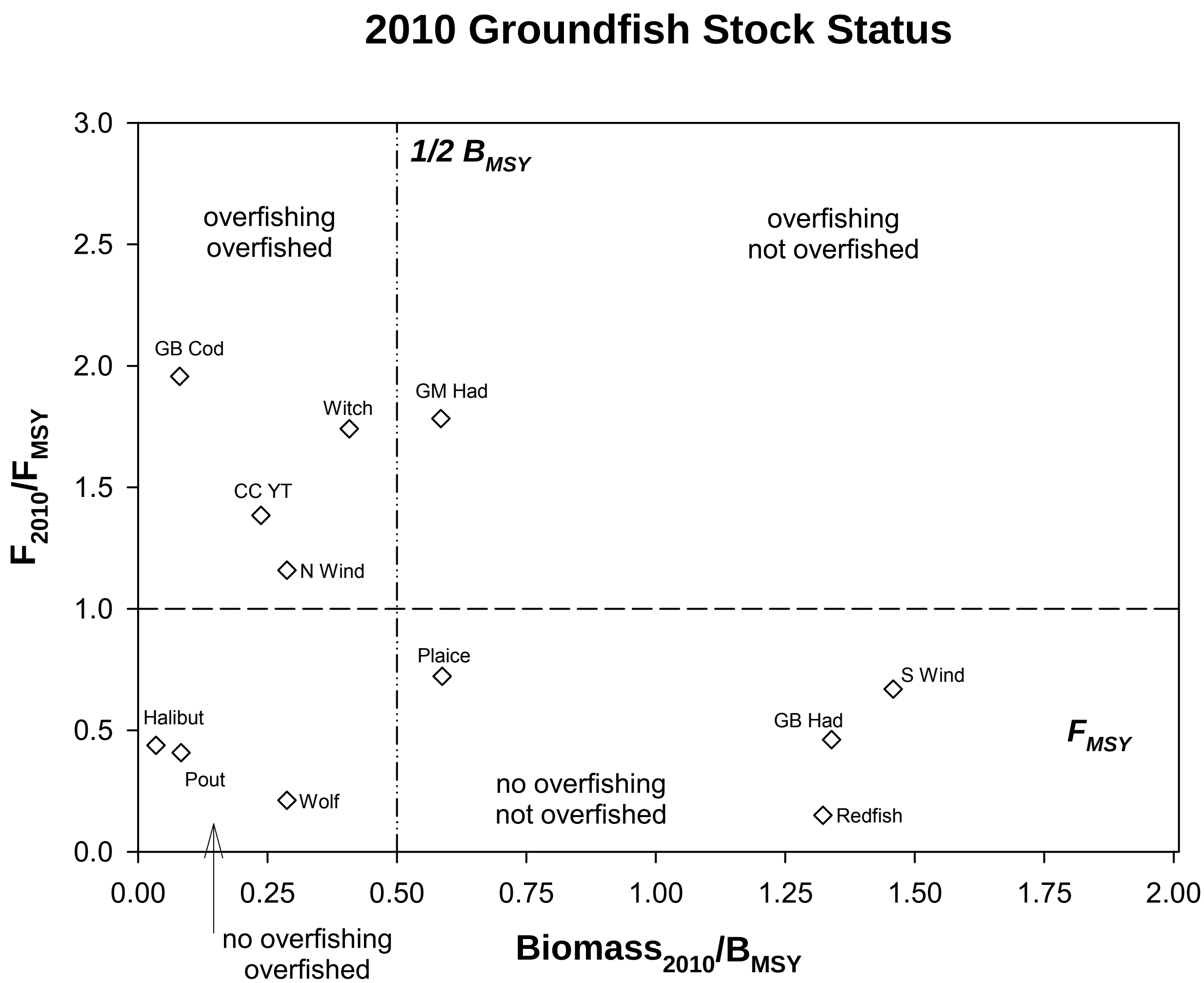



Figure 1. Status of 12 groundfish stocks in 2010 with respect to $F_{MSY}$ and $B_{MSY}$ proxies.

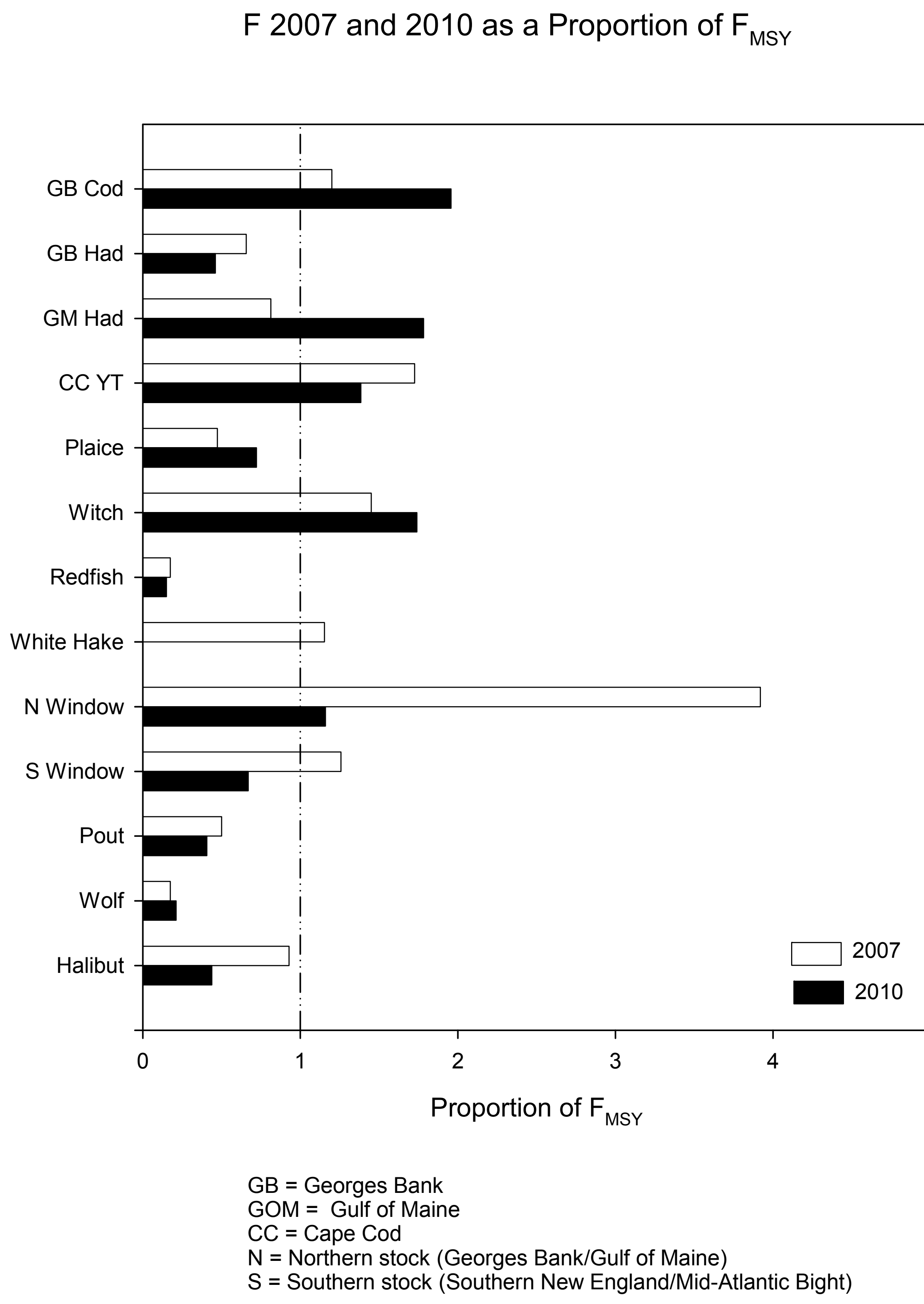
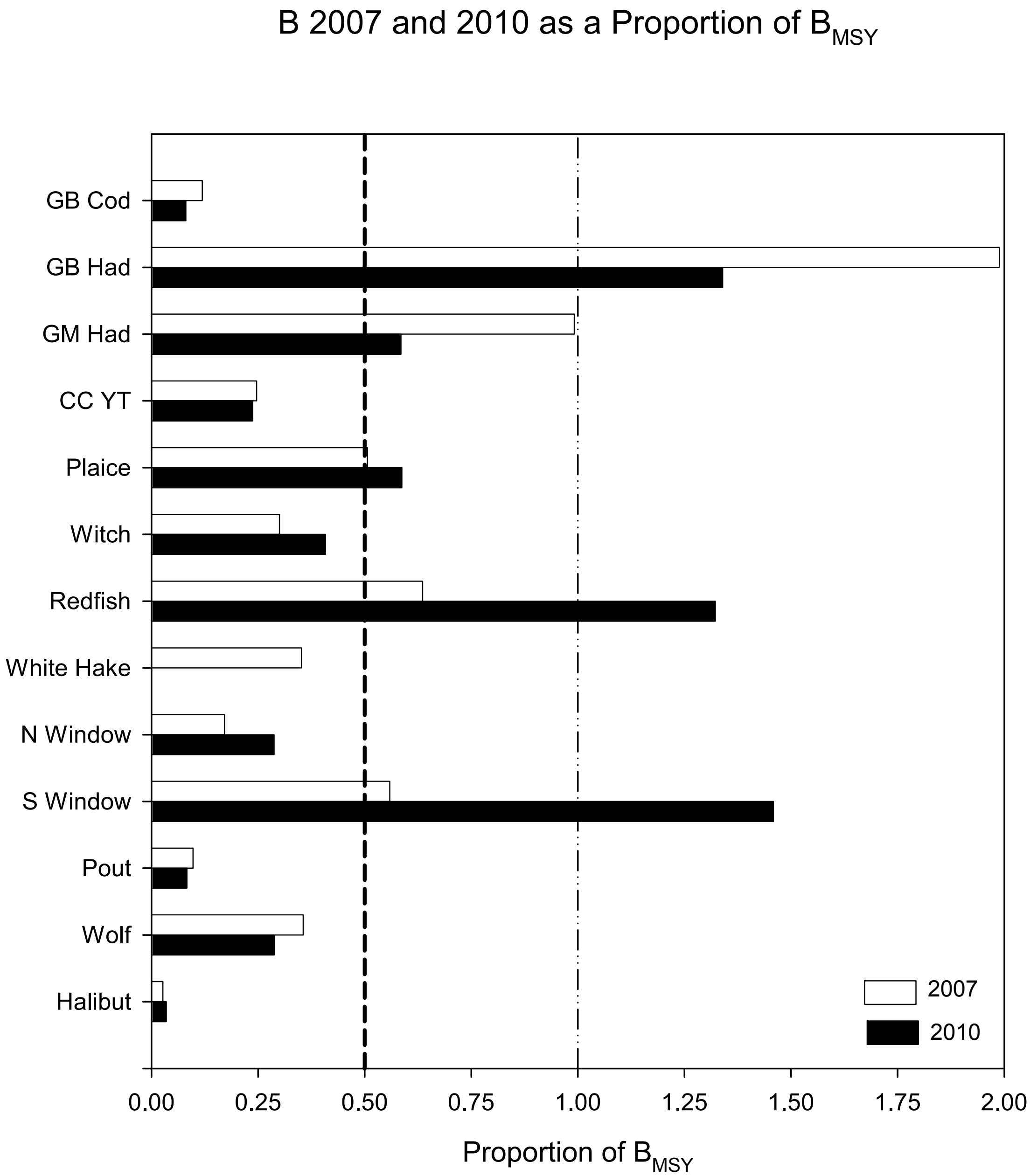



Figure 2. Comparisons between 2007 and 2010 fishing mortality with respect to $F_{MSY}$ proxy based on GARM III and the 2012 Groundfish updates.




GB = Georges Bank
GOM = Gulf of Maine
CC = Cape Cod
N = Northern stock (Georges Bank/Gulf of Maine)
S = Southern stock (Southern New England/Mid-Atlantic Bight)

Figure 3. Comparisons between 2007 and 2010 measures of stock biomass with respect to $B_{MSY}$ proxy based on GARM III and the 2012 Groundfish updates.

Table 3. Stock Status summary for **biomass** and comparisons between GARM III and Groundfish Updates Peer Review, Feb 13-17, 2012, for 13 stocks.

| Stock Code | Count | Stock | Model | [1]Biomass (mt or kg/tow if noted) | | | | | Status | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2012 Update | | | GARM III | | Overfished? | |
| | | | | $B_{msy\ proxy}$ | $B_{2010}$ | $B_{2007}$ | $B_{msy\ proxy}$ | $B_{2007}$ | [2]GARM III | 2012 Update |
| A | 1 | GB cod | VPA | 140,424 | 11,289 | 9,494 | 148,084 | 17,672 | YES | YES |
| B | 2 | GB haddock | VPA | 124,900 | 167,279 | 252,065 | 158,873 | 315,975 | NO | NO |
| C | 3 | GOM haddock | VPA | 4,904 | 2,868 | 6,796 | 5,900 | 5,850 | NO | NO |
| D | 4 | CC GOM YT flounder | VPA | 7,080 | 1,680 | 824 | 7,790 | 1,922 | YES | YES |
| E | 5 | American plaice | VPA | 18,398 | 10,805 | 12,271 | 21,940 | 11,106 | NO | NO |
| F | 6 | witch flounder | VPA | 10,051 | 4,099 | 2,710 | 11,447 | 3,434 | YES | YES |
| G | 7 | Acadian redfish | SCAA | 238,000 | 314,780 | 241,090 | 271,000 | 172,342 | NO | NO |
| H | 8 | white hake | (data update) | -- | -- | -- | 56,254 | 19,800 | YES | -- |
| I | 9 | GOM GB windowpane | Index | 1.60 kg/tow | 0.46 kg/tow | 0.242 kg/tow | 1.40 kg/tow | 0.24 kg/tow | YES | YES |
| J | 10 | SNE MAB windowpane | Index | 0.24 kg/tow | 0.35 kg/tow | 0.19 kg/tow | 0.34 kg/tow | 0.19 kg/tow | NO | NO |
| K | 11 | ocean pout | Index | 4.94 kg/tow | 0.41 kg/tow | 0.47 kg/tow | 4.94 kg/tow | 0.48 kg/tow | YES | YES |
| L | 12 | Atlantic wolffish[2] | SCALE | 1,756 | 505 | 490 | 2184 - 2202 | 562 - 998 | YES | YES |
| M | 13 | Atlantic halibut | Replacement yield | 49,000 | 1,700 | 1,320 | 49,000 | 1,300 | YES | YES |

Table 4. Stock Status summary for **fishing mortality** and comparisons between GARM III and Groundfish Updates Peer Review, Feb , 2012, for 13 stocks.

| Stock Code | Count | Stock | Model | Fishing mortality (instaneous rates or 000 mt landings per survey kg/tow) | | | | | Status | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2012 Update | | | GARM III | | Overfishing? | |
| | | | | $F_{msy\ proxy}$ | $F_{2010}$ | $F_{2007}$ | $F_{msy\ proxy}$ | $F_{2007}$ | [2]GARM III | 2012 |
| A | 1 | GB cod | VPA | 0.23 | 0.45 | 0.88 | 0.25 | 0.3 | YES | YES |
| B | 2 | GB haddock | VPA | 0.39 | 0.18 | 0.19 | 0.35 | 0.23 | NO | NO |
| C | 3 | GOM haddock | VPA | 0.46 | 0.82 | 0.23 | 0.43 | 0.35 | NO | YES |
| D | 4 | CC GOM YT flounder | VPA | 0.26 | 0.36 | 1.02 | 0.24 | 0.414 | YES | YES |
| E | 5 | American plaice | VPA | 0.18 | 0.13 | 0.08 | 0.19 | 0.09 | NO | NO |
| F | 6 | witch flounder | VPA | 0.27 | 0.47 | 0.52 | 0.2 | 0.29 | YES | YES |
| G | 7 | Acadian redfish | SCAA | 0.04 | 0.006 | 0.0049 | 0.04 | 0.007 | NO | NO |
| H | 8 | white hake | (data update) | -- | -- | -- | 0.13 | 0.15 | YES | -- |
| I | 9 | GOM GB windowpane | Index[3] | 0.44 | 0.51 | 2.082 | 0.5 | 1.96 | YES | YES |
| J | 10 | SNE MAB windowpane | Index[3] | 2.09 | 1.4 | 1.82 | 1.47 | 1.85 | YES | NO |
| K | 11 | ocean pout | Index[3] | 0.76 | 0.31 | 0.35 | 0.76 | 0.38 | NO | NO |
| L | 12 | Atlantic wolffish[2] | SCALE | 0.33 | 0.07 | 0.33 | .13 - .32 | 0.158 | UNK | NO |
| M | 13 | Atlantic halibut | Replacement yield[4] | 0.073 | 0.032 | 0.062 | 0.07 | 0.065 | NO | NO |

[1] Column is labelled "Biomass", but for many stocks this refers to spawning stock biomass (SSB). See individual stock chapters.

[2] Wolffish was reviewed in the DPSWG (2009a,b), and not in GARM III (NEFSC 2008)

[3] For Index stocks, this is a relative F based on catch over an abundance index; units= kt/kg/tow

[4]Fishng mortality is approximated as total catch (mt) divided by stock biomass (mt)

Table 5. OFL, ABC and ACL for 2012 by stock, with provisional projected catch in 2012 (mt) under different F scenarios. Projected catches in 2012 assume that 2011 catches equal those in 2010. Estimates may be updated for management purposes. MSY estimates are listed from the 2012 Assessment Updates as well as from GARM III.

| | | NEFMC SSC Recommendations | | Framework 47 | Projected catch (mt) for 2012 based on 2012 update | | | | MSY | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Stock Code** | **Stock** | [1]OFL (mt) | [1]ABC (mt) | [2]ACL (mt) | Fmsy proxy | 75% Fmsy proxy | Frebuild | F status quo | 2012 Update | GARM III |
| A | GB cod | 7,311 | 5,616 | 4,861 | -- | 2787 | 1566 | 6651 | 28,774 | 31,159 |
| B | GB haddock | 51,150 | 39,846 | 29,260 | 45,600 | -- | -- | -- | 28,000 | 32,746 |
| C | GOM haddock | 1,296 | 1,013 | 958 | 327 | 258 | -- | -- | 1,177 | 1,360 |
| D | CC-GOM yellowtail flounder | 1,508 | 1,159 | 1,104 | 723 | 558 | | 796 | 1,600 | 1,720 |
| E | American plaice | 4,727 | 3,632 | 3,459 | -- | 1636 | 0 | 1075 | 3,385 | 4,011 |
| F | witch flounder | 2,141 | 1,639 | 1,563 | 1,207 | 919 | 854 | -- | 2,075 | 2,352 |
| G | Acadian redfish | 12,036 | 9,224 | 8,786 | 13,654 | 10,286 | -- | 2,196 | 8,891 | 10,139 |
| H | white hake | 5,306 | 3,638 | 3,465 | -- | -- | -- | -- | -- | 5,800 |
| I | GOM-GB windowpane flounder | 230 | 173 | 163 | 201 | -- | -- | -- | 700 | 700 |
| J | SNE-MAB windowpane flounder | 515 | 386 | 381 | 729 | 752 | -- | -- | 500 | 500 |
| K | ocean pout | 342 | 256 | 240 | -- | -- | -- | -- | 3,754 | 3,754 |
| L | Atlantic wolffish | 92 | 83 | 77 | -- | -- | -- | -- | 261 | NA |
| M | Atlantic halibut | 143 | 85 | 83 | -- | -- | 91 | -- | 3,500 | 3,500 |

**[1]OFL and ABC values are from Science and Statistical Committee memo (page 4) to Paul Howard, for Sept. 26-29, 2011 NEFMC meeting.**

**[2]2012 ACL values are from Draft Framework Adjustment-47 to the NEFMC Groundfish FMP, Table 10, dated 11/14/11.**

**"--" = not computed**

## 5. Sources of Uncertainty

Sources of uncertainty were identified for each assessment update (see individual chapters for details). Some of these include (Table 6):

- changes in weights at age, or questions about other life history parameters,
- estimates of catch that depend on available or estimated historical data, and/or assumed discard mortality rate,
- which years in the recruitment time series to include in projections,
- whether the research surveys are representative of stock size/abundance,
- importance of the conversion to a new research survey vessel in 2009,
- retrospective patterns in the VPA model output.

Another source of uncertainty is the ability to accurately project stock size for alternative harvesting scenarios. Appendix 5 compares projected catches and stock sizes from GARM III with the stock assessment updates herein. The Groundfish PDT used updated estimates of catches to project stock size and fishing mortality using the initial stock sizes from GARM III. In general, projected stock sizes exceeded realized values. Resulting fishing mortality estimates associated with recommended catches generally exceeded the projected confidence interval of fishing mortality from GARM III.

Much research has already been done to try to understand causes of retrospective patterns (NEFSC 2008, Legault 2009). There was discussion during the peer review meeting about potential new directions for research related to retrospective patterns. Ideas included performing retrospective analyses to determine how applying retrospective adjustments have (or would have) impacted the probability of overfishing through time. Another idea was to see if there are observable properties in the retrospective patterns that might allow distinction between transient and long-lasting retrospective patterns. There was general consensus that major advances in improving fisheries management advice in the face of retrospective patterns would likely involve extensive simulation testing.

Two research recommendations, applicable to several stocks were suggested: 1) explore the possibility of refining the calibration factors within the assessment model itself (e.g, splitting the survey tuning series and using the results from the calibration experiment as a prior); and 2) continue to examine the trends in mean weights at age and their possible underlying factors.

Table 6. Sources of uncertainty in 2012 assessment updates, by stock. (The white hake row is not filled because the assessment was not updated.)

| Stock Code | Stock | Life history | M | Catch data and assumed discard mortality | Historical discards | Survey as tuning index of abundance | Survey selectivity | Bigelow Conversion factor | Low productivity depite low catches | Abundance estimate of of recent year class | Cause of Population Decrease | Projections (Weights at age, or years to include for average recruitment | Retrospective Pattern |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | GB cod | x | | x | x | | | | | | | x | x |
| B | GB haddock | x | | | | | | | | x | | x | |
| C | GOM haddock | | | x | | | | | | | | x | |
| D | CC-GOM yellowtail flounder | | | | | | | x | | | | x | x |
| E | American plaice | | | x | x | | x | | | | | x | x |
| F | witch flounder | x | | x | | x | | | | | | | x |
| G | Acadian redfish | | | | | | x | | | | | | |
| H | white hake | | | | | | | | | | | | |
| I | GOM-GB window. flounder | | | x | | | | | | | | | |
| J | SNE-MAB window. flounder | | | | | | | x | | | | | |
| K | ocean pout | | | | | | | | x | | x | | |
| L | Atlantic wolffish | x | | | | x | | x | | | | | |
| M | Atlantic halibut | x | x | x | | x | | | | | | | |

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