# Economic Impacts of Measures Considered in NEMS Framework 53

By

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### *Introduction*

Framework 53 proposes several primary categories of measures including (a) No Action and Modifications to Annual Catch Limits (ACLs) for Fishing Year (FY) 2015; (b) two Closure Options to protect Gulf of Maine (GOM) cod spawning aggregations; and (c) Prohibition on possessing GOM cod.

All of these measures and their sub-options are inter-related and, other than the No Action options, the impacts of each must be analyzed together. There are seven possible combinations:

1. No Action ACLs
2. Modified (FW53) ACLs with no closures and existing GOM cod retention requirements
3. FW53 ACLs with spawning closures Option A and existing GOM cod retention requirements
4. FW53 ACLs with spawning closures Option B and existing GOM cod retention requirements
5. FW53 ACLs with no closures and zero retention of GOM cod
6. FW53 ACLs with spawning closures Option A and zero retention of GOM cod
7. FW53 ACLs with spawning closures Option B and zero retention of GOM cod

The Framework proposes allowing only vessels carrying an observer to fish in multiple broad stock areas if fishing in the GOM stock area at all. This measure is intended to improve catch accounting by documenting the proportions of catch from different stock areas within a trip. The provision for allowing a waiver for trips carrying an observer is intended to enhance flexibility and profitability when an observer is allocated to that trip. The benefits of accurate catch accounting and enhanced data quality are difficult to over-state—the ACL system relies on accurate catch information for assessment and Allowable Biological Catch setting and the costs of getting either of these wrong are bounded only by the sum of all benefits derived from the fishery. The costs of restricting non-observed trips to one side or the other of 70 deg 15 min West latitude include potentially increased steaming time and search costs.

Additional measures including revised Status Determination Criteria for Georges Bank (GB) yellowtail flounder, potential implementation of common pool and sector sub-ACLs for the two windowpane flounder stocks, a separate northern windowpane flounder sub-ACL for the scallop fishery, a rollover provision for sub-ACLs in years when measures are not enacted before the beginning of the FY, and a modification of sector carry-over provisions are not expected to have significant direct economic consequences over the time period of this analysis.

Impacts of the proposed measures on recreational fisheries are discussed in separate correspondence.

### *Methods*

The Quota Change Model (QCM) is used to analyze the impacts of each combination of measures on the Sector portion of the groundfish fishery, which comprises over 98% of the groundfish landings and revenues. The QCM is a Monte Carlo simulation model that selects from existing records the most likely trips to take place under new regulatory conditions. To do this a large pool of actual trips is created from a reference data set. The composition of this pool is conditioned on each trip's utilization of allocated ACE, under the assumption that the most likely trips to take place in the FY being analyzed are those fishing efficiently under the new regulatory requirements. The more efficiently a trip used its ACE, the more likely that trip is to be drawn into the sample pool. ACE efficiency is determined by the ratio of ACE expended to net revenues on a trip, iterated over each of the 17 allocated stocks. Net revenues are calculated as gross revenues minus trip costs minus quota opportunity costs, where trip costs are based on observer data and quota opportunity costs are estimated from an inter-sector lease value model, based here on FY 2013 (details on the methods can be found in Murphy et al. 2013). After the sample pool has been constructed, trips are pulled from the pool at random, summing the ACE expended for the 17 allocated stocks as each trip is drawn. When one stock's ACE reaches the Sector sub-ACL limit, no further trips from that broad stock area are selected. The model continues selecting trips until Sector sub-ACLs are achieved in all three broad stock areas or, alternatively, if sub-ACLs are reached for one of the unit stocks the trip selection process ends for all broad stock areas at once. This selection process forms a "synthetic fishing year" and a number of years are drawn to form a model. Median values and confidence intervals for all draws in a model are reported.

By running simulations based on actual fishing trips, the model implicitly assumes that:

- stock conditions, fishing practices and harvest technologies existing during the data period are representative;
- trips are repeatable;
- demand for groundfish is constant, noting that fish prices do vary between the reference population and the sample population but this variability is consistent with the underlying price/quantity relationship observed during the reference period;
- quota opportunity costs and operating costs are both constant; and,
- ACE flows seamlessly from lesser to lessee such that fishery-wide caps can be met without leaving ACE for constraining stocks stranded.

These assumptions will surely not hold—fisherman will continue to develop their technology and fishing practices to increase their efficiency, market conditions will induce additional behavior changes, and fishery stock conditions are highly dynamic. Fuel and other operating costs may change due to larger economic shifts or shoreside industry consolidation. Demand for quota lease may drop as a result of time/area closures and/or zero retention policies, but the substantial decline in GOM cod quota supply will likely outweigh the impact of these forces and, at least, GOM cod lease values will almost certainly rise.

The net effect of the constraints placed by these assumptions is unclear. The selection algorithm draws only efficient trips—fisherman making relatively inefficient trips will bias the model results high. Fisherman, however, are for the most part quite good at their job and, through a combination of technological improvement (gear rigging, equipment upgrades, etc.) or behavioral modifications, are likely to improve on their ability to avoid constraining stocks This will bias the model results low.

Additionally, the model will in general under-predict true landings and/or revenues if stock conditions for non-constraining stocks improve, if demand for groundfish rises, or if fishing practices change and fisherman become still more efficient at maximizing the value of their ACE. Conversely, the model will over-predict true landings and/or revenues if stock conditions of non-constraining stocks decline, markets deteriorate or fishing costs increase. Importantly, the model will over-predict landings if stock conditions for constraining stocks improve substantially and/or fisherman are unable to avoid the stock--in this circumstance, better than expected stock conditions will lead to worse than anticipated fishery performance. The opposite is also true—if a stock predicted to be constraining to the fishery becomes easier to avoid due to technological or behavioral improvements in targeting, or due to declining stock conditions, the model will under-predict revenues.

The model is intended to capture fishery-wide behavioral changes with respect to groundfish sub-ACL changes and it is catch of groundfish that is maximized by the constrained optimization algorithm. Catch of non-groundfish stocks on groundfish trips are captured in the model but not explicitly modeled, such that constraints on other fisheries are not incorporated.

To model the impacts of the proposed measures, several changes to standard QCM methods were made. Time/area closures were accommodated by removing from the sample pool of available trips all trips that occurred inside closure areas during closed months. Zero retention is modeled by converting all kept cod to discards, and the associated revenues are deducted from each trip's revenue. This changes the relative efficiency of trips, and the consequent probability that a trip will be drawn into a synthetic fishing year during model runs. In this respect the behavioral changes associated with both time/area closures (i.e. the need to fish in other areas or other times) and zero retention (i.e. the reduced incentive to fish in areas of the Gulf of Maine where cod are likely to be present in significant abundance) are directly incorporated in the model results.

That said, the true impacts of zero retention policies are difficult to model. Such policies in a fishery with less than 100% catch monitoring incentivize fishing significantly differently when an observer is present. The incentive is even stronger when, as in this case, the stock is allocated and discards are the likely constraint on fishing in the broad stock area.

If observed GOM cod discard rates can be brought below the rate that would be profitable when all trips are observed, nominal GOM cod catch is reduced by that amount and, assuming GOM cod is constraining, additional fishing can then take place. Further, and more insidious, unobserved trips are free to fish as profitably as possible with no additional GOM cod ACE constraint. The net effect is both substantially higher aggregate fishery revenues, and the potential for substantial unaccounted for fishing mortality. This situation is addressed in slightly more detail in the *Discussion* section.

A last modification of the model was made to increase the likelihood, however slightly, that inefficient trips may happen. Between 1-2% of trips drawn into this version of the model would, under previous versions of the QCM, not have been drawn. This accommodation is made in deference to the possibility that an unknown number of trips may encounter unforeseen and unplanned levels of constraining stocks, primarily GOM cod. The inclusion of this modification decreases predicted aggregate fishery revenues, but this decrease is deemed appropriate given the very low allocation of GOM cod.

Groundfish vessels on groundfish trips form the unit of measurement for this analysis and gross revenues from groundfish trips and from groundfish species alone are reported metrics. Many groundfish fisherman are involved in other fisheries in addition to groundfish fishing and groundfish trip revenues may represent anywhere from 100% to a small fraction of the total revenues of individual fishing business impacted by these regulations.

The QCM is a prediction model and understanding how well it predicts may be of interest. The model was developed during FY2011 to make predictions for FW48 (FY 2012) and has been used in analyzing the impacts of all subsequent groundfish management actions that included ACL changes for the groundfish fishery. Table 1, below, summarizes its performance over the past few years.

We can glean some lessons from this table. First, model results are highly sensitive to stock conditions. For example, the model over-predicted FY 2011 by about 20% and this was almost exclusively attributed to GB haddock catch rates being higher in the reference year (FY10) than the prediction year (FY11). Back out GB haddock, and gross revenues for groundfish are over-predicted by only about 5%.

The longer the lag between the reference year and the prediction year, the more likely stock conditions are to diverge, compromising prediction accuracy. In FY 2012 and 2013 the model handled quota reductions well, over-predicting slightly in 2012 and under-predicting slightly in 2013. Stock conditions for non-constraining stocks appear to be improving for FY 2014, as both the original FW51 and subsequent models using FY 2013 input data both appear to be biased low relative to an FY14 linear catch trajectory, although given interim management measures the linear projection certainly over-estimates FY14 revenues. Nonetheless, revenues for FY 2014 will likely be higher that FY 13, and higher than those previously predicted. This is primarily driven by improved stock and fishery conditions for offshore stocks such as GB haddock and redfish.

Cost predictions are less straightforward. The QCM demonstrates a persistent low bias when predicting operations costs—those associated with making a fishing trip, such as fuel, ice and food. This is a result of the model optimizing the trips taking place in the prediction year. What we see in reality is that the model predicts total catches and revenues somewhat accurately, but arrives at these totals from a substantially lower number of trips than, in reality, it takes to obtain those catches—the model predicts on the order of 30% fewer trips than are realized. The low cost prediction bias will likely be consistent across time and year-on-year trends may prove meaningful (or, of course, they may not, and only time will tell). Between FY12 and FY13 the model predicted a six percentage point increase in operational profit (gross revenues as a percent of variable costs). This six percentage point increase emerged from the realized data as well. One year does not a trend make, but the model predicts a substantial decrease in operational profit between FY13-14. Such a decrease would be consistent with longer steaming times for inshore vessels due to interim 2014 measures, but may be somewhat mitigated by increased fishing opportunities offshore for larger vessels. These trips will have lower quota opportunity costs (the cost of using a pound of ACE, whether leased in or not leased out) as stocks like GB haddock and redfish have low ACE lease values.

*Table 1 – QCM predictions, FY2011 – 2014 (2014 $ millions)*

| | | FY2010 | FY2011^ Model calibration | | FY2012 FW 47 (modified) | | FY2013 FW 48 | | FY2014 FW 51 | | FY2014 GOM had/cod EA^^ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Realized | Predicted* | Realized | Predicted** | Realized | Predicted*** | Realized | Predicted*** | Realized | Predicted**** | Projected^^^ |
| **Revenues** | **Gross revenue** | 110.2 | 137.8 | 121.4 | 92.3 | 93.1 | 75.5 | 79.2 | 71.0 | n/a | 81.0 | 90.0 |
| | ***Gross groundfish revenue*** | *89.1* | *114.4* | *93.7* | *73.5* | *70.4* | *57.0* | *58.6* | *55.6* | *n/a* | *64.3* | *70.5* |
| **Costs** | **Operations cost** | 25.1 | 30.4 | 32.9 | 17.8 | 31.5 | 15.0 | 26.1 | 21.6 | n/a | 24.3 | n/a |
| | **Quota opportunity cost** | 21.0 | 29.4 | 28.4 | 21.4 | 17.6 | 12.4 | 11.3 | 12.0 | n/a | 12.0 | n/a |
| | **Sector cost** | 2.5 | 3.3 | 2.7 | 1.9 | 2.0 | 1.8 | 1.8 | 1.6 | n/a | 1.7 | n/a |
| *Pct gross revenues net of variable costs* | | *56%* | *54%* | *47%* | *55%* | *45%* | *61%* | *51%* | *50%* | | *53%* | |

**All estimates based on FY 2010-2013 DMIS data**

**Values reported in millions, 2014 dollars**

^ FY2011 revenues from GB haddock were predicted at $25.2 million. Realized revenues from GB haddock were $11.7 million

Gross groundfish revenues less GB haddock were predicted at $82.7mil and realized $76.7mil

* Reference pool = FY 2010

** Refence pool = FY 2010-11 (last six months FY10, first six months FY11)

*** Reference pool = FY2012

**** Reference pool = FY2013

^^ Based on updated GOM haddock ACL and GOM cod interim measures

^^^Linear projection from Oct 23, 2014

### *Data*

Data Management and Imputation System (DMIS) data are used throughout. DMIS derives sub-trip/stock level landings and discards from Vessel, Dealer and Observer reports as well as the Sector and Permit databases maintained by NMFS GARFO and NEFSC.

### *Results*

The No Action sub-ACL option specifies no sub-ACL for pollock. Under this scenario, vessels enrolled in sectors would not be permitted to fish for groundfish. Similarly, the common pool would not be able to operate and there would be no directed groundfish fishery. As this option is inconsistent with several Magnusson-Stevens Act (MSA) provisions, a more likely outcome would be additional interim measures proposed by the Greater Atlantic Regional Office (GARFO). This option is unlikely and was not given additional consideration.

For the six remaining proposed measures permutations, gross revenues on groundfish trips are predicted to decline by roughly 5-10% from an FY14 baseline of $81 million (Table 2). Gross revenues are predicted to be about $1.5mil higher under closure Option A than the FW 53 ACL option alone. Closure option B is predicted to realize about $500k less in gross revenues than option A. Zero retention options have non-linear impacts across the closure options. Under the FW 53 ACLs with no additional closures, the predicted cost of zero retention alone is on the order of $250K. Closure A with zero retention is predicted to have about $1.5 mil higher revenues than zero retention without the closures. Closure B, however, is predicted to have only $200k less aggregate benefit than the Closure A option.

In FY14 under the interim measures, American plaice and witch flounder are predicted to be the most constraining stocks, with pollock contributing more revenues than any other stock (note that mid-FY14 projections indicate that GB haddock and not pollock will likely be the highest-grossing stock in the groundfish complex) (Table 4-Table 9). Under all six FW 53 permutations, constraining stocks are predicted to be GB winter flounder, Southern New England (SNE) yellowtail flounder and GOM cod. Under the Closure options (both for zero and full GOM cod retention) catch of redfish, plaice, witch flounder and white hake are higher than under options with no additional closures.

Losses relative to the FY14 baseline are not distributed evenly across the fleet (Table 10, Table 11). Gloucester and other coastal Massachusetts towns on the North and South shore of Boston, all ports in New Hampshire and the ports of Southern Maine are predicted to see disproportionate declines on the order of 20-55% from the FY14 baseline. Boston, MA and Portland, ME are predicted to experience smaller declines of 5-15%, while ports farther south such as New Bedford, MA and Point Judith, RI may actually see additional revenues under all proposed scenarios due either to additional fishing opportunities or vessels relocating to these ports in search of profits.

Similar to the port-level impacts, these measures are predicted to disproportionately affect smaller vessels (Table 12, Table 13). Vessels in the 30’-50’ size class are predicted to see 30-60% declines in gross revenues fleet-wide, while vessels in the 50’-75’ size class are predicted to see a more modest 10-15% reduction. Vessels 75’ and larger are predicted to see very slight gains, particularly under options with additional GOM cod spawning closures.

*Table 2 – Summary of median predicted gross revenues for seven models ($, millions, median values with 5th and 9th percentile confidence intervals from 500 simulations)*

| Model | All groundfish trips, gross Revenues | p5 Revenues | p95 Revenues | All groundfish, gross Revenues | p5 Revenues | p95 Revenues | % Change from FY14 - Groundfish trips | % Change from FY14 - Groundfish |
|---|---|---|---|---|---|---|---|---|
| **FY14 Baseline** | 81.0 | 77.8 | 84.0 | 64.6 | 61.9 | 67.2 | | |
| **FW 53 ACLs** | 75.3 | 71.1 | 79.4 | 58.2 | 54.6 | 61.5 | -7% | -10% |
| **FW 53 ACLs + Closure A** | 76.9 | 72.6 | 80.4 | 59.6 | 56.1 | 62.6 | -5% | -8% |
| **FW 53 ACLs + Closure B** | 76.1 | 71.8 | 80.0 | 58.9 | 55.4 | 62.1 | -6% | -9% |
| **FW 53 ACLs + Zero retention GOM cod** | 75.2 | 71.0 | 79.1 | 58.2 | 54.9 | 61.5 | -7% | -10% |
| **FW 53 ACLs + Zero retention GOM cod + Closure A** | 76.8 | 72.9 | 80.1 | 59.4 | 56.1 | 62.1 | -5% | -8% |
| **FW 53 ACLs + Zero retention GOM cod + Closure B** | 76.6 | 72.5 | 80.3 | 59.3 | 56.0 | 62.5 | -5% | -8% |

*Table 3 –FY14 Baseline, predicted stock level catch, utilization and revenues*

| | Sub-ACL | Catch | Utilization | Revenue | p5 Revenue | p95 Revenue |
|---|---|---|---|---|---|---|
| Pollock | 13,138 | 4,793 | 36% | 10.9 | 10.2 | 11.5 |
| GB Winter Flounder | 3,364 | 1,587 | 47% | 6.0 | 5.4 | 6.9 |
| GB Haddock West | 18,666 | 4,208 | 23% | 10.7 | 9.8 | 11.8 |
| GB Cod West | 1,584 | 1,482 | 94% | 5.6 | 5.3 | 6.0 |
| White Hake | 4,308 | 1,964 | 46% | 5.8 | 5.5 | 6.1 |
| Plaice | 1,359 | 1,329 | 98% | 4.6 | 4.3 | 4.7 |
| Redfish | 10,522 | 4,504 | 43% | 5.0 | 4.5 | 5.5 |
| SNE Winter Flounder | 968 | 758 | 78% | 2.5 | 2.2 | 2.8 |
| Witch Flounder | 601 | 590 | 98% | 3.1 | 3.0 | 3.2 |
| GB Haddock East | 9,971 | 1,034 | 10% | 2.5 | 2.0 | 3.0 |
| SNE/MA Yellowtail Flounder | 450 | 365 | 81% | 1.1 | 1.0 | 1.2 |
| GOM Cod | 814 | 700 | 86% | 3.6 | 3.4 | 3.8 |
| CC/GOM Yellowtail Flounder | 467 | 372 | 80% | 1.1 | 1.0 | 1.2 |
| GOM Haddock | 432 | 187 | 43% | 0.7 | 0.6 | 0.8 |
| GOM Winter Flounder | 690 | 163 | 24% | 0.6 | 0.6 | 0.7 |
| Halibut | 0 | 51 | . | 0.2 | 0.2 | 0.2 |
| GB Yellowtail Flounder | 252 | 40 | 16% | 0.2 | 0.1 | 0.2 |
| GB Cod East | 145 | 25 | 17% | 0.1 | 0.1 | 0.1 |
| Northern Windowpane | 0 | 218 | . | 0.0 | 0.0 | 0.0 |
| Ocean Pout | 0 | 32 | . | . | . | . |
| Southern Windowpane | 0 | 112 | . | . | . | . |
| Wolffish | 0 | 16 | . | . | . | . |
| Non groundfish | 0 | 9,331 | . | 16.3 | 15.6 | 17.1 |

*Table 4 – FW 53 sub-ACLs (no closures), predicted stock level catch, utilization and revenues*

| | Sub-ACL | Catch | Utilization | Revenue | p5 Revenue | p95 Revenue |
|---|---|---|---|---|---|---|
| Pollock | 13,632 | 3,803 | 28% | 8.6 | 8.0 | 9.2 |
| GB Winter Flounder | 1,875 | 1,869 | 100% | 7.0 | 6.5 | 7.3 |
| GB Haddock West | 16,206 | 4,454 | 27% | 11.3 | 9.6 | 13.2 |
| GB Cod West | 1,629 | 1,531 | 94% | 5.8 | 5.2 | 6.1 |
| White Hake | 4,313 | 1,643 | 38% | 4.9 | 4.5 | 5.2 |
| Plaice | 1,382 | 1,156 | 84% | 3.9 | 3.6 | 4.2 |
| Redfish | 10,988 | 3,924 | 36% | 4.3 | 3.8 | 4.9 |
| SNE Winter Flounder | 1,147 | 838 | 73% | 2.7 | 2.3 | 3.1 |
| Witch Flounder | 598 | 512 | 86% | 2.6 | 2.5 | 2.8 |
| GB Haddock East | 5,402 | 1,067 | 20% | 2.6 | 2.1 | 3.2 |
| SNE/MA Yellowtail Flounder | 457 | 457 | 100% | 1.4 | 1.3 | 1.5 |
| GOM Cod | 202 | 201 | 100% | 1.0 | 1.0 | 1.0 |
| CC/GOM Yellowtail Flounder | 443 | 215 | 48% | 0.6 | 0.5 | 0.7 |
| GOM Haddock | 948 | 122 | 13% | 0.4 | 0.4 | 0.5 |
| GOM Winter Flounder | 375 | 97 | 26% | 0.4 | 0.3 | 0.4 |
| Halibut | 0 | 46 | . | 0.2 | 0.2 | 0.2 |
| GB Yellowtail Flounder | 192 | 53 | 28% | 0.2 | 0.1 | 0.4 |
| GB Cod East | 124 | 30 | 24% | 0.1 | 0.1 | 0.1 |
| Northern Windowpane | 0 | 250 | . | . | . | . |
| Ocean Pout | 0 | 35 | . | . | . | . |
| Southern Windowpane | 0 | 148 | . | . | . | . |
| Wolffish | 0 | 14 | . | . | . | . |
| Non groundfish | 0 | 9,932 | . | 16.9 | 15.8 | 18.1 |

*Table 5 – FW 53 sub-ACLs with Closure A, predicted stock level catch, utilization and revenues*

| | Sub-ACL | Catch | Utilization | Revenue | p5 Revenue | p95 Revenue |
|---|---|---|---|---|---|---|
| **Pollock** | 13,632 | 3,880 | 28% | 8.7 | 8.0 | 9.3 |
| **GB Winter Flounder** | 1,875 | 1,867 | 100% | 6.9 | 6.4 | 7.3 |
| **GB Haddock West** | 16,206 | 4,597 | 28% | 11.6 | 10.0 | 13.2 |
| **GB Cod West** | 1,629 | 1,550 | 95% | 5.8 | 5.2 | 6.1 |
| **White Hake** | 4,313 | 1,757 | 41% | 5.2 | 4.8 | 5.6 |
| **Plaice** | 1,382 | 1,235 | 89% | 4.2 | 3.9 | 4.5 |
| **Redfish** | 10,988 | 4,306 | 39% | 4.8 | 4.2 | 5.3 |
| **SNE Winter Flounder** | 1,147 | 839 | 73% | 2.7 | 2.3 | 3.1 |
| **Witch Flounder** | 598 | 533 | 89% | 2.7 | 2.5 | 2.9 |
| **GB Haddock East** | 5,402 | 1,122 | 21% | 2.7 | 2.2 | 3.3 |
| **SNE/MA Yellowtail Flounder** | 457 | 457 | 100% | 1.4 | 1.3 | 1.5 |
| **GOM Cod** | 202 | 201 | 100% | 1.0 | 1.0 | 1.0 |
| **CC/GOM Yellowtail Flounder** | 443 | 147 | 33% | 0.4 | 0.4 | 0.5 |
| **GOM Haddock** | 948 | 128 | 13% | 0.4 | 0.4 | 0.5 |
| **GOM Winter Flounder** | 375 | 82 | 22% | 0.3 | 0.2 | 0.3 |
| **Halibut** | 0 | 47 | . | 0.2 | 0.2 | 0.2 |
| **GB Yellowtail Flounder** | 192 | 52 | 27% | 0.2 | 0.1 | 0.4 |
| **GB Cod East** | 124 | 30 | 24% | 0.1 | 0.1 | 0.1 |
| **Northern Windowpane** | 0 | 245 | . | 0.0 | 0.0 | 0.0 |
| **Ocean Pout** | 0 | 35 | . | . | . | . |
| **Southern Windowpane** | 0 | 138 | . | . | . | . |
| **Wolffish** | 0 | 14 | . | . | . | . |
| **Non groundfish** | 0 | 9,369 | . | 17.1 | 16.1 | 18.3 |

*Table 6 – FW 53 sub-ACLs with Closure B, predicted stock level catch, utilization and revenues*

| | Sub-ACL | Catch | Utilization | Revenue | p5 Revenue | p95 Revenue |
|---|---|---|---|---|---|---|
| **Pollock** | 13,632 | 3,749 | 28% | 8.4 | 7.8 | 9.0 |
| **GB Winter Flounder** | 1,875 | 1,869 | 100% | 7.0 | 6.4 | 7.3 |
| **GB Haddock West** | 16,206 | 4,535 | 28% | 11.5 | 10.0 | 13.2 |
| **GB Cod West** | 1,629 | 1,526 | 94% | 5.7 | 5.2 | 6.0 |
| **White Hake** | 4,313 | 1,700 | 39% | 5.0 | 4.6 | 5.4 |
| **Plaice** | 1,382 | 1,233 | 89% | 4.2 | 3.9 | 4.5 |
| **Redfish** | 10,988 | 4,181 | 38% | 4.6 | 4.0 | 5.2 |
| **SNE Winter Flounder** | 1,147 | 820 | 72% | 2.6 | 2.3 | 3.1 |
| **Witch Flounder** | 598 | 531 | 89% | 2.7 | 2.5 | 2.9 |
| **GB Haddock East** | 5,402 | 1,095 | 20% | 2.7 | 2.2 | 3.3 |
| **SNE/MA Yellowtail Flounder** | 457 | 457 | 100% | 1.4 | 1.3 | 1.5 |
| **GOM Cod** | 202 | 201 | 100% | 1.0 | 1.0 | 1.0 |
| **CC/GOM Yellowtail Flounder** | 443 | 195 | 44% | 0.5 | 0.5 | 0.6 |
| **GOM Haddock** | 948 | 129 | 14% | 0.5 | 0.4 | 0.5 |
| **GOM Winter Flounder** | 375 | 91 | 24% | 0.3 | 0.3 | 0.4 |
| **Halibut** | 0 | 46 | . | 0.2 | 0.2 | 0.2 |
| **GB Yellowtail Flounder** | 192 | 54 | 28% | 0.2 | 0.1 | 0.4 |
| **GB Cod East** | 124 | 29 | 24% | 0.1 | 0.1 | 0.1 |
| **Northern Windowpane** | 0 | 243 | . | 0.0 | 0.0 | 0.0 |
| **Ocean Pout** | 0 | 34 | . | . | . | . |
| **Southern Windowpane** | 0 | 137 | . | . | . | . |
| **Wolffish** | 0 | 14 | . | . | . | . |
| **Non groundfish** | 0 | 9,330 | . | 17.1 | 16.1 | 18.1 |

*Table 7 – FW 53 sub-ACLs with zero GOMcod retention, predicted catch, utilization and revenues*

| | Sub-ACL | Catch | Utilization | Revenue | p5 Revenue | p95 Revenue |
|---|---|---|---|---|---|---|
| Pollock | 13,632 | 3,811 | 28% | 8.6 | 8.0 | 9.2 |
| GB Winter Flounder | 1,875 | 1,870 | 100% | 7.0 | 6.5 | 7.4 |
| GB Haddock West | 16,206 | 4,428 | 27% | 11.3 | 9.7 | 13.2 |
| GB Cod West | 1,629 | 1,522 | 93% | 5.7 | 5.2 | 6.2 |
| White Hake | 4,313 | 1,640 | 38% | 4.8 | 4.5 | 5.2 |
| Plaice | 1,382 | 1,153 | 83% | 3.9 | 3.6 | 4.3 |
| Redfish | 10,988 | 3,908 | 36% | 4.3 | 3.8 | 4.9 |
| SNE Winter Flounder | 1,147 | 824 | 72% | 2.6 | 2.3 | 3.0 |
| Witch Flounder | 598 | 515 | 86% | 2.7 | 2.5 | 2.9 |
| GB Haddock East | 5,402 | 1,058 | 20% | 2.6 | 2.0 | 3.3 |
| SNE/MA Yellowtail Flounder | 457 | 457 | 100% | 1.4 | 1.3 | 1.5 |
| GOM Cod | 202 | 201 | 100% | 0.0 | 0.0 | 0.0 |
| CC/GOM Yellowtail Flounder | 443 | 210 | 47% | 0.6 | 0.5 | 0.7 |
| GOM Haddock | 948 | 126 | 13% | 0.4 | 0.4 | 0.5 |
| GOM Winter Flounder | 375 | 95 | 25% | 0.4 | 0.3 | 0.4 |
| Halibut | 0 | 46 | . | 0.2 | 0.2 | 0.2 |
| GB Yellowtail Flounder | 192 | 54 | 28% | 0.2 | 0.1 | 0.4 |
| GB Cod East | 124 | 29 | 23% | 0.1 | 0.1 | 0.1 |
| Northern Windowpane | 0 | 254 | . | 0.0 | 0.0 | 0.0 |
| Ocean Pout | 0 | 35 | . | . | . | . |
| Southern Windowpane | 0 | 147 | . | . | . | . |
| Wolffish | 0 | 14 | . | . | . | . |
| Non groundfish | | | | | | |

*Table 8 - FW 53 sub-ACLs with zero GOMcod retention and Closure A, predicted catch, utilization and revenues*

| | Sub-ACL | Catch | Utilization | Revenue | p5 Revenue | p95 Revenue |
|---|---|---|---|---|---|---|
| **Pollock** | 13,632 | 3,885 | 28% | 8.7 | 8.1 | 9.3 |
| **GB Winter Flounder** | 1,875 | 1,868 | 100% | 6.9 | 6.4 | 7.3 |
| **GB Haddock West** | 16,206 | 4,540 | 28% | 11.5 | 10.0 | 13.3 |
| **GB Cod West** | 1,629 | 1,537 | 94% | 5.7 | 5.3 | 6.1 |
| **White Hake** | 4,313 | 1,778 | 41% | 5.2 | 4.8 | 5.6 |
| **Plaice** | 1,382 | 1,248 | 90% | 4.3 | 3.9 | 4.5 |
| **Redfish** | 10,988 | 4,289 | 39% | 4.7 | 4.1 | 5.4 |
| **SNE Winter Flounder** | 1,147 | 861 | 75% | 2.7 | 2.3 | 3.1 |
| **Witch Flounder** | 598 | 533 | 89% | 2.7 | 2.5 | 2.9 |
| **GB Haddock East** | 5,402 | 1,110 | 21% | 2.7 | 2.2 | 3.3 |
| **SNE/MA Yellowtail Flounder** | 457 | 457 | 100% | 1.4 | 1.2 | 1.5 |
| **GOM Cod** | 202 | 201 | 100% | 0.0 | 0.0 | 0.0 |
| **CC/GOM Yellowtail Flounder** | 443 | 152 | 34% | 0.4 | 0.4 | 0.5 |
| **GOM Haddock** | 948 | 129 | 14% | 0.4 | 0.4 | 0.5 |
| **GOM Winter Flounder** | 375 | 83 | 22% | 0.3 | 0.3 | 0.3 |
| **Halibut** | 0 | 47 | . | 0.2 | 0.2 | 0.2 |
| **GB Yellowtail Flounder** | 192 | 51 | 27% | 0.2 | 0.1 | 0.3 |
| **GB Cod East** | 124 | 30 | 24% | 0.1 | 0.1 | 0.1 |
| **Northern Windowpane** | 0 | 244 | . | 0.0 | 0.0 | 0.0 |
| **Ocean Pout** | 0 | 34 | . | . | . | . |
| **Southern Windowpane** | 0 | 137 | . | . | . | . |
| **Wolffish** | 0 | 15 | . | . | . | . |
| **Non groundfish** | 0 | 9,390 | . | 17.1 | 16.1 | 18.2 |

*Table 9 – FW 53 sub-ACLs with zero GOMcod retention and Closure B, predicted catch, utilization and revenues*

| | **Sub-ACL** | **Catch** | **Utilization** | **Revenue** | p5 Revenue | p95 Revenue |
|---|---|---|---|---|---|---|
| **Pollock** | 13,632 | 3,815 | 28% | 8.5 | 7.8 | 9.1 |
| **GB Winter Flounder** | 1,875 | 1,869 | 100% | 7.0 | 6.4 | 7.3 |
| **GB Haddock West** | 16,206 | 4,524 | 28% | 11.4 | 10.0 | 13.1 |
| **GB Cod West** | 1,629 | 1,538 | 94% | 5.7 | 5.2 | 6.1 |
| **White Hake** | 4,313 | 1,745 | 40% | 5.1 | 4.7 | 5.6 |
| **Plaice** | 1,382 | 1,247 | 90% | 4.3 | 3.9 | 4.6 |
| **Redfish** | 10,988 | 4,282 | 39% | 4.7 | 4.2 | 5.3 |
| **SNE Winter Flounder** | 1,147 | 836 | 73% | 2.7 | 2.3 | 3.1 |
| **Witch Flounder** | 598 | 539 | 90% | 2.7 | 2.5 | 2.9 |
| **GB Haddock East** | 5,402 | 1,116 | 21% | 2.7 | 2.2 | 3.3 |
| **SNE/MA Yellowtail Flounder** | 457 | 456 | 100% | 1.4 | 1.2 | 1.5 |
| **GOM Cod** | 202 | 201 | 100% | 0.0 | 0.0 | 0.0 |
| **CC/GOM Yellowtail Flounder** | 443 | 202 | 46% | 0.6 | 0.5 | 0.6 |
| **GOM Haddock** | 948 | 134 | 14% | 0.5 | 0.4 | 0.5 |
| **GOM Winter Flounder** | 375 | 96 | 26% | 0.3 | 0.3 | 0.4 |
| **Halibut** | 0 | 47 | . | 0.2 | 0.2 | 0.2 |
| **GB Yellowtail Flounder** | 192 | 54 | 28% | 0.2 | 0.1 | 0.4 |
| **GB Cod East** | 124 | 29 | 24% | 0.1 | 0.1 | 0.1 |
| **Northern Windowpane** | 0 | 245 | . | 0.0 | 0.0 | 0.0 |
| **Ocean Pout** | 0 | 34 | . | . | . | . |
| **Southern Windowpane** | 0 | 136 | . | . | . | . |
| **Wolffish** | 0 | 15 | . | . | . | . |
| **Non groundfish** | 0 | 9,395 | . | 17.2 | 16.0 | 18.3 |

*Table 10 – Homeport state and port predicted gross revenues from groundfish ($, millions, median values with 5th and 95th percentile confidence intervals from 500 simulations)*

| | **FY14 Baseline** | | | **FW 53 ACLs** | | | **FW 53 ACLs + Closure A** | | | **FW 53 ACLs + Closure B** | | | **FW 53 ACLs + Zero Retention GOM cod** | | | **FW 53 ACLs + ZR GOM cod + Closure A** | | | **FW 53 ACLs + ZR GOM cod + Closure B** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Rev** | **p5 rev** | **p95 rev** | **Rev** | **p5 rev** | **p95 rev** | **Rev** | **p5 rev** | **p95 rev** | **Rev** | **p5 rev** | **p95 rev** | **Rev** | **p5 rev** | **p95 rev** | **Rev** | **p5 rev** | **p95 rev** | **Rev** | **p5 rev** | **p95 rev** |
| **Connecticut** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Massachusetts** | 43.8 | 39.7 | 48.2 | 40 | 35 | 45.3 | 41.2 | 36.5 | 46.1 | 41 | 36.1 | 45.9 | 39.6 | 34.8 | 44.6 | 40.6 | 36 | 45.4 | 40.7 | 36 | 45.5 |
| *Boston* | *12.9* | *11.8* | *14.1* | *12.1* | *10.4* | *13.8* | *12.9* | *11.3* | *14.7* | *12.8* | *11* | *14.7* | *12* | *10.3* | *13.7* | *12.8* | *11.1* | *14.6* | *12.8* | *11.2* | *14.5* |
| *Gloucester* | *10.3* | *9.4* | *11.4* | *7.5* | *6.5* | *8.4* | *8.2* | *7.2* | *9.3* | *8.1* | *7.1* | *9.1* | *7.3* | *6.4* | *8.3* | *7.9* | *6.9* | *8.8* | *7.9* | *6.8* | *8.9* |
| *New Bedford* | *15.4* | *14* | *16.8* | *16.4* | *14.9* | *18.1* | *16.9* | *15.5* | *18.2* | *16.8* | *15.4* | *18.1* | *16.3* | *14.9* | *17.8* | *16.8* | *15.5* | *18.2* | *16.8* | *15.4* | *18.2* |
| **Maine** | 14.8 | 13.2 | 16.4 | 12.4 | 10.7 | 14.1 | 12.9 | 11 | 14.7 | 12.4 | 10.9 | 14.2 | 12 | 10.4 | 13.7 | 12.6 | 11 | 14.5 | 12.4 | 10.7 | 14.2 |
| *Portland* | *12.3* | *11* | *13.7* | *10.7* | *9.1* | *12.1* | *11.4* | *9.8* | *13* | *11.1* | *9.7* | *12.6* | *10.4* | *9* | *11.9* | *11.3* | *9.8* | *12.9* | *11.1* | *9.7* | *12.7* |
| **New Hampshire** | 2.4 | 2.1 | 2.7 | 1.4 | 1.2 | 1.6 | 1.3 | 1.1 | 1.5 | 1.3 | 1.1 | 1.5 | 1.3 | 1.1 | 1.5 | 1.2 | 1 | 1.4 | 1.2 | 1 | 1.4 |
| **New Jersey** | 0.3 | 0.2 | 0.3 | 0.2 | 0.1 | 0.3 | 0.2 | 0.1 | 0.3 | 0.2 | 0.2 | 0.3 | 0.2 | 0.1 | 0.3 | 0.2 | 0.2 | 0.3 | 0.2 | 0.1 | 0.3 |
| **New York** | 0.9 | 0.7 | 1.2 | 1.2 | 0.9 | 1.6 | 1 | 0.7 | 1.3 | 1 | 0.7 | 1.3 | 1.2 | 0.9 | 1.6 | 1 | 0.7 | 1.2 | 1 | 0.7 | 1.3 |
| **Rhode Island** | 2.1 | 1.8 | 2.5 | 2.7 | 2.3 | 3.2 | 2.6 | 2.1 | 3 | 2.6 | 2.1 | 3.1 | 2.7 | 2.3 | 3.2 | 2.5 | 2.1 | 3 | 2.5 | 2.1 | 3 |
| *Point Judith* | *1.6* | *1.4* | *1.8* | *2.1* | *1.8* | *2.4* | *1.9* | *1.7* | *2.2* | *1.9* | *1.7* | *2.2* | *2.1* | *1.8* | *2.3* | *1.9* | *1.7* | *2.2* | *1.9* | *1.7* | *2.2* |
| **Other Northeast** | 0.1 | 0 | 0.1 | 0 | 0 | 0 | . | . | . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 11 – Homeport state and port level predicted percent change in gross revenues from groundfish, relative to FY14 Baseline*

| | | **FW 53 ACLs** | **FW 53 ACLs + Closure A** | **FW 53 ACLs + Closure B** | FW 53 ACLs + Zero Retention GOM cod | FW 53 ACLs + ZR GOM cod + Closure A | FW 53 ACLs + ZR GOM cod + Closure B |
|---|---|---|---|---|---|---|---|
| **Connecticut** | | n/a | n/a | n/a | n/a | n/a | n/a |
| **Massachusetts** | | -9% | -6% | -6% | -10% | -7% | -7% |
| | *Boston* | -6% | 0% | -1% | -7% | -1% | -1% |
| | *Gloucester* | -27% | -20% | -21% | -29% | -23% | -23% |
| | *New Bedford* | 6% | 10% | 9% | 6% | 9% | 9% |
| **Maine** | | -16% | -13% | -16% | -19% | -15% | -16% |
| | *Portland* | -13% | -7% | -10% | -15% | -8% | -10% |
| **New Hampshire** | | -42% | -46% | -46% | -46% | -50% | -50% |
| **New Jersey** | | -33% | -33% | -33% | -33% | -33% | -33% |
| **New York** | | 33% | 11% | 11% | 33% | 11% | 11% |
| **Rhode Island** | | 29% | 24% | 24% | 29% | 19% | 19% |
| | *Point Judith* | 31% | 19% | 19% | 31% | 19% | 19% |
| **Other Northeast** | | n/a | n/a | n/a | n/a | n/a | n/a |

*Table 12 – Vessel size class predicted gross revenues from groundfish ($, millions, median values with 5th and 95th percentile confidence intervals from 500 simulations)*

| | FY14 Baseline | | | FW 53 ACLs | | | FW 53 ACLs + Closure A | | | FW 53 ACLs + Closure B | | | FW 53 ACLs + Zero Retention GOM cod | | | FW 53 ACLs + ZR GOM cod + Closure A | | | FW 53 ACLs + ZR GOM cod + Closure B | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Length class** | **Rev** | **p5 rev** | **p95 rev** | **Rev** | **p5 rev** | **p95 rev** | **Rev** | **p5 rev** | **p95 rev** | **Rev** | **p5 rev** | **p95 rev** | **Rev** | **p5 rev** | **p95 rev** | **Rev** | **p5 rev** | **p95 rev** | **Rev** | **p5 rev** | **p95 rev** |
| **<30'** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **30'to<50'** | 9.0 | 9.0 | 10.0 | 6.0 | 6.0 | 7.0 | 5.0 | 4.0 | 5.0 | 5.0 | 4.0 | 5.0 | 6.0 | 5.0 | 6.0 | 4.0 | 4.0 | 5.0 | 4.0 | 4.0 | 5.0 |
| **50'to<75'** | 19.0 | 18.0 | 20.0 | 16.0 | 15.0 | 18.0 | 17.0 | 16.0 | 19.0 | 17.0 | 16.0 | 18.0 | 16.0 | 15.0 | 18.0 | 17.0 | 16.0 | 18.0 | 17.0 | 16.0 | 18.0 |
| **75'+** | 36.0 | 34.0 | 38.0 | 35.0 | 32.0 | 38.0 | 37.0 | 34.0 | 40.0 | 36.0 | 34.0 | 39.0 | 35.0 | 32.0 | 38.0 | 37.0 | 34.0 | 39.0 | 37.0 | 34.0 | 39.0 |

*Table 13 – Vessel size class predicted percent change in gross revenues from groundfish, relative to FY14 Baseline*

| Length class | FW 53 ACLs | FW 53 ACLs + Closure A | FW 53 ACLs + Closure B | FW 53 ACLs + Zero Retention GOM cod | FW 53 ACLs + ZR GOM cod + Closure A | FW 53 ACLs + ZR GOM cod + Closure B |
|---|---|---|---|---|---|---|
| **<30'** | n/a | n/a | n/a | n/a | n/a | n/a |
| **30'to<50'** | -33% | -44% | -44% | -33% | -56% | -56% |
| **50'to<75'** | -16% | -11% | -11% | -16% | -11% | -11% |
| **75'+** | -3% | 3% | 0% | -3% | 3% | 3% |

### *Discussion*

This modeling points to two conclusions, one relatively obvious and the other perhaps counter-intuitive. The former is the relative magnitude of the predicted impacts on small inshore GOM vessels. Economic impact statements have for years been predicting significant losses for this component of the fleet, and it has surely been disproportionately affected as the groundfish fishery saw gross revenues decline from $120mil FY 2011 to $79mil in FY 2013. But the additional declines forecasted here will present serious and perhaps unprecedented difficulties for these vessels, owners and crew. Ports may see 50-80% declines in revenues from groundfish, and many vessels will either be forced to relocate or stop fishing altogether. It seems possible that some ports from Cape Cod to southern Maine that have been active in the groundfish fishery may have no groundfish landings whatsoever in FY15, regardless of the measures ultimately selected. The impacts on shoreside businesses in ports throughout the inshore GOM are difficult to predict, but infrastructure and facilities supporting fishing operations may be forced to consolidate, but may disappear altogether. Relocation of vessels to southern New England ports is likely. The impact of relocation on fishing families is an important issue that is difficult to quantify. As Table 13 shows, the adoption of either Closure A or B may make fishing from inshore GOM ports unsustainable for vessels that do not have the range to fish in profitable areas during times of inshore spawning closures.

The second, somewhat counter-intuitive conclusion is that the opportunity cost of quota may not be reflected in the ACE leasing markets currently. The analysis shows a consistent trend where closure areas lead to an *increase* in revenues relative to the FW53 sub-ACLs with no additional closures. The reason for this may be that quota, and GOM cod quota in particular, may not be flowing to those who may most profitably utilize it. Table 14 and Figure 1 both demonstrate that larger vessels are able to generate much more revenue per pound of GOM cod ACE than smaller vessels—sometimes many multiples more. When GOM cod is a constraining stock, as it was in FY2013, this should imply that vessels could still profitably afford to spend much more on GOM cod ACE lease, though this has not been evident in the ACE leasing market (Murphy *et al* 2012). The wonder is not that GOM cod ACE leases have, historically, been so high, but rather, for FY13, how lease values remained so low in the face of constraints. The interim measures adopted mid-way through the 2014 fishing year will likely mean that GOM cod is not constraining for vessels fishing in this stock area (modeling predicts plaice and witch flounder will constrain the fishery first) and so GOM cod ACE lease values will likely remain at the low end of their historical range, but FY15 may be the year that GOM cod ACE lease prices rise substantially above the ex-vessel price for cod.

This goes a long way toward explaining why the fishery may generate more revenues under the closure scenarios than under the sub-ACL options with no closures. Further, Figure 2 shows that vessels fishing farther east are able and may be willing to pay much more than vessels fishing west of, say, 70 deg west longitude—when GOM cod ACE is highly constraining, only vessels able to use it efficiently will be fishing it. The fact that the sub-ACL options with no closures are predicted to have lower gross revenues (in aggregate) than the closure options points to a situation where inshore GOM vessels are not being offered sufficiently high ACE lease prices or, alternatively, have been (and modeling indicates will continue to be) unwilling to accept such lease arrangements. There are many reasons this may be so, the most relevant being that fisherman may simply want to fish, and prioritize their profession over higher profits.

The shift toward fishing eastward and by larger vessels under all scenarios considered in FW 53 is shown in Table 15. With cod being constraining in the GOM, the closure options effectively force vessels that would otherwise chose to fish, to no longer fish. The model assumes that their quota will flow to those (larger) vessels who can use it. Whether this proves to be the case, or not, will remain to be seen.

The analysis of zero retention options presented here will underestimate realized revenues for all size classes and GOM ports, because these models assume that cod caught and discarded will be accounted for. This is not a realistic assumption. Because GOM cod is the primary constraint on fishing in the GOM, vessels will fish under two very different sets of incentives depending on whether or not a trip is observed. If a trip is observed, the primary incentive for captains will be to minimize cod as a percent of total catch. This incentive will be strong, as there is an inverse and nearly linear relationship between a Sector's discard rate for GOM cod and the number of trips that Sector's vessels will be able to make before being closed out of the broad stock area. The variance of cod caught on a trip is high, and it is possible (even likely) that captains will be able to achieve quite low discard rates on observed trips.

Unobserved trips have no such incentive. Rather, these trips will maximize revenue on all species irrespective of GOM cod catch. If Table 14 indicates that vessels can make $10-20 or more per pound of cod caught, even backing out the $2-3 of revenue forgone to discarding marketable cod demonstrates the potential for substantial revenue increases through unaccounted cod discarding.

The net effect will be twofold:

- true discards are likely to be many multiples of imputed discards, rendering—through absolutely no fault of the fishing industry—the catch data an incomplete picture of true fishing mortality; and
- gross revenues will be substantially higher than predicted for all aspects of the GOM fishery, as the nominal cod constraint is essentially relaxed through a combination of observer effects and mandated regulatory discards on unobserved trips.

Again, there is no regulatory or compliance aspect to this situation—captains are not required to "act the same on observed and unobserved trips" as, for one thing, that sentence has no practical meaning, and fishing profitably is precisely what fisherman are expected to do.

Finally, while the models run for these analyses include a higher probability of "ACE inefficient" trips occurring in the prediction scenarios than previous year's models, the extremely low GOM cod sub-ACL carries a very real risk that a small number of trips, particularly observed trips, that encounter unexpected quantities of GOM cod will endanger fishing operations for entire Sectors. Figure 3 shows the approximate Sector-level allocations of GOM cod. Inter-sector leases of GOM cod likely to be both low in volume and high in price. This analysis has attempted to incorporate the impact of sub-optimal trips, but if more such trips than predicted do occur gross revenues for affected sectors, and the entire fishery, may be substantially lower. Table 14 may provide evidence of a second problem—higher than expected GOM cod catch rates. The decrease in revenues per GOM cod ACE from 2012 to 2013 is especially worrying in light of the fact that GOM cod was a constraining stock in FY13. If cod become difficult for fisherman to avoid, these models will surely over-state aggregate revenues and under-state predicted losses for affected vessels, ports and communities.

*Table 14 – Median nominal gross revenues per pound of GOM cod ACE for all trips by vessels in four size classes*

| len_cat | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|
| **30' and u** | 4.38 | 5.56 | 85.43 | 33.58 |
| **30'to<50'** | 5.87 | 6.67 | 24.23 | 10.10 |
| **50'to<75'** | 9.03 | 8.69 | 34.45 | 21.18 |
| **75'+** | 68.42 | 88.88 | 300.20 | 140.72 |

*Table 15 – Predicted median gross revenues per pound GOM cod ACE and reported longitude*

| model | Revenue per lbs cod ACE | p5_rev | p95_rev | longitude | p5_lon | p95_lon |
|---|---|---|---|---|---|---|
| FY14 Baseline | 21 | 3 | 427 | -69.90 | -70.55 | -67.93 |
| ALCs no Closures | 47 | 13 | 529 | -69.72 | -70.50 | -67.68 |
| Closure A | 49 | 11 | 529 | -69.67 | -70.44 | -67.68 |
| Closure B | 44 | 11 | 512 | -69.70 | -70.47 | -67.70 |
| Zero ret no Closures | 47 | 13 | 529 | -69.72 | -70.50 | -67.70 |
| Zero ret Closure A | 49 | 11 | 529 | -69.67 | -70.45 | -67.68 |
| Zero ret Closure B | 46 | 12 | 512 | -69.69 | -70.47 | -67.68 |

*Figure 1 – Average nominal gross revenues generated per pound of GOM cod ACE for fishing trips by vessels in four size classes, FY 2010-2013*

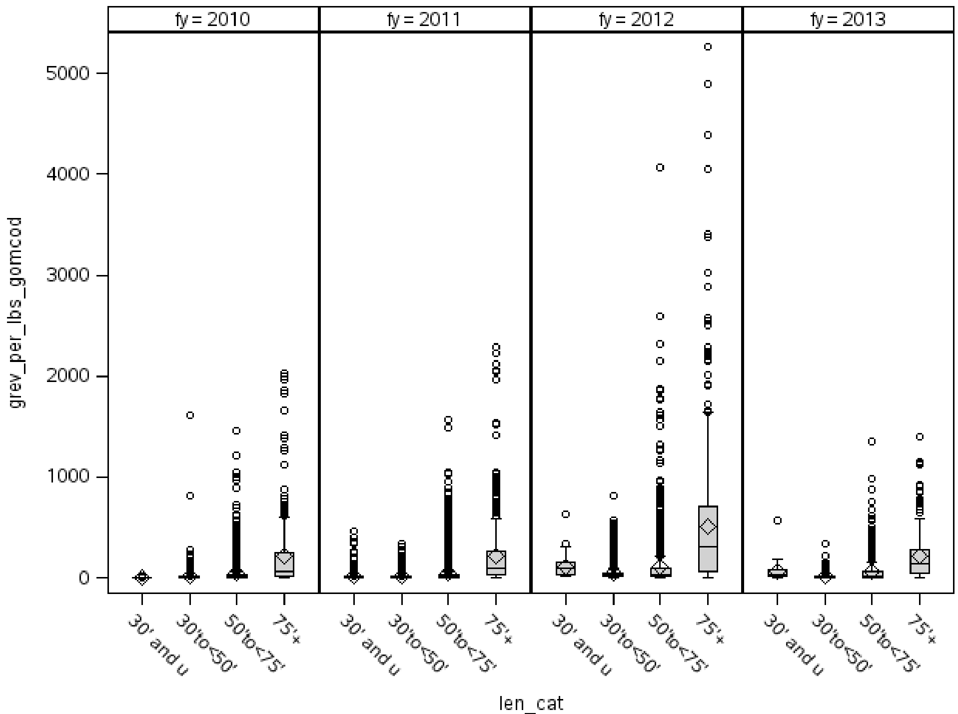


*Figure 2 – Average nominal gross revenues generated per pound of GOM cod ACE for fishing trips by longitude, FY 2010-13*

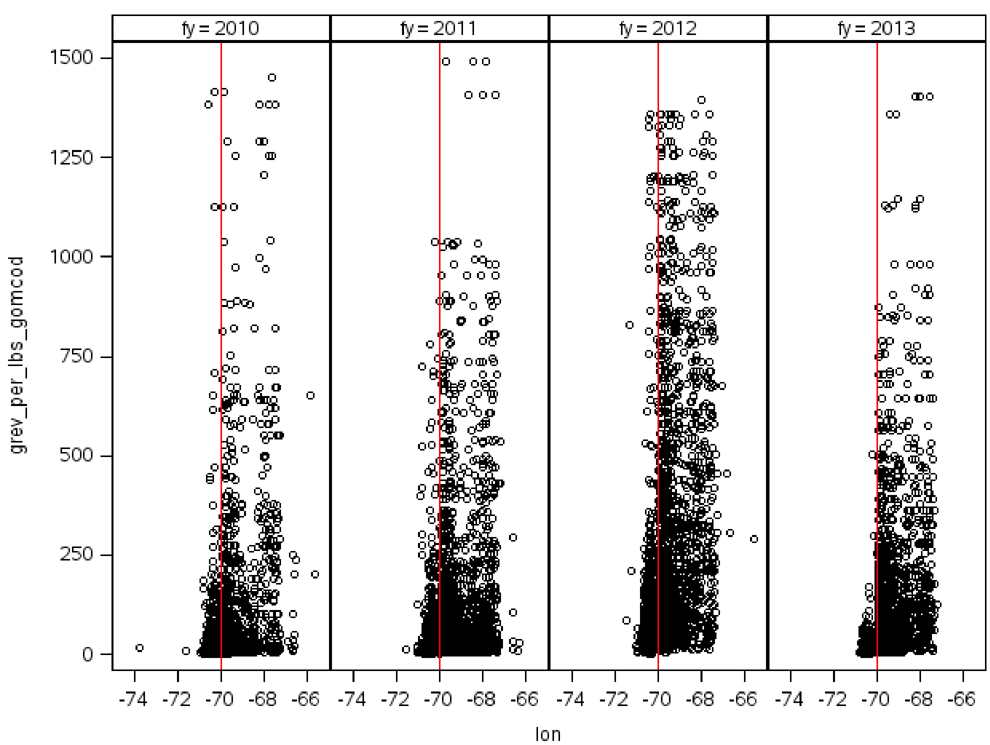

*Figure 3 – Sector-level allocations of GOM cod at an ABC of 400mt (slightly higher than the actual ABC of 386mt)*

| | FY13 Allocation | 400 |
|---|---|---|
| **Common** | 40,297 | 10,399 |
| **Fixed Gear Sector** | 44,396 | 11,457 |
| **Maine Coast Community Sector** | 84,065 | 21,694 |
| **Maine Permit Bank** | 21,018 | 5,424 |
| **NCCS** | 13,679 | 3,530 |
| **NEFS 10** | 96,165 | 24,817 |
| **NEFS 11** | 205,153 | 52,943 |
| **NEFS 12** | 44,349 | 11,445 |
| **NEFS 13** | 17,340 | 4,475 |
| **NEFS 2** | 336,353 | 86,801 |
| **NEFS 3** | 263,112 | 67,900 |
| **NEFS 4** | 175,681 | 45,337 |
| **NEFS 5** | 233 | 60 |
| **NEFS 6** | 53,313 | 13,758 |
| **NEFS 7** | 7,169 | 1,850 |
| **NEFS 8** | 8,986 | 2,319 |
| **NEFS 9** | 31,729 | 8,188 |
| **New Hampshire Permit Bank** | 20,797 | 5,367 |
| **Sustainable Harvest Sector 1** | 356,549 | 92,013 |
| **Sustainable Harvest Sector 3** | 9,452 | 2,439 |