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# Correspondence

New England Fishery Management Council
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C. M. "Rip" Cunningham, Jr., *Chairman* | Paul J. Howard, *Executive Director*

January 20, 2012

Mr. Dan Morris
Acting Regional Administrator
NOAA/NMFS
55 Great Republic Drive
Gloucester, MA 01930

Dear Dan:

Thank you for your recent letter forwarding an analysis of permissible sector carry-over. You requested that we forward this letter to the Science and Statistical Committee (SSC) for review at its January 25, 2012 meeting. Unfortunately, there is not time available for a review at that meeting and the review will have to be scheduled for a later date. As you know, we are about to begin a framework action to improve the operation of sectors and one of the issues the Groundfish Oversight Committee plans to consider in this action is the carry-over provisions. The analysis you provided will help our Plan Development Team as it works on this framework. There are a few questions that, if answered, will help the Committee and PDT's work:

(1) The analysis is based on the primary constraint that "...the realized fishing mortality rate could not exceed the overfishing threshold of $F_{MSY}$." It is often the case, however, that due to scientific uncertainty or rebuilding requirements the Acceptable Biological Catch (ABC) for multispecies stocks are usually based on a fishing mortality rate that is less than $F_{MSY}$. The constraint used in the analysis thus implicitly acknowledges that the carry-over levels suggested could lead to catches that exceed the ABC recommendation of the SSC. Is it consistent with the provisions of the Magnuson-Stevens Act to authorize a carry-over amount that results in allocating an amount of fish that is greater than the ABC? Is it consistent with the National Standard Guidelines to allow a carry-over amount that reduces the buffer for scientific uncertainty between the Overfishing Level (OFL) and the ABC to zero without explicit SSC concurrence?

(2) The analysis is based on assuming an equilibrium age structure under a constant recruitment assumption. Many multispecies stocks are at low levels of abundance and are in rebuilding programs, and recruitment is often highly variable and, for some stocks, recent recruitment is at low levels. How do these deviations from the underlying assumptions affect the amounts of permissible carry-over?

(3) If carry-over amounts are allowed to result in catches that exceed the ABC for a rebuilding program, how would that affect the prospects for rebuilding?

(4) In some cases ABCs decline due to expected fluctuations in the stock; in other cases it may be due to a change in assessment results. This creates the possibility that the proposed carry-over amounts may result in allocating an amount of fish greater than the OFL. Is this consistent with the M-S Act? Does a declining ABC affect the amount of permissible carry-over? Do these fluctuation need to be considered when setting carry-over levels?

As always, please call me if you have any questions.

Sincerely,

Paul J. Howard
Executive Director

**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
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NEW ENGLAND FISHERY MANAGEMENT COUNCIL

C.M. "Rip" Cunningham Jr., Chair
New England Fishery Management Council
50 Water Street
Newburyport, Massachusetts 01950

Dear Rip:

The Northeast Fisheries Science Center has recently completed an analysis that considers whether Northeast multispecies sector vessels could carry-over more than ten percent of their annual allocation from one fishing year to the next. The analysis, which is attached, was requested by Senator Kerry in a letter dated October 19, 2011, as well as by sector members and managers at the New England Fishery Management Council's (Council) October 25-26, 2011 Sector Workshop. NOAA's National Marine Fisheries Service intends to include this analysis in the draft environmental assessment of the fishing year 2012 sector operations plans as a range of potential increases to the current carry over allowance.

I recommend that the Council ask its Scientific and Statistical Committee to review this report at their January 2012 meeting if at all possible. Specifically, I am requesting that the Committee provide advice on the level of carryover increase that could occur (above 10%) without having a negative impact on the fishery management plan.

Sincerely,

Patricia A. Kurkul
Regional Administrator

Attachment

cc: TN, CBK, Exec Cte (1/4), PMF

*Analysis of Quota Rollover Percentages*
*NEFSC/READ/PDB*
*Initial Draft: November 30, 2011*
*Last Update: December 7, 2011*

**Executive Summary**

This report addresses the question of what is the appropriate percentage carryover of quota allocations from one year to the next. The carryover fraction of 10% in current regulations for sectors does not have an analytical basis with respect to its implications for overfishing. A deterministic model was used to evaluate the effects of alternative quota rollover fractions on the magnitude of fishing mortality in the year in which the previous year's quota is harvested. The primary constraint on harvest policy was that the realized fishing mortality rate could not exceed the overfishing threshold of the Fmsy proxy. The model was applied to a suite of age-structured stocks with parameters taken from the stock assessments from GARM III (NEFSC 2008).

Despite a wide range of biological differences among stocks, the maximum carryover percent was relatively uninfluenced by differences in growth rate or selectivity. Instead, the primary factor affecting the carryover percentage was the true rate of fishing mortality in relationship to the overfishing threshold. If the true fishing mortality rate is near the target fishing mortality rate specified in the management plan, i.e., 75% of Fmsy proxy, then the maximum carryover is about 28 to 30%. As the true fishing mortality rate approaches the Fmsy proxy the allowable carryover declines to zero. The maximum carryover fraction is further reduced by the current harvest control policy that factors in the effects of total catch attained in year t on the catches in year t+1. Shortfalls in the individual quotas are partially compensated by the increases in future quotas when the stock is fished at the fishing mortality rate associated with the $F_{ABC}$. When this expected increase in factored in AND contemporary F is actually at 75% of Fmsy, the maximum carryover percentage appears to be about 25-28% for the stocks examined.

The analyses suggest the importance of two critical factors, one scientific, the other policy related. The true relationship between the realized F in any given year and the Fmsy threshold is difficult to know given the uncertainty in initial stock sizes and implementation of the management policy. If stock sizes are overestimated, then fishing mortality rates will be too high and the margin for increased carryover will be reduced. The second critical aspect is harvest policy. Analyses in this report assume that fishing mortality cannot exceed the Fmsy proxy, i.e., overfishing is not allowed. If harvest policy restricts F to be less than or equal to $F_{ABC}$ then the allowable harvest carryover will be greatly diminished. Theoretically if the $F_{ACL} = F_{ABC}$ then there is no scope for carryover (i.e, the percent rollover is zero) because the overall quota for year t+1 will already have incorporated the maximum allowable catch.

This analysis does not consider the economic implications of carryovers or the potential implications for individual vessels or firms. Moreover, this report does not address longer term implications of a quota carryover system. Management strategy evaluation approaches suggest caution when implementing high quota carryover fractions because of the severe effects of contemporary overharvest on future catch streams.

**Introduction**

The suggested quota rollover provision currently allows for a 10% carryover of unused quota from one year to the next. The magnitude of the carryover is important because it has implications for the realized fishing mortality rate in the year in which the carryover quota is taken. In particular, current harvest policies stipulate that F cannot exceed the Fmsy proxy. In other words, overfishing is not allowable irrespective of the magnitude of the underharvest in a previous year. This constraint implies that the magnitude of carryover will be less than the loss in the previous year when the loss exceeds a certain threshold. For example, a loss of 20% in year t might be carried over to catches in year t+1 on a one for one basis. A loss of 50% in t, could imply overfishing in year t+1 if all of the catch were taken. If so, not all of the underage could be carried over. The purpose of this report is to investigate the biological implications of carryover policies for a number of representative groundfish species and alternative harvest policies.

**Methods**

To investigate the properties of alternative quota rollover percentages, a simple age structured dynamic model was used to investigate the effects of quota rollover percentages in the vicinity of the equilibrium. The biological parameters for growth and natural mortality were combined with estimates of fishery selectivity to project the population to an equilibrium age structure under a constant recruitment assumption. Fishing mortality was assumed to be 75% of Fmsy proxy. The population response in the vicinity of this equilibrium point was investigated by evaluating the implications for fishing mortality in year t+1 given an underage of magnitude $\Delta C$ in year t.

The initial population vector at t=0 is obtained by advancing an initial advanced in age using age-specific fishing mortality $F_a$ and an age and time invariant natural mortality (M) is 0.2 for all ages.

$$N_{a+1,t=0} = N_{a,t=0} e^{-M-F_{a,t=0}} \qquad (1)$$

Recruitment, defined as $N_{1,t}$ is assumed to be constant for all time periods such that

$$N_{1,t} = R_t = R \qquad (2)$$

Each cohort is decremented by age- and time-specific fishing mortality rates:

$$N_{a+1,t+1} = N_{a,t} e^{-M-F_{a,t}} \quad (3)$$

Total catch $C_t$ is estimated as the sum of age-specific catches multiplied by the average weight at age.

$$C_t = \sum_{a=1}^{A} \frac{F_{a,t}}{F_{a,t}+M} N_{a,t} (1 - e^{-F_{a,t}-M}) \qquad W_a \quad (4)$$

Where $W_a$ is the average weight of fish at age a.

The equilibrium catch, denoted as Co will be time invariant when R, M and $F_{a,t}$ are held constant. For the purpose of this analysis it is assumed that $F_{a,t}$ equals a fraction $\delta$ of the $F_{msy}$ proxy. Thus

Co is the expected equilibrium catch when $F_{a,t} = \delta F_{msy}.S_a$, where $S_a$ is the age specific selectivity. The maximum carryover that can occur is defined

$$C_t = C_o - \Delta C = \sum_{a=1}^{A} \frac{F'_{a,t}}{F'_{a,t}+M} N_{a,t}(1 - e^{-F'_{a,t}-M}) \quad W_a \quad (5)$$

$$C_{t+1} = C_o + \Delta C = \sum_{a=1}^{A} \frac{S_a F_{msy}}{S_a F_{msy} + M} N_{a,t+1}\left(1 - e^{-\left[S_a F_{msy} + M\right]}\right) \quad W_a \quad (6)$$

The maximum carry over catch $\Delta C$ is estimated by finding $F'_{a,t}$ in Eq. 5 such that Eq. 6 is satisfied. Note that it is assumed that the maximum harvest rate possible in year t+1 is less than or equal to $F_{msy}$. A harvest policy such as $F_{t+1} < F_{rebuild}$ or $F_{t+1} < F_{ABC}$ could be an alternative basis for deriving the carryover.

It is important to note that Eq. 5 and 6 are linked by Eq. 3. Since $F'_{a,t}$ is less than harvest policy $F_{a,t}$, then $N_{a,t+1}$ will be greater than it would have been. Thus $C_{t+1}$ will be greater than $C_o$ even if F remains the same. The current methodology used by the Groundfish PDT and the NEFMC SSC already incorporates an increase in catch for underages that occur in the preceding year.

$$C_o < C^*_{t+1} = \sum_{a=1}^{A} \frac{F_{a,t+1}}{F_{a,t+1}+M} N_{a,t+1}(1 - e^{-F_{a,t+1}-M}) \quad W_a \quad (7)$$

The increase in catch that would be allowed when the overall catch is below that projected, compensates for the underage but does not address sector specific issues.

To account for the fact that overall underages are already included in the estimated harvest limits for year t+1 (i.e., Eq. 7) the maximum carryover policy could be expressed as the difference between Eq. 7 and 6 such that

$$max\Delta C\% = \frac{\Delta C - (C^*_{t+1} - C_o)}{C_o} \quad (8)$$

Application of Eq. 8 implies that the harvest carryover cannot exceed that which would result in overfishing less the increment in yield that would occur when the underharvest of catch in year t results in an increase in harvest in year t+1 when $F_{ABC}$ is applied.

The maximum carryover was obtained by maximizing $\Delta C$ in Eq. 5 and 6 using SOLVER in Excel. In percentage terms, let $-\Delta C/C_o$ x100 represent the percentage reduction in year t in Eq. 5. The percentage gain in year t+1 is just $\Delta C/C_o$ but is it important to note that the expected catches in year t+1 to year t is $(C_o+\Delta C)/(C_o-\Delta C)$. Even a modest carryover of say 20% (1.2/0.8) implies a 50% increase in landings between years t and t+1. A carryover of 30% implies an 86% increase in between year landings (i.e., (1+0.3)/(1-0.3)=1.86)

Another important aspect of carryovers is that $C_o$ is a function of the baseline harvest policy and the $F_{msy}$ proxy. A fishing mortality rate designed to create a large buffer between $C_t$ given $F_{msy}$ (denoted as $C_t|F_{msy}$) and $C_t|F_{ACL}$ will allow a greater carry over that a harvest policy with a smaller buffer between the ACL and OFL. This would all be elementary if it was generally possible to know what the true relation between the targeted F and the realized F for any given year. If the buffer is actually closer to the OFL than the analysts suspects then the carryover should be smaller to account for potential for unrecognized overfishing. For stocks that exhibit strong retrospective patterns this is a primary source of uncertainty.

This limit depends on the relationship between the equilibrium Fabc and the Fmsy proxy. When the values are close $|Fabc-Fmsy| < \varepsilon$, then the fraction that can be transferred becomes progressively smaller. A candidate operating rule for allowing an increment in yield is given below:

*Maximum Carryover in year t= Min (|%loss in year t|, %gain in year t+1),*
*if %loss in year t <0,*
*= zero, otherwise*

**Application to Specific Stocks**

Seven stocks were examined in detail. These included GOM cod, Georges Bank haddock, witch flounder, American plaice, white hake, Southern New England yellowtail flounder and Cape Cod/Gulf of Maine yellowtail flounder. These stocks represent a broad range of longevity and growth rates. Model parameters were taken from the GARM III results (NEFSC 2008). The NEFMC SSC has set the target harvest rate at 75% of Fmsy. For the sake of consistency, all of the stocks were examined using this policy. The analyses were conducted in Excel and SOLVER was used to estimate the maximum carryover.

**Results**

The maximum carryover fraction that can be carried over on a one-for-one basis varied little among stocks (Table 1) when the target F is set at 75% of Fmsy. Differences in growth rates among stocks and fishery selectivity appeared to have little effect on carryover fraction pattern with roughly 28 to 30%. By far the greatest contribution to the allowable carryover fraction is the relationship between $F_{ABC}$ and the $F_{msy}$. When the population is actually being managed at a true F that is about 90% of $F_{msy}$ the maximum carryover % shows remarkable consistency with carryover percentages ranging between 9.4% and 10.1%.

These results, while not definitive are instructive as they suggest that carryovers greater than 30% would be excessive for a stock that is managed at a true F somewhere near 75% of $F_{msy}$. For stocks that are managed under a 75%$F_{msy}$, underages in year t that exceed 28-30% could be carried over into year t+1 but not proportionally. For example given an underage of 50% in year t the maximum carryover would be only 32%. Otherwise the realized F would exceed $F_{msy}$.

Figures 1 to 3 illustrate the need for a stepwise carryover policy that allows for a one to one carryover of catch up to a certain threshold. The threshold is relatively insensitive to differences among species. Instead, the primary influence is the buffer between the $F_{msy}$ or $F_{OFL}$ and the $F_{ABC}$. Gulf of Maine cod, Georges Bank haddock and witch flounder were judged to represent a range of life-history traits sufficient to reveal the expected responses of New England groundfish as a whole.

The influence of the harvest policy on the magnitude of allowable carryover is examined further in Figure 4. Applying Eq. 8 to Gulf of Maine cod, Georges Bank haddock and witch flounder demonstrates that the maximum carryover in year t+1 is driven primarily the magnitude of the buffer in harvest policy, expressed as a fraction of Fmsy. The magnitude of the allowable harvest increase in year t+1 increases with the buffer applied to F. Greater buffers imply lower Fs which mean that the stock size is greater such that larger fractions of catch can be carried over into year t+1. Differences among species have relatively minor influence on these computations.

IF the populations are actually being harvested at an F equal to 75% of Fmsy, then it appears that carryovers of about 29% are feasible. If the harvest rate is actually equal to 90% of Fmsy, owing to a biased stock size estimate (ie an underestimate biomass), then the carryover should be no more than 10%. In the unlikely event that the realized harvest policy was actually 50% of Fmsy instead of the 75% Fmsy target then the carryover could be as high as 70% (Fig 4, top line in each species plot).

**Discussion**

The analyses in this report rely on the behavior of modeled populations in the vicinity of an equilibrium point defined by a given harvest policy. For most New England groundfish this harvest policy is an F equal to 75% of Fmsy. For the seven species examined, the maximum carryover would be about 28 to 30% if the F were actually at 75% of Fmsy. If the true F exceeds this target, the maximum carryover that would avoid overfishing in year t+1 is much smaller, on the order of 8-9% when the true F is 90% of Fmsy. Uncertainty in the magnitude of the true F is the primary source of uncertainty in specifying a universal carryover policy.

Other sources of uncertainty include:

- The implications of increasing F for the target species also has implications for the F on co-occurring species. For example, a liberal haddock rollover policy could increase F on cod, which may not have been below it's quota in the previous year. Assuming that discards are being accurately monitored, the targeted quota for haddock in the "compensation" year might still be constrained by cod quota restrictions.
- The approach used herein does not account for nonequilibrium conditions that could be induced by temporal variations in recruitment or fishing mortality. Time did not permit a thorough investigation of the stochastic properties of such populations on allowable carryover.
- The analyses do not account for the additional uncertainty created by the carryover policy. A much more thorough analyses of carryover policies by Powers and Brooks (2008) revealed that carryover of underages can lead to poor performance of rebuilding and management systems. They noted a number of ways in which groups can attempt to "game" the system. Even when they made strong simplifying and unrealistic assumptions the ability to rebuild stocks was severely compromised by management policies that included carryover policies.

- Incorporating uncertainty in assessments, and imprecision or bias in estimated catch, is expected to reduce effectiveness of payback/carryover. Quantification of this uncertainty is difficult but it would ultimately have some bearing on the Council's risk policy.

Any carryover policy will be executed in real time, often without supporting evidence that the actions are appropriate given the current state of the stock. Hence consideration should be given to why the underage occurred in the first place. If the populations are truly are low in abundance then carryover policies could create an undesirable feedback loop that pushes the stock to progressively lower levels. Poor accounting of actual removals, if it creates perceived underages, would have a similar detrimental effect on population status. Stocks that are in rebuilding programs would be more vulnerable than rebuilt stocks.

There will be a large number of technical interactions among sectors and individual vessels. Many of these interactions will require detailed accounting measures that presently do not exist. Moreover there are many details to figure out for the specific case of NE groundfish sector ACE.

Carryover policies can be acceptable for management purposes as long as the risks are clearly understood and appropriate management actions are taken. The highly simplified model used to investigate the carryover policy ignores the uncertainty in the assessment, the reference points and the regulation implementation. Analyses of the efficacy of projections suggest major degradation of forecasting performance as the forecast period increased. All of these uncertainties suggest that major increases in harvest carryover policies should be approached with caution.

One final caveat for these analyses is that we have assumed that these harvest policies apply to the population as a whole. The diversity of behaviors that might arise within and between sectors has not been considered.

**References**

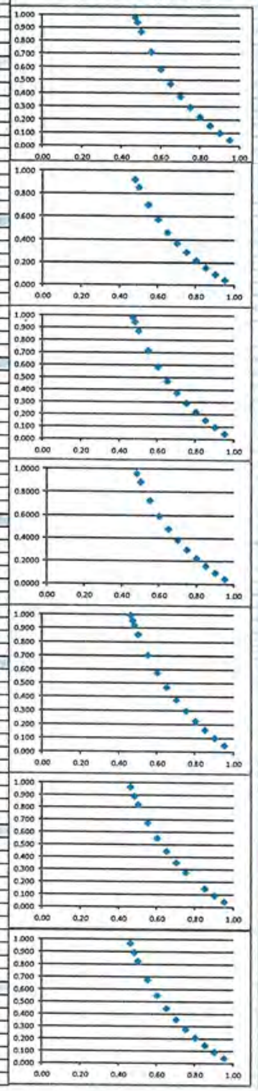

Powers, J. E., and Brooks, E. N. 2008. Penalties and rewards for over- and underages of catch allocations. ICES Journal of Marine Science, 65: 1541–1551.

Northeast Fisheries Science Center. 2008. Assessment of 19 Northeast Groundfish Stocks through 2007: Report of the 3rd Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts, August 4-8, 2008. US Dep Commer, NOAA FIsheries, Northeast Fish Sci Cent Ref Doc. 08-15; 884 p + xvii. http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0815/

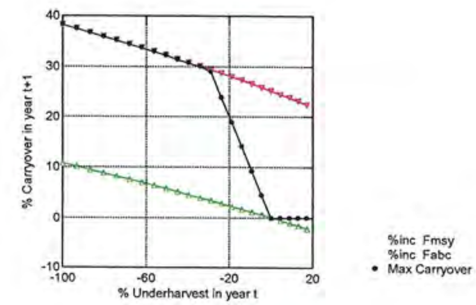
Table 1. Summary of maximum carryover fractions for varying levels of the true relationship between the realized F and the Fmsy proxy.

| Stock | Fmsy | *case* | *Fraction of Fmsy* | *Target F to define C_o* | *Realized F in year t* | *Max carryover fraction* |
|---|---|---|---|---|---|---|
| Gulf of Maine cod | 0.24 | 1 | 0.95 | 0.228 | 0.214 | 0.047 |
| | | 2 | 0.90 | 0.216 | 0.189 | 0.099 |
| | | 3 | 0.85 | 0.204 | 0.165 | 0.157 |
| | | 4 | 0.80 | 0.192 | 0.142 | 0.221 |
| | | ***5*** | ***0.75*** | ***0.18*** | ***0.119*** | ***0.294*** |
| | | 6 | 0.70 | 0.168 | 0.097 | 0.376 |
| | | 7 | 0.65 | 0.156 | 0.076 | 0.471 |
| | | 8 | 0.60 | 0.144 | 0.055 | 0.582 |
| | | 9 | 0.55 | 0.132 | 0.034 | 0.712 |
| | | 10 | 0.50 | 0.12 | 0.014 | 0.868 |
| | | 11 | 0.48 | 0.1152 | 0.006 | 0.940 |
| | | 12 | 0.47 | 0.1128 | 0.002 | 0.978 |
| Georges Bank haddock | 0.23 | 1 | 0.95 | 0.2185 | 0.205 | 0.047 |
| | | 2 | 0.90 | 0.207 | 0.181 | 0.099 |
| | | 3 | 0.85 | 0.1955 | 0.158 | 0.156 |
| | | 4 | 0.80 | 0.184 | 0.135 | 0.219 |
| | | ***5*** | ***0.75*** | ***0.1725*** | ***0.114*** | ***0.291*** |
| | | 6 | 0.70 | 0.161 | 0.093 | 0.372 |
| | | 7 | 0.65 | 0.1495 | 0.073 | 0.465 |
| | | 8 | 0.60 | 0.138 | 0.053 | 0.574 |
| | | 9 | 0.55 | 0.1265 | 0.034 | 0.701 |
| | | 10 | 0.50 | 0.115 | 0.015 | 0.854 |
| | | 11 | 0.48 | 0.1104 | 0.007 | 0.924 |
| Witch Flounder | 0.2 | 1 | 0.95 | 0.19 | 0.179 | 0.047 |
| | | 2 | 0.90 | 0.18 | 0.158 | 0.100 |
| | | 3 | 0.85 | 0.17 | 0.138 | 0.158 |
| | | 4 | 0.80 | 0.16 | 0.119 | 0.223 |
| | | ***5*** | ***0.75*** | ***0.15*** | ***0.100*** | ***0.296*** |
| | | 6 | 0.70 | 0.14 | 0.081 | 0.380 |
| | | 7 | 0.65 | 0.13 | 0.063 | 0.476 |
| | | 8 | 0.60 | 0.12 | 0.045 | 0.588 |
| | | 9 | 0.55 | 0.11 | 0.028 | 0.719 |
| | | 10 | 0.50 | 0.1 | 0.011 | 0.877 |
| | | 11 | 0.48 | 0.096 | 0.004 | 0.950 |
| | | 12 | 0.47 | 0.094 | 0.001 | 0.988 |
| American Plaice | 0.17 | 1 | 0.95 | 0.1615 | 0.1520 | 0.0479 |
| | | 2 | 0.90 | 0.153 | 0.1345 | 0.1009 |
| | | 3 | 0.85 | 0.1445 | 0.1174 | 0.1598 |
| | | 4 | 0.80 | 0.136 | 0.1008 | 0.2258 |
| | | ***5*** | ***0.75*** | ***0.1275*** | ***0.0846*** | ***0.3003*** |
| | | 6 | 0.70 | 0.119 | 0.0687 | 0.3853 |
| | | 7 | 0.65 | 0.1105 | 0.0532 | 0.4829 |
| | | 8 | 0.60 | 0.102 | 0.0379 | 0.5967 |
| | | 9 | 0.55 | 0.0935 | 0.0230 | 0.7308 |
| | | 10 | 0.50 | 0.085 | 0.0084 | 0.8914 |
| | | 11 | 0.48 | 0.0816 | 0.0026 | 0.9650 |
| White Hake | 0.29 | 1 | 0.95 | 0.2755 | 0.255 | 0.050 |
| | | 2 | 0.90 | 0.261 | 0.224 | 0.103 |
| | | 3 | 0.85 | 0.2465 | 0.194 | 0.161 |
| | | 4 | 0.80 | 0.232 | 0.166 | 0.225 |
| | | ***5*** | ***0.75*** | ***0.2175*** | ***0.139*** | ***0.297*** |
| | | 6 | 0.70 | 0.203 | 0.113 | 0.378 |
| | | 7 | 0.65 | 0.1885 | 0.088 | 0.470 |
| | | 8 | 0.60 | 0.174 | 0.064 | 0.578 |
| | | 9 | 0.55 | 0.1595 | 0.041 | 0.704 |
| | | 10 | 0.50 | 0.145 | 0.018 | 0.855 |
| | | 11 | 0.48 | 0.1392 | 0.009 | 0.924 |
| | | 12 | 0.47 | 0.1363 | 0.005 | 0.961 |
| | | 13 | 0.46 | 0.1334 | 0.000 | 0.999 |
| Southern New England yellowtail flounder | 0.25 | 1 | 0.95 | 0.2375 | 0.223 | 0.045 |
| | | 2 | 0.90 | 0.225 | 0.198 | 0.094 |
| | | 3 | 0.85 | 0.2125 | 0.173 | 0.149 |
| | | 4 | 0.85 | 0.2125 | 0.173 | 0.149 |
| | | ***5*** | ***0.75*** | ***0.1875*** | ***0.126*** | ***0.279*** |
| | | 6 | 0.70 | 0.175 | 0.104 | 0.357 |
| | | 7 | 0.65 | 0.1625 | 0.082 | 0.448 |
| | | 8 | 0.60 | 0.15 | 0.061 | 0.553 |
| | | 9 | 0.55 | 0.1375 | 0.040 | 0.677 |
| | | 10 | 0.50 | 0.125 | 0.019 | 0.825 |
| | | 11 | 0.48 | 0.12 | 0.011 | 0.893 |
| | | 12 | 0.46 | 0.115 | 0.003 | 0.967 |
| Cape Cod/Gulf of Maine yellowtail flounder | 0.24 | 1 | 0.95 | 0.228 | 0.215 | 0.045 |
| | | 2 | 0.90 | 0.216 | 0.190 | 0.094 |
| | | 3 | 0.85 | 0.204 | 0.167 | 0.149 |
| | | 4 | 0.80 | 0.192 | 0.144 | 0.210 |
| | | ***5*** | ***0.75*** | ***0.18*** | ***0.121*** | ***0.279*** |
| | | 6 | 0.70 | 0.168 | 0.100 | 0.358 |
| | | 7 | 0.65 | 0.156 | 0.079 | 0.449 |
| | | 8 | 0.60 | 0.144 | 0.058 | 0.554 |
| | | 9 | 0.55 | 0.132 | 0.038 | 0.679 |
| | | 10 | 0.50 | 0.12 | 0.018 | 0.828 |
| | | 11 | 0.48 | 0.1152 | 0.011 | 0.897 |
| | | 12 | 0.46 | 0.1104 | 0.003 | 0.971 |

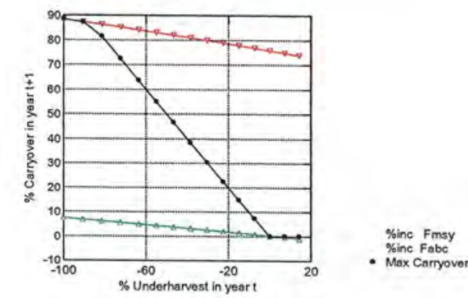
X axis is fraction of Fmsy to define baseline catch
Y axis is Maximum Carryover fraction



GOM cod: True F=75% Fmsy




GOM cod: True F=50% Fmsy




GOM cod: True F=90% Fmsy

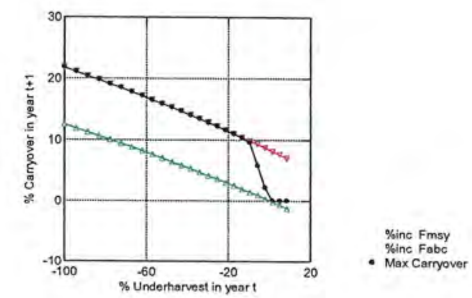
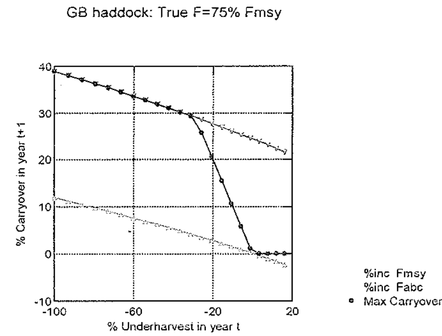
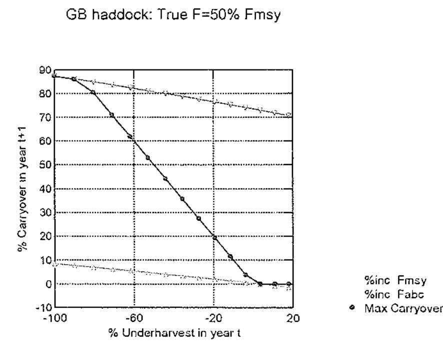


Fig. 1. Illustration of influence of true F in relation to Fmsy on the maximum carryover percentage for Gulf of Maine cod. X-axis is the underharvest fraction in year t; Y-axis is the carryover percentage in year t+1. The lower green line in each plot represents the expected increase in catch above the baseline equilibrium when $F=F_{ABC}$ in year t+1. The upper redline represents the maximum carryover that would be allowed when $F=F_{msy}$ in year t+1. The black solid line represents a complex control rule that allows a one for one carryover between year t and t+1 up to the point at which F exceeds $F_{msy}$. Three separate scenarios are considered in which the true F is set at 75%, 50% or 90% of $F_{msy}$.



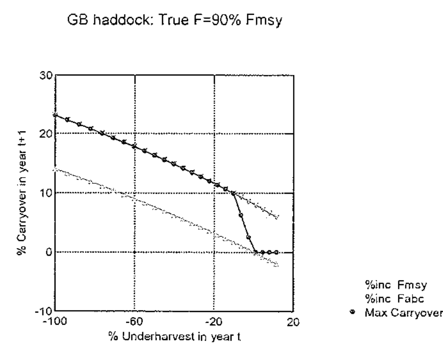



Fig. 2. Illustration of influence of true F in relation to Fmsy on the maximum carryover percentage for Georges Bank haddock. X-axis is the underharvest fraction in year t; Y-axis is the carryover percentage in year t+1. The lower green line in each plot represents the expected increase in catch above the baseline equilibrium when $F=F_{ABC}$ in year t+1. The upper redline represents the maximum carryover that would be allowed when $F=F_{msy}$ in year t+1. The black solid line represents a complex control rule that allows a one for one carryover between year t and t+1 up to the point at which F exceeds $F_{msy}$. Three separate scenarios are considered in which the true F is set at 75%, 50% or 90% of $F_{msy}$.

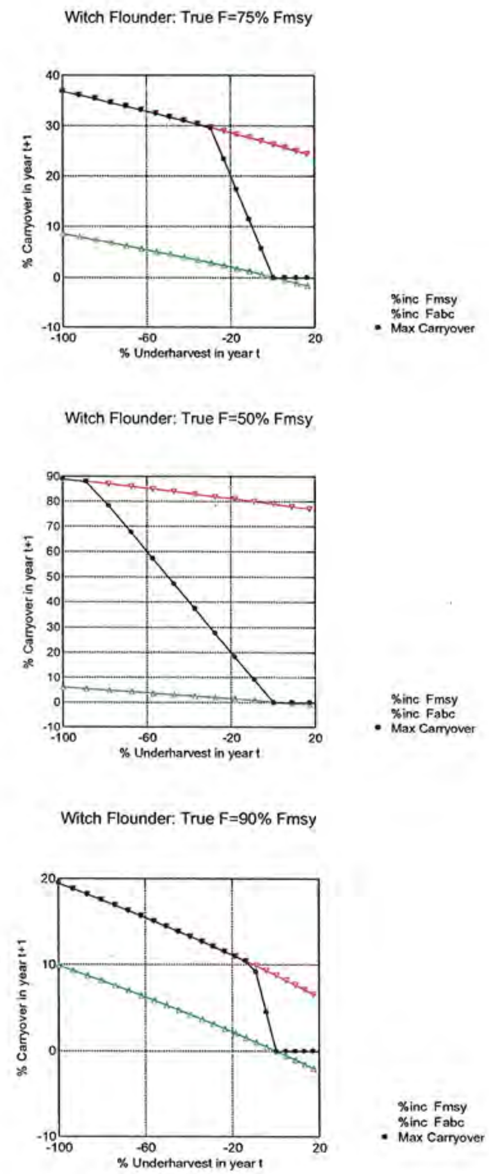
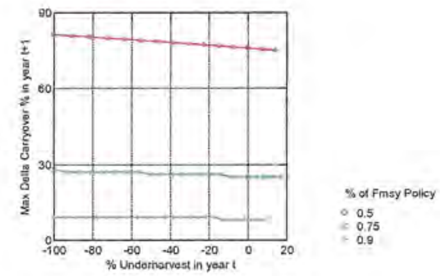
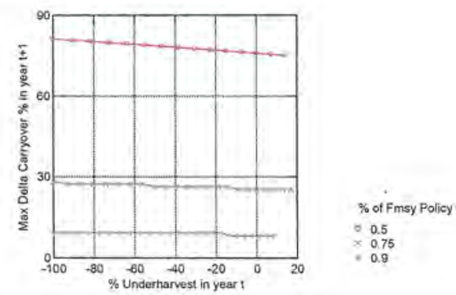


Fig. 3. Illustration of influence of true F in relation to Fmsy on the maximum carryover percentage for witch flounder. X-axis is the underharvest fraction in year t; Y-axis is the carryover percentage in year t+1. The lower green line in each plot represents the expected increase in catch above the baseline equilibrium when $F=F_{ABC}$ in year t+1. The upper redline represents the maximum carryover that would be allowed when $F=F_{msy}$ in year t+1. The black solid line represents a complex control rule that allows a one for one carryover between year t and t+1 up to the point at which F exceeds $F_{msy}$. Three separate scenarios are considered in which the true F is set at 75%, 50% or 90% of $F_{msy}$.

GOM cod: Max Increment Carryover given Alternative %Fmsy




GOM cod: Max Increment Carryover given Alternative %Fmsy




Witch Flounder: Max Increment Carryover given Alternative %Fmsy

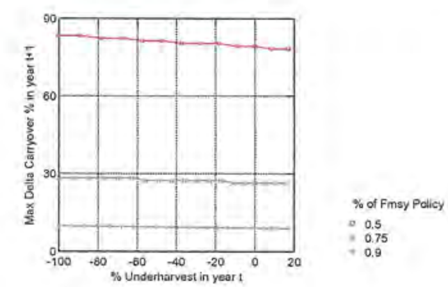


Fig. 4. Maximum percent increase in year t+1, expressed as the difference between a percent increase based on an $F_{msy}$ upper limit in year t+1 less an upper limit based on an $F_{ABC}$ harvest policy in year t versus the percent underharvest in year t. See Eq. 8 for computational details. Results illustrate that the maximum carryover in year t+1 is driven primarily the magnitude of the buffer in harvest policy, expressed as a fraction of Fmsy. The magnitude of the allowable harvest increase in year t+1 increases with the buffer in F. Greater buffers imply lower Fs which mean that the stock size is greater such that larger fractions of catch can be carried over into year t+1. Differences among species have relatively minor influence on these computations.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1315 East-West Highway
Silver Spring, Maryland 20910
THE DIRECTOR

JAN 13 2011



Mr. C.M. Cunningham, Jr.
Chairman
New England Fishery Management Council
50 Water Street
Newburyport, MA 01950

Dear Mr. Cunningham:

Thank you for your letter regarding Amendment 18 to consider accumulation limits and fleet diversity in the Northeast groundfish fishery. The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) is committed to working with the New England Fishery Management Council (Council) on this amendment as one of a suite of actions to support fishing community sustainability, a guiding principle in the National Oceanic and Atmospheric Administration catch share policy.

We recognize this will be a challenging issue for the Council and NMFS to tackle together given the demands of other priority actions and the concerns that have been expressed with respect to accumulation limits and fleet diversity. We have heard from those who support and those who do not support the implementation of such limits. As we move forward it will be critical to engage with as many members of industry as possible to formulate how to address this complex issue. We recognize the Gulf of Maine cod stock assessment and resulting changes in management measures, if needed, could significantly influence the purchase and sale of permits in the groundfish fishery.

NMFS is facing significant reductions to its fiscal year 2012 budget, including funding for catch share programs. However, we consider Amendment 18 to be of paramount importance in establishing an appropriate level of fleet diversity and therefore we are committed to advancing the amendment and will provide leadership and technical assistance within existing resources to address the tasks the Council identifies as necessary.

We look forward to working with the Council on the priority actions it has identified for 2012. If you have further questions, please contact the NMFS Northeast Regional Office, Sustainable Fisheries Division at (978) 281-9135.

Sincerely,

Eric C. Schwaab

THE ASSISTANT ADMINISTRATOR
FOR FISHERIES



cc: tn, ah.

(3)

New England Fishery Management Council
50 WATER STREET | NEWBURYPORT, MASSACHUSETTS 01950 | PHONE 978 465 0492 | FAX 978 465 3116
C.M. "Rip" Cunningham, Jr., *Chairman* | Paul J. Howard, *Executive Director*

November 28, 2011

Mr. Eric Schwaab
Assistant Administrator for Fisheries
National Marine Fisheries Service
1315 East-West Highway
Room 14636
Silver Spring, MD 20910

Dear Eric:

The Council recently decided on its priority issues and tasks for 2012. One particular issue led to a realization that the Council requires a special effort by NOAA Fisheries to actually accomplish a difficult and important catch-share related task in 2012: making substantial progress on an amendment to consider accumulation limits and fleet diversity (Amendment 18). This letter is the Council's formal request for a NOAA Fisheries' initiative to assist with the progress of that amendment.

Groundfish continues to demand our attention, especially catch-share management and ways to improve the industry's financial condition by providing more opportunity to achieve optimum yield from allocated stocks. The Council decided to: (1) coordinate action on the habitat omnibus amendment to include possible modifications of the groundfish closed areas; (2) prepare a framework action to adjust sector rules based on lessons learned from the October 2011 Sector Workshop, e.g., OY, is not being caught and measures should be developed to achieve OY, and increase the 10% quota rollover provision in response to the Regional Administrator's June 20, 2011 letter; (3) prepare a framework to respond to new assessment information for nine stocks; (4) develop options to move unused ACE between scallop/groundfish fleets and between groundfish commercial and recreational fleets; and (5) continue Amendment 18 to consider fleet diversity and accumulation caps.

Recognizing the demand on our time, funding, and staff resources to accomplish all these tasks and NOAA Fisheries' intent to constructively advance catch-share programs and initiatives, the Council decided to reference the NOAA Catch Share Policy and, accordingly, to ask for your assistance. The following motion was made and adopted:

> *"Consistent with (1) NOAA's catch share policy to 'support the design, implementation, and monitoring of catch share programs' to ensure these programs have the highest likelihood of success and (2) the NMFS commitment to work with the Council to address the problem of individual permit holders acquiring excessive control of fishing privileges (Amendment 16 final rule), the Council requests NOAA Fisheries provide leadership, technical assistance, and funding to reduce administrative and organizational impediments for the development of Amendment 18 dealing with fleet diversity and consolidation issues."*

Without added resources we suspect this amendment will have little chance of being completed in a timely way and consistent with NOAA's Catch Share Policy.

The Council fully appreciates the many demands on NOAA Fisheries. Nevertheless, we know resources can be marshaled when there is an urgent need, and we believe that need exists because without addressing what currently may be unrestrained opportunities for consolidation and acquisition of "excessive" shares, we – and NOAA – could find ourselves violating the carefully crafted Catch Share Policy.

The need to address this could be made even more urgent if the ongoing GOM cod assessment finds a dramatic change in stock. The likely result will be action in 2012 to severely curtail the GOM cod. The Gulf of Maine groundfish fishery relies on cod and groundfish businesses in this area could be devastated. More fishermen could be without options except to sell their permits or lease away their low allocations and switch to other non-groundfish fisheries, if they have the necessary permits. This is not the outcome the Council or NOAA Fisheries wants for 2012. Therefore, it is paramount for us to have an added NOAA Fisheries commitment to assist and work with the Council to address your policy and the Council's objectives for implementing accumulation limits and maintaining fleet diversity. While we have not yet identified the exact tasks and timing that would be of greatest assistance, we felt it was important to convey this request for collaboration and assistance as we continue to develop this action.

We look forward to discussing our request with you at your earliest convenience.

Sincerely,

C.M. 'Rip' Cunningham, Jr.
Chairman

91 FAIRVIEW AVE
PORSTMOUTH NH 03801

**NORTHEAST HOOK FISHERMAN'S ASSOCIATION**



January 18, 2012

**New England Fishery Management Council**
50 Water Street, Mill 2
Newburyport, MA 01950
Phone: (978) 465-0492
Fax: (978) 465-3116

**SUBJECT: 53rd Northeast Regional Stock Assessment Workshop (SAW 53)/ Stock Assessment Review Committee (SARC) Meeting. 100% MORTALITY GOM COD**

Dear NEFMC Council Members & SSC Members:

The NEHFA represents a small group of Commercial Fishermen with the Limited Access Handgear (HA) Permits, employing the use Rod and Reel or Hand lines to catch Cod, Haddock and Pollock along with small quantities of other regulated and non-regulated marine fish. Our group takes great pride in the fact that we use traditional fishing methods that have been used for generations. Our numbers are low as is the quantity of fish we catch. Our method of fishing has been mostly replaced by modem fishing methods. We stubbornly employ the use of Handgear because we firmly believe it is the most environmentally friendly method of commercial fishing.

We wish to provide our years of on the water cod fishing experience to hopefully correct what our group feels is a flaw in the assessment process. Specifically with regard to the Discard Mortality of GOM cod. The results of the Stock Assessment Working Group Data Meeting came to the conclusion that the discard mortality of GOM cod will be 100% for Handline (commercial and recreational). They came to this conclusion over what appeared to be much debate. We firmly believe that this number for Handline jigged cod is 100% wrong. We believe that the actual discard mortality to be around 5-10% for this gear. We provide the following reasons:

1. "Survival of Discarded Sublegal Atlantic Cod in the Northwest Atlantic Demersal Longline Fishery" North American Journal of Fisheries Management 29:985–995, 2009 is **the best available science** on this topic and should be used as a primary reference for the assessment. Figure 2 clearly shows the survival of sub legal jigged cod is at approximately 90% for the cold water temperatures usually found in the GOM. Although "dead weak or injured fish" were not included in the study the percentage of cod jigged that would fall into this category would be very small. Most cod are caught in the mouth when jigged and only a small area where the hook penetrates is where the fish would be harmed. This study backs up our experience and states "Because only healthy jigged fish were selected, the calculated survival rate is for these fish only and does not take into account those that died and were discarded. That said, **it was rare to discard jigged fish, as most of them were vigorous when captured** and before caging. Regrettably, the number of jigged fish that were discarded was not recorded".

2. The Stock Assessment Working Group reviewed various studies and hypnotized how they may be flawed. We disagree with almost all of their assumptions made to invalidate the results of the various studies available. We will address each of the assumptions below:

    a) ***Handling*:** Commercial cod jig fishermen typically use J style de-hookers. The cod is quickly unhooked and released over the side in one quick motion. The cod is typically not handled since the jig is held with one hand and the de-hooker in the other. The whole process takes split seconds and no slime is removed nor does the fish ever touch the deck.

    b) ***Impacts on growth due to reduced feeding ability*:** This would be insignificant concern. Cod are voracious predators and will not be deterred from feeding. Several cod tagging studies for cod caught in the GOM have shown that cod continue to grow normally after captured and released. The small wound from a fish hook would very quickly heal.

    c) ***Whether predator avoidance was compromised or predator exposure was increased at release time (birds, mammals, other fish predators):*** Cod are essentially the chief predator for most of the year in the GOM. When they are found in abundance in the spring and early summer the only predator would be the porbegal shark. Since porbegal sharks are not common, the interaction between a recently released cod and these sharks would be extremely rare. Blue sharks are another potential predator (in the summer) but like porbegal sharks the interaction would also be very rare for a recently released cod. As far as any other predators (Birds, mammals, etc.) these interactions would be de minimus. Spiny Dogfish usually appear in the GOM in July after the majority of the spring cod have moved on with the baitfish. Spiny dogfish do not normally prey on sub legal cod of the size that are typically caught by jigging. Again any interaction between spiny dogfish and sub legal cod when using Handlines would be de minimus.

    d) ***"It was noted that studies where fish were held in cages to evaluate survival could be biased either high or low. On the one hand, being held in a cage reduces exposure to predation, which would inflate estimates of survival. On the other hand, the cage could induce stress, damage to fish from contact with the cage, and even mortality due to cannibalism—all factors that could potentially increase mortality".*:** We do not believe the cages in the various studies protected the cod from predation due to the low interaction between the cod and predators as mentioned above. We do believe there could be some increased mortality when the cod are kept in cages after being caught. The fish is stressed from being caught and then placed into a cage potentially causing more stress since the fish can't seek its preferred depth or temperature to recover naturally.

3. The Stock Assessment Working Group failed to adequately consider the "Activity and distribution of cod in the Ipswich Bay spawning area" Northeast Consortium 2005. Although this study did not deal with release mortality it should be noted that the cod for the study were caught using a trawl. The fish were sedated, operated on to insert DST tags, and released. Even with the stress encountered during this study, the recapture rate was 15.5% and some cod traveled 48km with some recaptures 757 days later. I personally participated in this study and I was quite amazed with the ability for cod to recover from the process of inserting a DST tag into the belly of the fish. **By observation one can infer this process would be much more stressful on a cod then catching cod using Handlines.**

4. The Stock Assessment Working Group failed to adequately review the various tagging studies for GOM cod such as the "Northeast Regional Cod Tagging Program (NRCTP)" and other cod tagging studies that may have used handlines to tag cod. There may be a wealth of information that can be obtained by reviewing the percentage of cod tagged that were returned using handlines. It should be obvious that if a cod was tagged, traveled many miles and was recaptured years later that it is not logical to assume 100% discard mortality. **How can a successful cod tagging study be possible if they all die after being caught?**

The members of the NEHFA are asking you to fully reject the 100% discard mortality values used for commercially caught cod using handlines and I would suspect that the 100% discard mortality for recreationally caught cod is also an inappropriate value. Accepting the 100% discard mortality of hook and line caught cod flies in the face of conservation. We request that you ask the working group to go back and try again. This time it is suggested that experience handline fishermen should have a seat at the table as a member so their experience and wealth of real knowledge can utilized to hopefully to produce a GOM cod assessment that can be accepted by all. **This is a very significant issue** with the introduction of catch shares fishery Management. The implications are that the NMFS may use the 100% discard mortality and quotas may be cut in half. **It would be absolutely wrong to assume every cod that is caught by using a handline ends up dead.**

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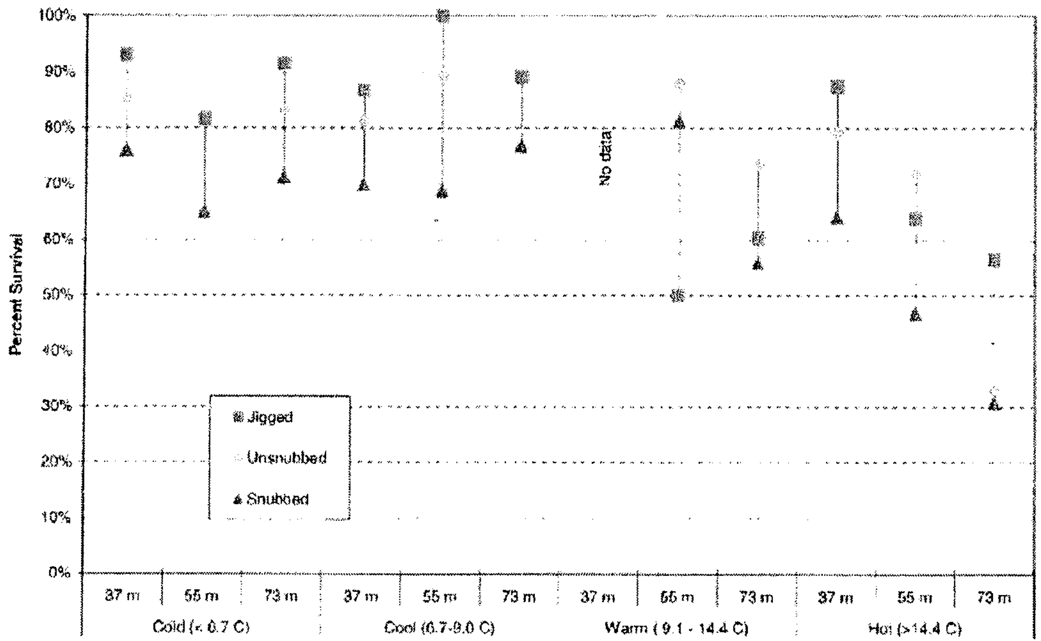



FIGURE 2.—Survival of sublegal-size Atlantic cod by depth of capture, sea surface temperature, and capture or dehooking technique.

**Respectfully,**

**Marc Stettner**

NEHFA MEMBERS: Christopher DiPilato, Paul Hoffman, Hilary Dombrowski, Scott Rice, Ed Snell, Marc Stettner

*If you are a holder of a groundfish HA permit and wish to join the NEHFA, please contact the NEHFA at the address above.*

UNITED STATES DEPARTMENT OF COMMERCE
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Science Center
166 Water Street
Woods Hole, MA 02543-1026



January 17, 2012

RECEIVED
JAN 17 2012
NEW ENGLAND FISHERY
MANAGEMENT COUNCIL

Capt. Paul J. Howard
Executive Director
New England Fishery Management Council
50 Water Street
Newburyport, MA 01950

Dear Paul:

Thank you for your letter of January 11 requesting the Center to review the document prepared by Mr. David Goethel on the SARC 53 Gulf of Maine cod assessment. My staff has reviewed this document, and enclosed are our comments for consideration by the SSC at its January 25 meeting.

If you have any questions, please contact me.

Sincerely,

William A. Karp, Ph.D.
Acting Science and Research Director

Enclosure

# 2010 Gulf of Maine Cod Working Group Assessment Notes

The following notes were prepared by NOAA's Northeast Fisheries Science Center at the request of the New England Fishery Management Council to assist its Scientific and Statistical Committee in reviewing the recent assessment of Gulf of Maine cod. The issues addressed were raised by a council member in written form, and that document will also be considered by the Scientific and Statistical Committee.

## Biology

- *Stock identification is incorrect for cod in New England*
    - *Tagging evidence suggests that cod stock boundaries should be separated into: eastern Gulf of Maine-Eastern Georges Bank, and western Gulf of Maine-Cape Cod-Southern New England.*
    - *Information regarding stock structure and discussions regarding proper stock boundaries were explicitly avoided during the assessment meetings for Gulf of Maine cod even though the current boundaries are highly questionable in light of the last decade of scientific research.*

    Reconsidering cod stock boundaries requires a comprehensive evaluation for all stock components and available information, including any new tagging data, rather than one component in isolation. This kind of review is beyond the normal SAW/SARC benchmark assessment process, and was not a term of reference for the SARC 53 Gulf of Maine cod assessment. Reconsideration of boundaries also affects management measures that are based on them, such as annual allocations of cod to the fishery, and fishery data collection and monitoring requirements. This kind of thorough biological and management review is best conducted in collaboration with Canadians and all stakeholders well in advance of any benchmark assessment for a single stock.

    *It is widely believed that the recent expansion of cod into Southern New England (a region with historically low cod abundance in recent decades) is due to a 'spillover' migration effect of cod from the Gulf of Maine. This suggests that the Gulf of Maine cod stock is actually expanding and contradicts the stock contraction hypothesis being presented by NEFSC.*

Based on NEFSC survey data for cod, the contraction of cod to the western Gulf of Maine is a statement of fact. Within the Gulf of Maine region cod do not exhibit a wide spatial distribution as they did prior to 1980; cod are not showing up in areas where they have been historically plentiful (central and eastern Gulf of Maine). We are aware that fishermen are reporting cod in high densities in certain areas of southern New England. However, preliminary explorations of biomass trends in the southern New England waters suggests that overall biomass in these areas has declined over the past forty years with little to no evidence of recent increases (more details on these analyses are presented later). Such trends would appear to run counter to a 'spillover' hypothesis.

- *The length-weight relation and catch weight-at-age matrix are unreliable*
    - *The length-weight relation is based on survey catch and not on the commercial catch*

    The rationale for how the length-weight relationship was derived was provided on page 15 of SARC 53 WP#1:

    *"Currently in the Northeast Region, fishery surveys are the only source of individual length-weight sampling."*

    Had other sources of individual lengths and weights been available and presented during the Gulf of Maine Cod Data Meeting, these could have been evaluated and compared to the LW relationships generated from the survey data. The length-weight relationship is used not only to estimate catch weights, but to also derive spawning and stock weights. It is more appropriate to use a survey-based length-weight relationship to derive spawning and stock weights to avoid bias caused any size-at-age selectivity associated with gears used in the fishery.

    - *Catch weight-at-age matrix is averaged over the recreational and commercial fisheries and over discard and landed catch*
        - *This acts to blur the signals in the catch because the weight of recreationally caught fish are lower than that of commercial fish thereby decreasing the weight of 'caught' fish in the model*

    This is precisely why the weights-at-age used in the previous (2008) assessment were biased high; the previous assessment did not fully account for the lighter fish-at-age that characterize the discard component of the catch. An average weight-at-age from all catch sources is the correct method to estimate true catch weights-at-age. Additionally, the average weights-at-age were not simple arithmetic averages across all catch sources, but rather were weighted proportionally by the numbers in each of the catch sources. A numbers-weighted average approach preserves the proportional contribution of each catch source to the weight-at-age. This is clearly documented on page 28 of SARC 53 WP#1:

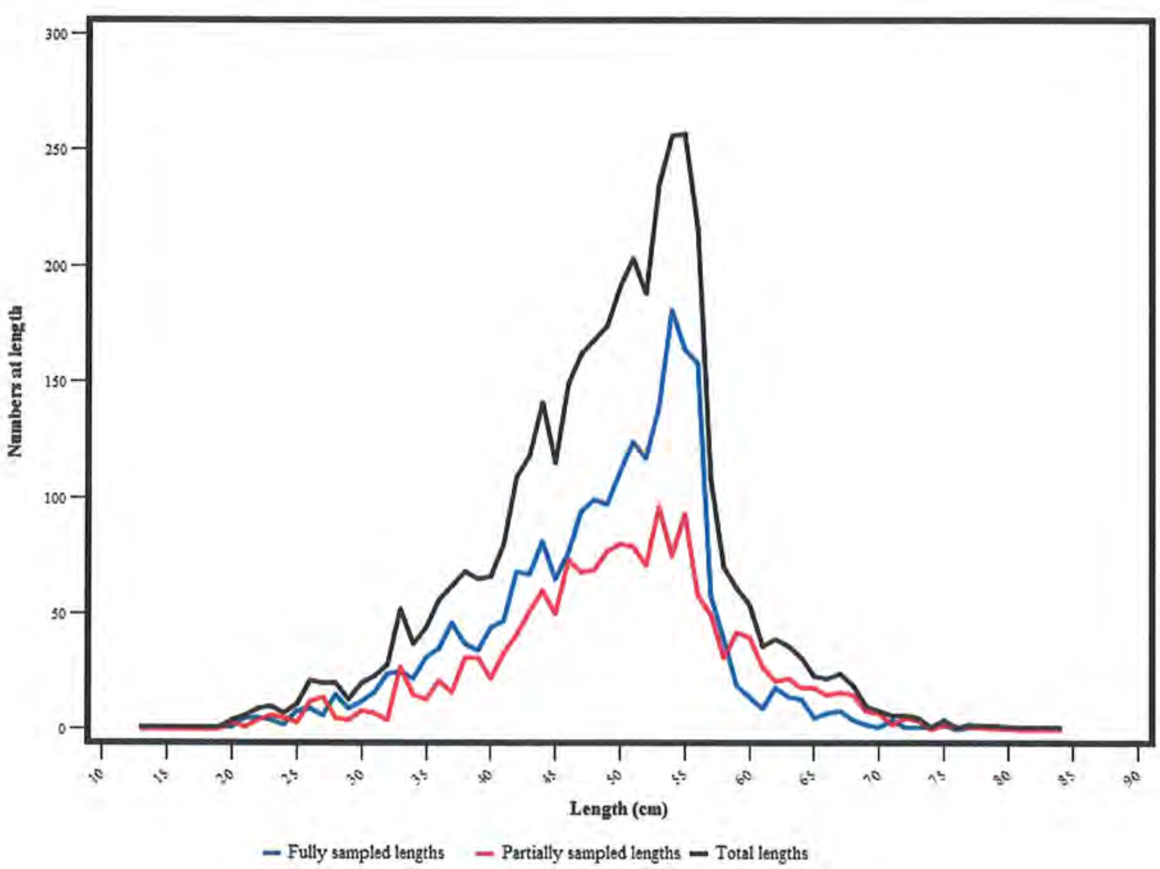
    "Mean catch weights-at-age were estimated by using a numbers weighted average of the individual catch component's mean weight-at-age."

- *There is an apparent under-sampling of older fish in the catch-at-age, which gives the appearance of a truncated age-structure and increased F-at-age*

    The basis or evidence for this statement is not clear. Sampling coverage rates, by market category (Table A.10), reveal a nearly 10-fold increase in sampling coverage since the 1990s. Moreover, in recent years, the number of length samples of "large" cod has often exceeded the number of samples of "market" size cod.

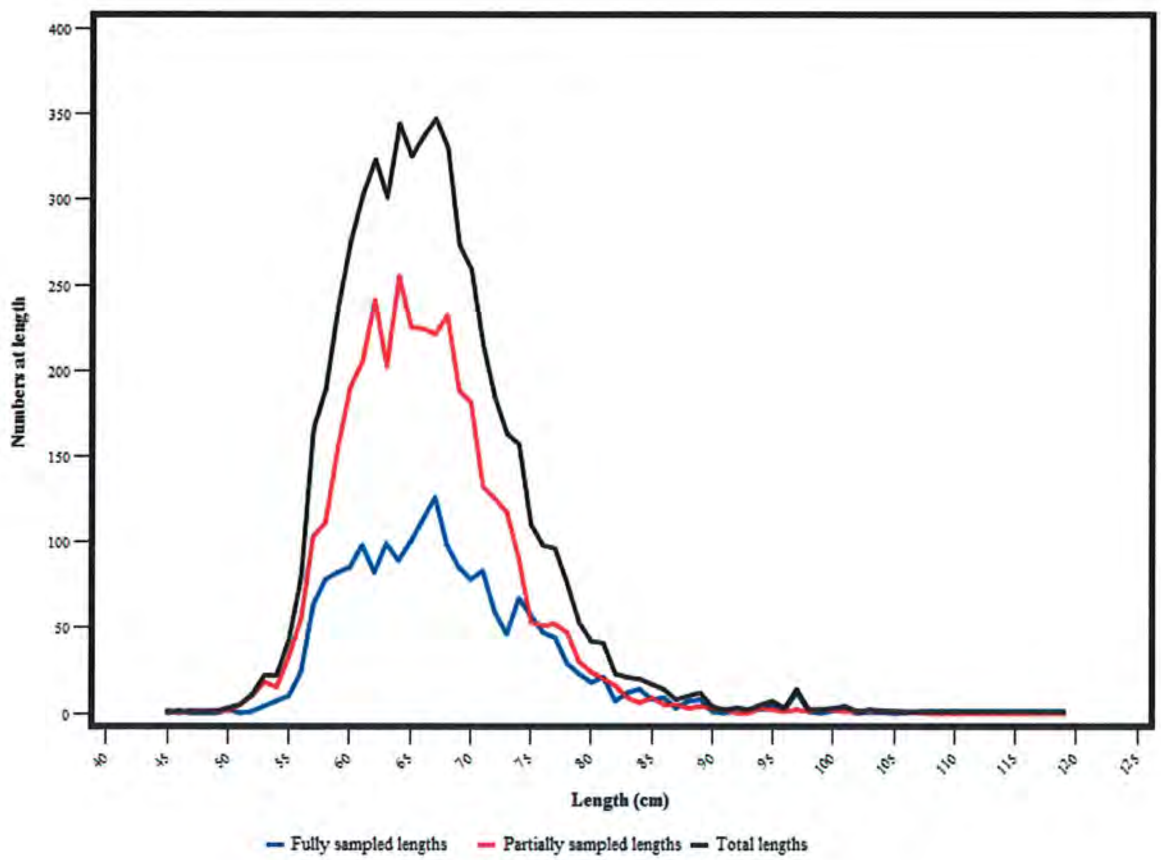
- *Observer samples do not accurately reflect the actual catch, perhaps due to focusing on measuring smaller discarded fish.*

  The available data do not support this statement. As an example, the figure depicts the length frequency distribution of Gulf of Maine cod discarded by the otter trawl fleet in 2008, based on two types of length frequency samples taken by observers: the blue line represents the length frequency distribution when all discarded cod in a particular tow were measured (n=2,305 lengths); the red line represents the length frequency distribution when only a fraction of the discarded cod could be measured (n=1,671 lengths) (and the black line is the combined length frequency distribution using all the sampling data). Partial sampling occurs when an observer cannot measure the entire catch due to time constraints, or the volume of discards is so great that a representative subsample is taken to adequately characterize the size distribution of the catch. If observers preferentially measured small fish in the discards when they sampled only a subset of the fish, the red line should be shifted to the left. However, it is not. The length frequencies from the two types of samples are nearly identical indicating that when observers take subsamples, they do so in a manner that provides an accurate representation of the length composition of the catch.



- *Large, older fish are not being properly sampled and this has led to a lack of old (age-7+) fish being 'seen'.*

  Assuming that this refers to observer catch samples, the available data do not support this statement. As most older cod are the larger cod that are typically retained and landed, the analysis shown above for discarded cod was repeated, except using the observed length frequencies of the retained catch (year=2009, gear=otter trawl). In the figure below, the blue line is the length frequency distribution when all retained cod in a particular tow were measured (n=1,923 lengths), and the red line is the length frequency distribution when only a fraction of the retained cod could be measured (n=3,691 lengths). Again, the length frequency distributions are nearly identical implying that all lengths (and ages) are representatively sampled.




- *Very few otoliths of fish greater than age -7 are being taken during surveys (which is used for determining the length-weight equation).*

  Large cod taken in the survey have the same sampling intensity as any other size group of cod. The survey samples otoliths in proportion to the length composition of the survey catches. The sampling protocol for cod on surveys throughout most of the assessment time series has been to obtain 3 otolith samples per 3 cm length frequency interval.

- *It is likely that port samples of cod otoliths are also biased towards smaller fish (reported samples are divided by market category and not age; it is likely that samplers are taking a majority of otoliths from smaller fish within each market category and sampling at times of year and ports where large fish are not being landed, thereby violating the random stratified sampling design).*

  The basis for this statement is not presented. Table A.10 in the assessment report shows the thoroughness of the sampling effort with respect to market categories and seasonal sampling. This table also indicates that substantial improvements have occurred in commercial sampling efforts during the past 10 years.

- *Use of external data sources could help to verify age-structure information (e.g., gear studies and tagging studies that have information on age or length structure could be used as an exploratory check).*

  Agreed. However, no validation data were brought forward for consideration by the Data Working Group

- *The age-9+ formulation is invalid and underutilizes the flexibility of the Age-Structured Assessment Program (ASAP) framework.*

  It is unclear how use of an age $9^{+}$ group underutilizes the flexibility of the ASAP framework, or why the age 9+ formulation is thought to be "invalid". Clearly, considerable uncertainty exists in the catch-at-age beyond age 9, and even at younger ages earlier in the assessment time period (see Table A.14 in SARC 53 WP#1). More importantly, for 13 years in the time period covered in the assessment, no fish older than 11 years old occurred in the catch samples. Moving the plus age group beyond age 9 was explored in several of the ASAP sensitivity runs, as well as in the base VPA model examined by the Models Working Group and the SARC Panel. Models with extended age structure produced highly uncertain estimates of selectivity on the older ages, and did not alter the perception of the resource.

  - *The length-weight relation clearly shows that fish continue to grow past age-16, yet the age-structure used implicitly assumes no growth after age-9 by assuming a plus group at this age and an associated average weight of fish in this group.*

    - *Considering cod's ability to put on significant weight after age-9, this formulation inherently underestimates SSB and biomass if even a few older fish survive out to ages greater than age-9*

      The mean weight-at-age of the age $9^{+}$ group is neither the weight-at-age of the age 9 fish, nor a straight average of the age $9 – 11^{+}$ fish. It is a numbers-weighted average of all age groups included in the plus group, and thus explicitly accounts for growth of fish out to the maximum age in the catch in any given year. This is illustrated by examining Table A.40 in SARC 53 WP#1.

- *Constant natural mortality (M=0.2) assumption is biologically unrealistic*
    - *This estimate is based on a maximum age of 15-17 years, yet the length-weight relation indicates cod continue growing past this age so it seems unlikely that the fish would [not] continue to grow up until the maximum age.*

      See the previous response with regard to growth. The use of M=0.2 in the assessment is not based on a maximum age of 15-17 years. M=0.2 is the precedent used in previous Gulf of Maine cod assessments. This assumption was reviewed as part of the SARC 53 benchmark assessment and evaluated using meta-analyses to determine the validity of this assumption. The Working Group examined alternate values of M that were based on a suite of life history parameters, such as maximum observed age, growth, and energy allocation strategies. All approaches suggested that the assumption of M=0.2 remained appropriate for this stock (that is, it is biologically realistic).

    - *Additionally, changes in the ecosystem over the last 3 decades would indicate the necessity for a time-varying natural mortality rate and also an age-varying natural mortality*
        - *Juveniles are well documented to inhabit different habitats from adults and predation is much heavier on juveniles (e.g., seal and dog fish predation)*
        - *Lack of 2007 year class recruiting to fishery as predicted in GARM III might be an indication of high predation on age-1 fish meaning a higher M is supported for juvenile cod.*

          It is assumed that the statement above refers to the 2005 year class, not the 2007 year class. These types of ecosystem issues were discussed by the Working Group, but no empirical evidence (i.e., data) was available to support or evaluate their validity. An additional hypothesis, other than predation, variable/different natural mortality, or sampling anomalies (i.e. the cohort was never really that large), is unreported discarding of undersized fish. Unfortunately, there are no data to evaluate this hypothesis either.

## Catch

- *Observed catch is split by recreational/commercial and landed/discarded but models fitted to these more 'complex' data sets were deemed too unstable and showed results "similar to the simple (lumped catch) model"*
    - *Although the model might be more statistically stable, it is much less biologically realistic due to the severe differences in selectivity and weight of the commercial and recreational catch.*

    While biological realism in any model is a desired goal, model stability is critical if the sensitivity of the model to alternate assumptions is to be explored. The flexibility to perform these types of sensitivity runs is precisely why the more complex models were abandoned; they did not provide the stability that would allow a full exploration of model sensitivity to alternate assumptions. Nonetheless, the results from the more complex model configurations were very similar to the final BASE model put forward at the SARC. These results support the robustness of the BASE model output and indicate that the catch and weight components were aggregated in a technically appropriate way.

- *Tradeoffs between biological realism and statistical assumptions must be made, however this assessment always errs on the side of statistics instead of actual, proven biology.*

  The basis for this statement is unclear and not supported. The assessment modeling process placed a premium on making objective evidence (including biological data and all statistical and modeling assumptions) available for examination and comment by all.

- *Fishery selectivity was broken down into two time blocks (pre and post 1991) based on statistical fit, yet no management actions or fishery changes support this choice.*

This statement is not correct. The decision about where to split the two selectivity blocks was informed by the major changes that occurred in the fishery during the early 1990s. This is clearly documented on page 37 of SARC 53 WP#1:

> *"An additional selectivity block was introduced beginning in 1989 and several intermediate models were run exploring splits from 1989 to 1994. The period from 1989 to 1994 encompassed major changes in data availability, reporting sources and fisheries management. The model with the 1990/91 split had the lowest objective function and offered improved fit to the age composition in the way of the reduced residual patterning."*

- *Due to lumping of fishery catch across recreational and commercial fleets it is impossible to gain any biological insight into what the estimated selectivity patterns indicate (i.e., is one fleet fishing more heavily on older fish, etc...) and it is impossible to determine the individual effects of each fleet (i.e., is the fishing mortality greater from the recreational or commercial component, which is an important facet when determining possible future management scenarios)*

  - *This is another indication that degradation of the data in order to simply increase statistical fit at the cost of biological insight is inappropriate*

    Model configurations that split the catch into individual components were explored as documented in SARC 53 WP#1 (page 36-37), and had very little impact on the overall assessment results. These earlier models had severe diagnostic problems and did not fit the data very well (e.g. consistent overestimation/underestimation of some catch inputs). A model with a poor statistical fit raises serious concerns about how accurately it is interpreting the data, and whether such a model presents a solid framework on which to base management advice. Models with poor statistical fits are almost invariably rejected by peer-review panels.

    Furthermore, stability is desirable in terms of reducing retrospective patterns. The BASE model has a much more stable basis and a reduced retrospective error compared to alternative, more complex model configurations.

- *Marine Recreational Fishery Statistic Survey (MRFSS) data is used to estimate recreational catch-at-age by imputation based on MRFSS estimates of numbers caught at length and applying the NEFSC survey length-weight equations*
    - *Uncertainty in MRFSS data is well known and estimates in recent years counter data from other sources and common sense*
        - *Vessel trip reports (VTR) from recreational head boats indicate catch estimates 75% lower than MRFSS data.*

          VTR data are only collected from federally permitted vessels. On average, 55% of the recreational catch comes from private vessels with no VTR reporting requirements (SARC WP#1, Table A.25). Additionally, the VTR data provide almost no information on the magnitude of recreational discards.

        - *It is difficult to believe that recreational vessels accounted for the same level of catch (~5500mt) as commercial vessels in 2010.*

          There is uncertainty in the MRFSS numbers, particularly the 2010 estimate, and this is noted in the assessment (page 26 of SARC 53 WP#1). Preliminary MRIP numbers (which were not available at the time of the assessment) suggest that recreational catch may be less than the MRFSS estimate. Sensitivity of the ASAP model to lower estimates of recreational catch have been conducted and —while the modeling results are similar—the net effect is that the MRIP-adjusted ASAP run estimate of the 2010 spawning stock biomass (11,033 mt) is lower relative to the estimate from the base ASAP model (11,868 mt).

- *This is the first time that recreational discard levels have been included in the assessment, however estimates are basically guesses with extremely high and ever increasing levels (~2300mt in 2010).*

  Recreational discards have been reported in previous assessments, but never formally incorporated into the assessment model. The inclusion of all fishery catch components in the updated assessment represents an improvement over past assessments. Estimates of recreational discards are about as certain as type B1 recreational landings. Type B1 landings have been included in previous assessments and, over the course of the assessment period, typically have accounted for more than half of the recreational landings.

- *Discard mortality is assumed 100% for all fisheries because the literature does not provide a comprehensive estimate of mortality rates for all gear type and seasonal combinations*
    - *Most literature proves that discard mortality is less than 100%, which considering levels of assumed discard rates could provide substantial sources of biomass that are being falsely accounted as mortality within the model, yet no sensitivity runs were undertaken to look at the affect of the assumed discard mortality rate.*

      Mortality estimates provided in the literature typically only consider short term survival (<72 hours) in the absence of post-release predation. There is work to suggest that short-term survival may underestimate true post-capture mortality by as much as 50%. Additionally, literature studies indicate a compromised ability of discarded fish to avoid predators post-release (e.g., inability to dive due to swelling of the air bladder, decreased schooling ability, compromised swimming ability, and fatigue). Although it is reasonable to assume that some fraction of the discarded fish survives, the literature available is insufficient to accurately quantify the extent of this survival. While sensitivity runs evaluating alternate assumptions of discard mortality were not explicitly performed as part of the SARC 53 (the VPA bridge building process allowed some evaluation of the impacts), subsequent sensitivity runs have been conducted. The net impact of assuming lower discard mortality lowers estimates of both spawning stock biomass and fishing mortality. Even under an assumption of 0% discard mortality, the Gulf of Maine cod stock remains overfished (virtually no change in 2010 SSB) and overfishing is still occurring at a fishing mortality rate 3 times higher than $F_{MSY}$.

## Surveys

- *Inshore strata of the NEFSC surveys were excluded from the assessment due to inconsistent sampling even though they provide indications of higher age-0 to 2 indices of abundance.*

  Inshore survey data were not used because the inshore areas have been inconsistently sampled. Therefore inclusion of these data would add noise, rather than a signal, to the age 0-2 survey indices used in the assessment. Had the survey captured more age 0-2 fish, recruitment estimates would not necessarily have been have been higher. The model estimates a selectivity ogive for each survey that provides information on the relative selectivity by age in that survey. Had inshore indices been included, this would likely have resulted in higher selectivity-at-age for the NEFSC survey similar to that observed for the MADMF survey. The higher selectivity would have generated the same basic age 0-2 signal in the survey, as observed in the offshore survey data. The best surveys are those that provide precise estimates of population trend, regardless of scale. Higher, but more variable indices degrade the performance of a model and decrease the likelihood of a model providing accurate results.

- *Massachusetts Division of Marine Fisheries (MADMF) surveys are the only reliable estimators of juvenile fish abundance because they survey inshore juvenile habitat, however they are consistently down weighted and the MADMF fall survey was completely removed from the final model.*

  The MADMF spring survey data were not down-weighted. The MADMF spring survey was given the same treatment as the two NMFS surveys. The MADMF fall survey was removed from the final model because: (a) this survey primarily catches only age 0 and 1 fish, and catches of these age groups are highly variable and have been shown to be poor indicators of incoming recruitment (see Fig. A.102 in SARC 53 WP#1); and (b) the removal of the MADMF fall survey did not affect the assessment results.

- *Surveys supposedly cover all areas of major cod catch and accurately represent abundance trends, yet years with high catch rates are consistently considered outliers.*

  The last phrase in this statement is not correct. Years with high catch rates are NOT considered outliers. The ASAP model uses all data, both high and low survey indices, and uses the information contained in the survey data itself (estimates of precision) to determine how well to fit any given year of survey data.

  - *Over the entire time series the NEFSC may cover all areas of major cod catches, but not on a consistent year to year basis (i.e., major areas of cod concentration are sampled sporadically over the last 15 years, however on a year to year basis many concentrations are missed which is likely one contribution to seeing large tows dominate survey catch and cause jumps in catch from year to year).*

    The NEFSC surveys use a random stratified sampling design. Sampling only cod concentrations would impart a positive bias to the fisheries-independent estimates of abundance. The intent of the survey is to achieve a consistent and random sampling of the entire region, not just areas of high fish concentration. This is the primary difference between fisheries-independent estimates of abundance (survey indices) and fisheries-dependent CPUE estimates. If only areas of high cod concentrations were sampled, and the numbers from these data then expanded by assuming that the density of fish in these high concentration areas was the same throughout the stock area, this would imply that cod are plentiful throughout the entire Gulf of Maine. This is obviously not the case, and is why a stratified random sampling scheme in the NEFSC surveys is appropriate.

  - *It is entirely possible that years with high catch rates are actually representative of the population and that the low catches are outliers due to survey locations in areas where cod are not found (e.g., due to the surveys avoiding hard-bottom habitats which cod often inhabit).*

    See the previous response concerning 'outliers.'

- *NEFSC survey catchability is approaching 1.0 and back-transformed catchabilities for R/V Bigelow are above 1.0, indicating that the two research boats are approaching or above 100% efficiency even though almost no catch of fish older than age 7 are reported and area swept estimates of stock biomass approach model estimates of biomass for the entire stock*
  - *Regardless of statistical arguments provided by NEFSC these values indicate poor model performance and should not be treated lightly.*

    A comparison of model-independent and model-based estimates of stock biomass was presented at the SARC and showed close agreement between the two approaches. It is incorrect to assume that the high values of survey catchability (q) are indicative of poor model performance. The reason for the high q values was clearly shown during SARC 53 to be a by-product of the expansion scalar used to convert the raw survey indices to area-swept indices of abundance. Alternate expansion factors (which do not alter the assessment results) generate much lower estimates of q. The absolute values of q are a byproduct of expansions performed outside of the model and should not be over-interpreted.

- *Survey selectivity is flat topped and fixed at 100% for ages 6+*
  - *Assessment claims "little biological evidence" for domed selectivity, however allowing for domed selectivity increases SSB by 21%.*

    There is no empirical evidence or statistical basis in the form of model fit to support an assumption of domed-survey selectivity. Nonetheless, several domed survey selectivity sensitivity runs of the ASAP model were explored, and gave results that were generally within the confidence intervals of the base model.

  - *Tagging evidence indicates that shorter tows allow older, larger fish to more easily escape the net than younger fish*
    - *Survey tow times average between 20-30 minutes and therefore present a very high probability that older fish are able to out swim the net and escape.*

      The NEFSC surveys catch a higher proportion of older age fish compared to the fishery, in which tow durations are much longer.

    - *It is therefore more likely that the survey selectivity is heavily domed and that is why few fish older than age-7 are seen in it, as opposed to the current assumption that fishery selectivity is domed (where commercial tows are often upwards of 3-5 hours) and survey selectivity is flat-topped.*

      See previous comment that explains why this statement is not supported by data.

  - *In combination with the survey catchability estimates around 1.0, it appears that there is an issue within the model with the survey time series*
    - *The assumptions used to fit this data consistently err on the side of a pessimistic instead of optimistic stock status (e.g., allowing for domed survey selectivity and bounding catchabilities around .7 would greatly increase abundance estimates).*

      With respect to survey catchability, see the previous response on this subject.

      Bounding catchability at 0.7 would likely increase biomass. However, this would increase biomass beyond the model-independent estimates of biomass derived from the survey data. This result would not be biologically realistic.

## Catch-per-Unit Effort

- *NEFSC claim that incorporating CPUE data is not possible due to problems standardizing effort statistics, however the final GARM III model used a CPUE data set and initial ASAP runs made use of this same data set until it was determined that the model was insensitive to its inclusion.*

  Earlier ASAP models, as well as the VPA, did include a LPUE (landing per unit effort) time series covering the 1982 – 1993 period, as this index had been used in previous assessments. The rationale to not extend the LPUE time series beyond 1993 is clearly documented on page 32 of SARC 53 WP#1:

  > *"Given the uncertainty in VTR reported fishing effort since 1994 and the impact of DAS, rolling closures and trip limits on the comparability of LPUEs estimated from 1994 onward with the earlier time series, the time series has not been extended beyond 1993."*

  Since the time series has not been updated since 1993, removal of the time series had no influence on the assessment model results.

- *Recently calculated CPUE data from NEFSC scientists indicate that CPUE has been consistently and drastically increasing since 2000 with large decreases in effort and increases in cod landings, however NEFSC refuses to attempt any exploratory runs with this data set due to the 'difficulty' in incorporating CPUE data.*

  The NEFSC did not refuse to attempt any exploratory runs with this data set. The Data Working Group did not have the opportunity to make any such attempt as the data only became available during the SARC 53 meeting. The CPUE data represent <u>nominal</u> CPUE, which does not account for the major changes that have occurred in the fishery over the last ten years (see comments below for examples), and therefore the data set needs to be standardized prior to inclusion in an assessment model. Cod undergo hyperaggregation when reduced to low stock sizes and a fishery-dependent CPUE index obtained in this situation may not accurately represent overall stock abundance (e.g., Canadian northern cod). Nominal CPUE indices have been constructed for the commercial and recreational fisheries and compared to biomass estimates, but have been shown to be poor indicators of stock abundance.

  - *If old CPUE data sets were possible to incorporate there should be no reason that new data cannot be used.*

    Major input controls (i.e., designed to curtail fishery efficiency) were implemented in the groundfish fishery in 1994 and have since changed frequently. In 1999, for example, trip limits were reduced to 30 lb/day at sea, and then were gradually increased to 800 lb/day over the next five years. Beginning in 1994, marked reductions in the days at sea have occurred including the 2:1 accounting of DAS in western GoM beginning in 2006. There has also been a high rate of exit from the fishery of less profitable vessels, leaving more efficient vessels in the fishery. All of these changes make interpretation of nominal CPUE indices extremely difficult, and standardization of any CPUE time series data for Gulf of Maine cod a daunting challenge.

- *The data shows that the increasing CPUE trend is robust to multiple effort statistics and greatly contradicts the notion that the stock is decreasing as demonstrated by recent survey data.*

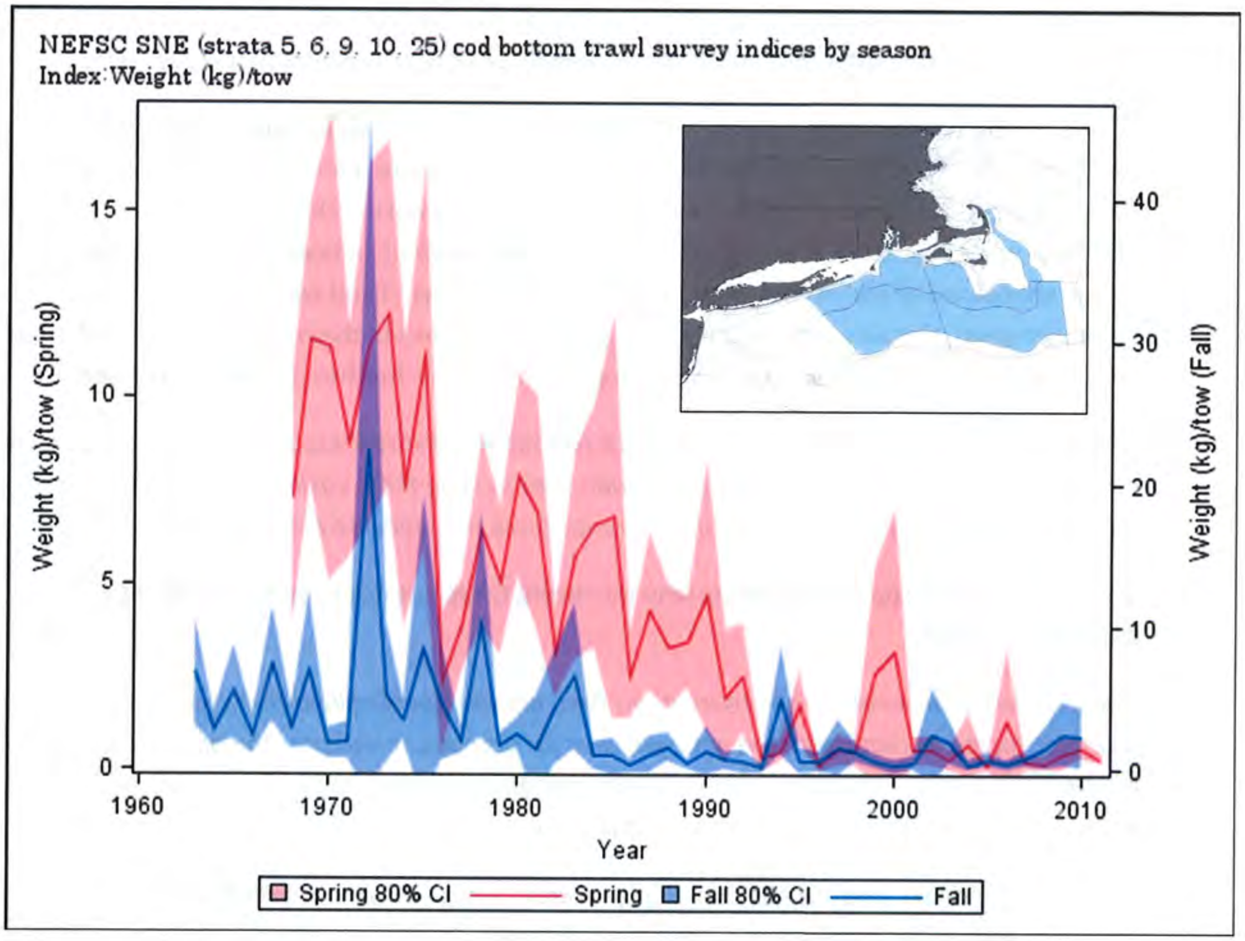
  At face value, the increasing trend in CPUE indicates increases in abundance (if the other concerns with interpreting fisheries-dependent CPUE indices are ignored) in the area where the fishery is occurring. However, because the fisheries occur almost exclusively in the western Gulf of Maine, where the stock is now also concentrated, these CPUE indices provide no information on the abundance of cod in central and eastern Gulf of Maine. If cod were abundant in these latter two areas, this would be reflected in high survey catches in these areas as occurred in the 1970s and/or the fisheries would be operating in these areas. Neither is currently happening.

- *NEFSC argue that this data supports the stock contraction theory (because CPUE will increase as fish concentrate together at smaller population sizes making them easier to catch) and thus do not want to include it because it would inherently force the model to estimate higher biomass.*

  See the previous response explaining why the recent CPUE has not been incorporated in the assessment model.

- *However, taken in context with observations from around New England that cod are being caught in locations that they have not been seen for decades, it indicates the opposite of what the NEFSC is portraying; cod appear to be expanding and higher CPUE is due to an enormous cod biomass throughout the region and not just at small, concentrated locales.*

  In the Gulf of Maine, cod are not showing up in areas where they have been historically abundant such as the central and eastern Gulf of Maine. Fishermen are now reporting cod in high densities in certain areas of southern New England. However, preliminary explorations of biomass trends in the southern New England waters suggests that, like the central and eastern Gulf of Maine, overall biomass in these areas has declined over the past forty years. The region included in these preliminary investigations is shaded in blue in the next figure.




## Historical VPA Bridge Assessment

- *Updated data used from the previous assessment (i.e., new length-weight equation, updated weight-at-age, updated catch-at-age, inclusion of discards-at-age, and a revised maturity schedule) have caused a complete change in stock status from the GARM III assessment without changing any of the model formulation or adding new data since 2007 (i.e., the change in historic data since 2007 has changed stock status without adding the last 3 years of data or changing any of the model framework)*
  - *F in 2007 has increased by .1 (21.7%) to F=.56 and SSB has decreased by 14,428mt (42.6%) to SSB=19,445.*

    The major change that affected stock status was how weights-at-age are now estimated. The methods used in GARM III did not fully account for the true weights-at-age of the population. All other data changes resulted in only minor modifications of terminal SSB and F.

## Final ASAP Model Results

- *Current estimates of fishing mortality and spawning stock biomass go against all information from the fishery (decreasing effort and increasing CPUE) and management actions (increasingly stringent measures over the last 2 decades).*

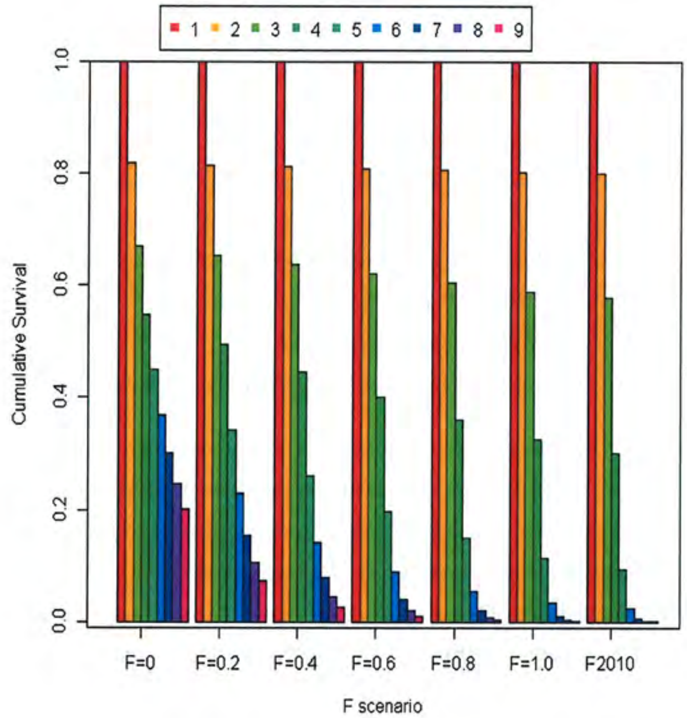
  See previous comments related to CPUE.

- *Current instantaneous fishing mortality rates on fully selected fish of 1.14 indicates that 68% of these age classes are harvested in a given year and total mortality (i.e., including a natural mortality of 0.2) indicates that almost 74% of these age classes die*
  - *Such estimates are absurd and if correct this stock should have collapsed long ago.*

    Spawning stock biomass is only about half of the total biomass, and stocks can be subjected to very high Fs for short period of time (a few years). Existing management measures regulating minimum mesh sizes, minimum retention sizes, and area closures have resulted in a fishery selectivity pattern that allows Gulf of Maine cod to spawn one to two times (on average) prior to capture in the fishery. These spawning opportunities—prior to recruitment in the fisheries—have allowed the stock to withstand high fishing pressure.

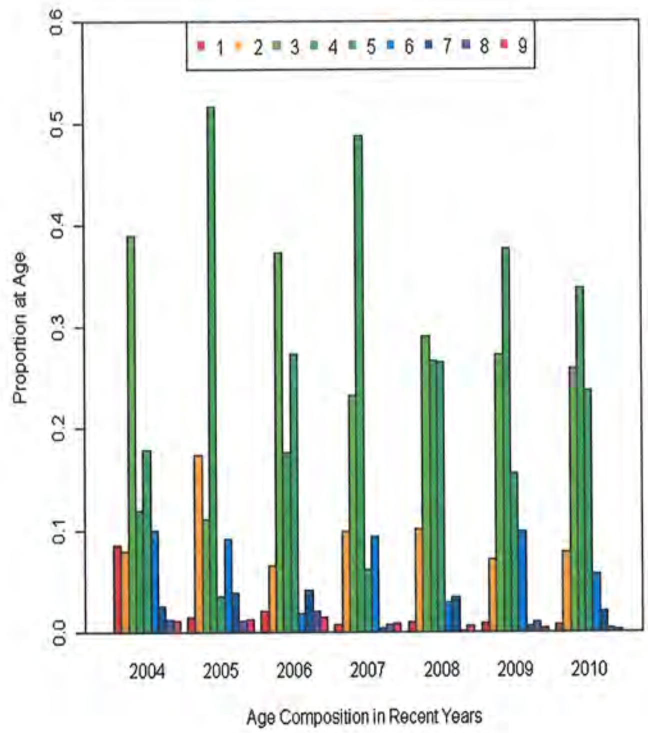
  - *Under this mortality regime only .056% of fish live to age-9, which means that the 2010 age-class of 4.286 million fish would yield only 2418 age-9 fish*

    Although this statement is true, it is important to examine the cumulative survival to ages less than 9, under a variety of F levels, and mindful of the proportion of Gulf of Maine cod mature at age: age 1=9.4%; age 2=28.7%; age 3=61%; age 4=85.9%; age 5=95.9%; age 6=98.9%; age 7=99.7%; age 8=99.9%; age 9+=1.0. The calculations of cumulative survival at age for F=0, 0.2 ($F_{MSY}$), 0.4, 0.6, 0.8, 1.0, and 1.14 ($F_{2010}$) indicate that young cod have opportunities to spawn prior to their full selection to the fishery (see the figure below). Due to low fishery selectivity at the youngest (undersize) ages, the difference in cumulative survival to age 3 differs little over a wide range of F values. Cumulative survival is about 30% at age 4 and 10% at age 5 given the estimated F in 2010; however, the decline in survival is precipitous for ages 6 and older.




- *Such results are difficult to believe in the face of current catch compositions and catch rates.*

  A cumulative survival of 0.056% would only be realized if fishing occurred at an F=1.14 for 9 consecutive years. This has not been the case at any point in the modeled time series, and clearly is a circumstance is to be avoided. The figure below depicts the age composition of the Gulf of Maine cod catches for the last 7 years. Ages 3, 4, and 5 dominate the catch in numbers, consistent with the stock age composition results from the assessment.




- *Lack of diagnostics (coefficient of variations) for all model parameters makes it impossible to objectively assess model fit and performance; only CVs are given for selectivity parameters and indicate the model is poorly estimating these parameters.*

  The model input files and software were provided to the SARC 53 Panel to allow the Panel to run the models and evaluate model parameters as deemed appropriate. The Panel requested several additional analyses of model diagnostics, which were all provided to the Panel during the SARC meeting. The CVs on the selectivity parameters are generally less than 0.30, which does not indicate poor estimation. The CVs on the estimates of selectivity on some of the older ages are high, reflective of the limited information at these older ages to precisely estimate selectivity.

- *The use of incremental sensitivity analysis to look at how changing a single assumption at a time affects stock status does not necessarily portray these affects accurately.*

  Without performing sensitivity runs independently, it is impossible to really comprehend how each change to a model (or to the input data) affects the model results.

  - *In reality the base assessment has a number of assumptions that go against the basic biology of the fishery and results should be given showing the effects of changing multiple assumptions simultaneously*

- *For example, what is the effect of allowing domed survey selectivity, bounding catchability at reasonable levels, calculating age-structure out to ~age-16, splitting commercial and recreational catch, incorporating CPUE data, decreasing discard mortality, and decreasing unrealistic recreational catch levels?*

  The available data are insufficient to conduct analyses out to age 16. In most years in the assessment times series, no age information is available beyond age 12 for either the catches or the surveys. As mentioned previously, using a model formulation that splits commercial and recreational catches results in an unstable model that does not allow these sorts of sensitivities to be evaluated. These types of issues were openly, publically, and thoroughly discussed at both the Data Working Group and Models Working Group Meetings.

  Two sensitivity models, which addressed four of the seven concerns noted above, were presented at SARC 53 and gave results that were within the confidence intervals of the base model results.

- *No single change will greatly alter the output of a model, however when numerous assumptions do not reflect reality it makes sense to change all simultaneously and see how the model responds, something that was never considered in the development of the Gulf of Maine cod assessment.*

  No evidence has been presented (i.e., data) to indicate that the model assumptions are not reflective of reality, or that the base model is incorrectly specified. When multiple changes are made to a model, these must be done in a careful and methodical manner so that the impacts of each change can be evaluated. Indeed, such a process was followed in this assessment. When moving from the previous assessment to the current benchmark assessment, many changes were made that better reflected reality. This bridge from the old to the new was not conducted in a haphazard manner by making several changes all at once. Rather, changes were made incrementally so that the impacts of each change could be evaluated. The cumulative effect of these changes was substantial and culminated in a much more realistic final base model.

- *Biological Reference Points are based on an ASAP run back to 1970 (longer time series than the actual assessment) assuming a Beverton and Holt stock-recruit function*
  - *However, analysis by Butterworth and Raddenmeyer (2011) demonstrate that if the model is extended into the late 1960s a decline in recruitment at extremely high stock sizes is present (possibly due to cannibalism on juveniles by adult cod, etc...) indicating that a Ricker style stock-recruit curve is more appropriate and model estimates indicate that GoM cod is NOT overfished.*

    The biological reference points approved by the SARC Panel are NOT based on a spawner-recruit relationship, but rather on long-term projections at $F_{40\%}$ (consistent with the methods used to establish biological reference points in the previous assessment). The methodology proposed by

Butterworth and Rademeyer were not supported by the Models Working Group (of which Butterworth was a member) because (a) age composition data for the fishery are not available prior to 1982 leading to high uncertainty in recruitment estimates; and (b) the stock-recruit function, even when estimated through an extended model time series, is poorly defined. Hence, the biological reference points estimated from such models are uninformative. The decision of the Models Working Group not to use data prior to 1982 in the modeling work was supported by the SARC Panel. Additionally, in a sensitivity exercise, the Models Working Group actually used a SR relationship from a model with a 1970 start date to justify the use of $F_{35\%}$ as opposed to $F_{40\%}$. This decision of the Models Working Group was not supported by the SARC Panel.

With respect to the Butterworth and Rademeyer work using a Ricker-style stock-recruit fit; their model had substantial diagnostic problems, most notably a very strong retrospective pattern which can be problematic for determining stock abundance and making catch advice.

## Summary

- *Observations throughout New England indicate cod are expanding their range and not contracting as NEFSC hypothesize.*

  No evidence exists suggesting that Gulf of Maine cod are currently occupying a larger range than historically documented. In fact, the available evidence from the survey and extent of the existing fishery suggests the opposite. Gulf of Maine cod no longer appear to be present in the central and eastern Gulf of Maine, areas where historically they were abundant. Survey data also suggest that cod biomass in southern New England waters has declined substantially over the last 40 years

- *Under-sampling of catch has led to a perceived age-structure truncation that does not match large numbers of old, large cod being caught by commercial fishermen.*

  The available data collected by fishery observers do not support this statement.

- Recreational catch is highly overestimated by MRFSS data.

  There is some validity to this statement, but sensitivity runs conducted to adjust for potential overestimation of recreational catch in the MRFSS surveys show that the assessment results are robust to assumptions about lower recreational catches.

- *Flat topped survey selectivity is unrealistic and allowing the model to estimate domed selectivity causes a large increase in biomass and SSB.*

  A domed survey sensitivity run was conducted and presented in the final report. The assumption of a domed survey selectivity pattern results in slightly higher estimates of SSB and lower estimates of F, but these estimates are within the confidence intervals of the base model results, and do not alter the stock status determination. It should be noted that there was no model support for domed selectivity (i.e., allowing a domed survey selectivity did NOT improve the overall fit of the model to the data). More importantly, there are no data to support a domed survey selectivity, and what data do exist support higher selectivity in the survey relative to the fishery.

- *The purposeful avoidance of exploratory analysis of recent NEFSC CPUE data within the assessment indicates a lack of objectivity by the assessment scientists as this data clearly counters recent trends in NEFSC survey abundance and indicates an expansion of cod biomass in the Gulf of Maine.*

  There was no purposeful avoidance of an exploratory analysis of CPUE data. No source of CPUE data was brought forward to either the Data or Models Working Group. The first mention of recent CPUE data was brought up during the SARC Meeting, and the SARC Panel (not NEFSC scientists) determined that it was not appropriate to introduce these data at that time. The basis for this determination was that (a) the CPUE data had not been standardized to account for changes in fishery efficiency over time, and (b) the CPUE data had not undergone the same amount of review that all other input data received during the Data and Models Working Group Meetings

- *Model results go against all recent management actions and observed biology and are based solely on noisy, unreliable surveys (since catch trends do not reflect the biomass under a hard total allowable catch system, they simply reflect management expectations regarding stock abundance assuming the TAC is fully harvested; CPUE is the only real indication of biomass levels that can be garnered from catch data in this instance).*

  These statements have been addressed and rebutted elsewhere in this document.

- *Tradeoffs between biological realism and statistical assumptions must be made, however this assessment always errs on the side of statistical fit instead of actual, proven biology resulting in many biologically unrealistic modeling assumptions often causing a more pessimistic view of stock status.*

  To imply that the modeling assumptions led to a more pessimistic view of stock status ignores the breadth of sensitivity runs presented during the SARC 53 Meeting. There were a total of 14 ASAP sensitivity runs presented during the SARC. Exactly half of the sensitivity runs provided more optimistic perceptions of stock status relative to the base model. The results from only two of the sensitivity runs fell outside the confidence limits of the base model; one was above, one was below. The consistency of the sensitivity runs provides additional confidence in the assessment results.

New England Fishery Management Council
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C. M. "Rip" Cunningham, Jr., *Chairman* | Paul J. Howard, *Executive Director*

January 11, 2012

Dr. William Karp
Acting Science and Research Director
Northeast Fisheries Science Center
166 Water Street
Woods Hole, MA 02543-1026

Dear Bill:

Welcome to the sleepy backwater of New England fisheries management!

You may be aware that Mr. David Goethel provided Council members with a review of the SARC 53 Gulf of Maine cod assessment (see attached). We plan to provide the Science and Statistical Committee with this report and they may discuss it at their January 25, 2012 meeting. Is there any possibility that the Center could review this document and provide comments for the SSC's consideration? If this is possible it would greatly facilitate their deliberations.

I recognize this request is coming at a very late date, with the meeting barely two weeks away, and a detailed response may not be feasible. If you can provide any information at all we would like to mail it to SSC members as soon as possible. Please contact me if you have any questions.

Sincerely,

Paul

Paul J. Howard
Executive Director

attachment

Hi Sam,

Enclosed is a list of issues related to the current Gulf of Maine Cod stock assessment. Daniel and I have arranged it so that it outlines the issues and offers some possible solutions. We both agree that these are the major problems, but the list is not all-inclusive. As you can see, we feel that many of the assumptions made in this model are erroneous. In most cases assumptions were based on improving statistical fit at the cost of biological reality. Additionally, a change in almost any one of these assumptions will change the output of the model. However, altering all or some of these incorrect assumptions simultaneously will drastically increase estimates of spawning stock biomass and reduce fishing mortality. This is one aspect not considered within the working group because sensitivity runs are carried out incrementally and not simultaneously. Thus, reviewers are not given a chance to view how model outputs are altered when, for instance, survey selectivity is allowed to be domed AND catchability is bounded at reasonable levels (considering domed selectivity alone results in a 21% increase in biomass, it is easy to speculate that the combined effect would be even greater). Since the working group already feels that it has provided the best available science to the peer review, I see no sense in forwarding it to them alone. Rather I would send this to each member of the peer review committee and request that they detail a response in writing in their peer review report. Until these issues are resolved to everyone's satisfaction, we cannot and will not, accept the current assessment as the best available science.

I remain concerned that the terms of reference were too narrowly defined and specifically excluded the findings of the Cod Tagging Working Group, which requested a reexamination of the Cod Stock boundaries in the Gulf of Maine and Georges Bank. Also, there are many peer reviewed cooperative research projects available on Gulf of Maine Cod which should also be reviewed. Further, the Study Fleet Data on GOM vessels should be examined for trends in CPUE. Chad Demerast and Tom Nies worked at the eleventh hour to provide CPUE data which was also not examined by the Peer Review Team. Such data indicates a strong increasing trend in CPUE that counters recent declines in survey abundance. NEFSC has claimed that such increases are indicative of a contracting stock, however this hypothesis goes against what is being seen across the Gulf of Maine and this data clearly show that biomass is expanding not contracting. The fact that the science center is avoiding using this data in even an exploratory run (by arguing that it demonstrates cod contraction and would give a falsely optimistic output and/or claiming that CPUE is too unreliable due to difficulty in standardizing effort statistics despite using CPUE in the GARM III assessment and initial ASAP runs) clearly portrays the lack of objectivity of assessment scientists. All of these studies and bodies of work should be forwarded to the Peer Review Team or the Peer Review Team should be reconvened before their final report is delivered.

While I think that Friday's meeting was a good first step in identifying the issues, I remain concerned that some people are falling back on well worn scientific clichés that have not been examined as they relate to the Gulf of Maine Ecosystem. Thus, in my view, these arguments have no scientific validity in the current debate. For example, the cod collapse in Newfoundland took place in an entirely different ecosystem. It was driven by the invention of ice breaking trawl vessels which could tow through the ice where the cod had been previously protected. Yes, the cod did aggregate into very dense schools in Newfoundland. However, this was a phenomenon which probably occurred for thousands of years as cod sought warm pockets of water in a very cold regime, but had not been documented by scientists until the dawn of the icebreakers. The excuse that the cod are aggregating as their numbers dwindle has been used over and over again in the GOM whenever the models do not reflect with what fishermen are experiencing.

I was greatly disturbed by the constant referral to sensitivity runs which in themselves only determine how many incremental changes you have to make until you turn an apple into a watermelon. Sensitivity analyses are being used in public presentations inappropriately to give the appearance of a high degree of certainty of the results.

Due to all of my concerns above, as a matter of conscience, I will not be able to accept this assessment, as currently written, for use in management advice.

I look forward to a resolution of these issues so that we can move forward jointly in order to do what is best for the fish and the fishermen in the Gulf of Maine.

Thank you,
David Goethel

## 2010 Gulf of Maine Cod WG Assessment Notes

### Biology

- Stock identification is incorrect for cod in New England
    - Tagging evidence suggests that cod stock boundaries should be separated into: eastern Gulf of Maine-Eastern Georges Bank, and western Gulf of Maine-Cape Cod-Southern New England
    - Information regarding stock structure and discussions regarding proper stock boundaries were explicitly avoided during the assessment meetings for Gulf of Maine cod even though the current boundaries are highly questionable in light of the last decade of scientific research
    - It is widely believed that the recent expansion of cod into Southern New England (a region with historically low cod abundance in recent decades) is due to a 'spillover' migration effect of cod from the Gulf of Maine
        - This suggests that the Gulf of Maine cod stock is actually expanding and contradicts the stock contraction hypothesis being presented by NEFSC
- The length-weight relation and catch weight-at-age matrix are unreliable
    - The length-weight relation is based on survey catch and not on the commercial catch
    - Catch weight-at-age matrix is averaged over the recreational and commercial fisheries and over discard and landed catch
        - This acts to blur the signals in the catch because the weight of recreationally caught fish are lower than that of commercial fish thereby decreasing the weight of 'caught' fish in the model
- There is an apparent under-sampling of older fish in the catch-at-age, which gives the appearance of a truncated age-structure and increased F-at-age
    - Observer samples do not accurately reflect the actual catch, perhaps due to focusing on measuring smaller discarded fish
    - Large, older fish are not being properly sampled and this has led to a lack of old (age-7+) fish being 'seen'
    - Very few otoliths of fish greater than age -7 are being taken during surveys (which is used for determining the length-weight equation) and it is likely that port samples of cod otoliths are also biased towards smaller fish (reported samples are divided by market category and not age; it is likely that samplers are taking a majority of otoliths from smaller fish within each market category and sampling at times of year and ports where large fish are not being landed, thereby violating the random stratified sampling design)
    - Use of external data sources could help to verify age-structure information (e.g., gear studies and tagging studies that have information on age or length structure could be used as an exploratory check)
- The age-9+ formulation is invalid and underutilizes the flexibility of the Age-Structured Assessment Program (ASAP) framework
    - The length-weight relation clearly shows that fish continue to grow past age-16, yet the age-structure used implicitly assumes no growth after age-9 by assuming a plus group at this age and an associated average weight of fish in this group

        - Considering cod's ability to put on significant weight after age-9, this formulation inherently underestimates SSB and biomass if even a few older fish survive out to ages greater than age-9
- Constant natural mortality (M=0.2) assumption is biologically unrealistic
    - This estimate is based on a maximum age of 15-17 years, yet the length-weight relation indicates cod continue growing past this age so it seems unlikely that the fish would continue to grow up until the maximum age
    - Additionally, changes in the ecosystem over the last 3 decades would indicate the necessity for a time-varying natural mortality rate and also an age-varying natural mortality
        - Juveniles are well documented to inhabit different habitats from adults and predation is much heavier on juveniles (e.g., seal and dog fish predation)
        - Lack of 2007 year class recruiting to fishery as predicted in GARM III might be an indication of high predation on age-1 fish meaning a higher M is supported for juvenile cod

## Catch

- Observed catch is split by recreational/commercial and landed/discarded but models fitted to these more 'complex' data sets were deemed too unstable and showed results "similar to the simple (lumped catch) model"
    - Although the model might be more statistically stable, it is much less biologically realistic due to the severe differences in selectivity and weight of the commercial and recreational catch
    - **Tradeoffs between biological realism and statistical assumptions must be made, however this assessment always errs on the side of statistics instead of actual, proven biology**
- Fishery selectivity was broken down into two time blocks (pre and post 1991) based on statistical fit, yet no management actions or fishery changes support this choice
- Due to lumping of fishery catch across recreational and commercial fleets it is impossible to gain any biological insight into what the estimated selectivity patterns indicate (i.e., is one fleet fishing more heavily on older fish, etc...) and it is impossible to determine the individual effects of each fleet (i.e., is the fishing mortality greater from the recreational or commercial component, which is an important facet when determining possible future management scenarios)
    - This is another indication that degradation of the data in order to simply increase statistical fit at the cost of biological insight is inappropriate
- Marine Recreational Fishery Statistic Survey (MRFSS) data is used to estimate recreational catch-at-age by imputation based on MRFSS estimates of numbers caught at length and applying the NEFSC survey length-weight equations
    - Uncertainty in MRFSS data is well known and estimates in recent years counter data from other sources and common sense
        - Vessel trip reports (VTR) from recreational head boats indicate catch estimates 75% lower than MRFSS data
        - It is difficult to believe that recreational vessels accounted for the same level of catch (~5500mt) as commercial vessels in 2010

- This is the first time that recreational discard levels have been included in the assessment, however estimates are basically guesses with extremely high and ever increasing levels (~2300mt in 2010)
- Discard mortality is assumed 100% for all fisheries because the literature does not provide a comprehensive estimate of mortality rates for all gear type and seasonal combinations
    - Most literature proves that discard mortality is less than 100%, which considering levels of assumed discard rates could provide substantial sources of biomass that are being falsely accounted as mortality within the model, yet no sensitivity runs were undertaken to look at the affect of the assumed discard mortality rate

## Surveys

- Inshore strata of the NEFSC surveys were excluded from the assessment due to inconsistent sampling even though they provide indications of higher age-0 to 2 indices of abundance
- Massachusetts Division of Marine Fisheries (MADMF) surveys are the only reliable estimators of juvenile fish abundance because they survey inshore juvenile habitat, however they are consistently down weighted and the MADMF fall survey was completely removed from the final model
- Surveys supposedly cover all areas of major cod catch and accurately represent abundance trends, yet years with high catch rates are consistently considered outliers
    - Over the entire time series the NEFSC may cover all areas of major cod catches, but not on a consistent year to year basis (i.e., major areas of cod concentration are sampled sporadically over the last 15 years, however on a year to year basis many concentrations are missed which is likely one contribution to seeing large tows dominate survey catch and cause jumps in catch from year to year)
    - It is entirely possible that years with high catch rates are actually representative of the population and that the low catches are outliers due to survey locations in areas where cod are not found (e.g., due to the surveys avoiding hard-bottom habitats which cod often inhabit)
- NEFSC survey catchability is approaching 1.0 and back-transformed catchabilities for R/V Bigelow are above 1.0, indicating that the two research boats are approaching or above 100% efficiency even though almost no catch of fish older than age 7 are reported and area swept estimates of stock biomass approach model estimates of biomass for the entire stock
    - Regardless of statistical arguments provided by NEFSC these values indicate poor model performance and should not be treated lightly
- Survey selectivity is flat topped and fixed at 100% for ages 6+
    - Assessment claims "little biological evidence" for domed selectivity, however allowing for domed selectivity increases SSB by 21%
    - Tagging evidence indicates that shorter tows allow older, larger fish to more easily escape the net than younger fish
        - Survey tow times average between 20-30 minutes and therefore present a very high probability that older fish are able to out swim the net and escape
        - It is therefore more likely that the survey selectivity is heavily domed and that is why few fish older than age-7 are seen in it, as opposed to the current assumption that

        - fishery selectivity is domed (where commercial tows are often upwards of 3-5 hours) and survey selectivity is flat-topped
    - In combination with the survey catchability estimates around 1.0, it appears that there is an issue within the model with the survey time series
        - The assumptions used to fit this data consistently err on the side of a pessimistic instead of optimistic stock status (e.g., allowing for domed survey selectivity and bounding catchabilities around .7 would greatly increase abundance estimates)

## Catch-per-Unit Effort

- NEFSC claim that incorporating CPUE data is not possible due to problems standardizing effort statistics, however the final GARM III model used a CPUE data set and initial ASAP runs made use of this same data set until it was determined that the model was insensitive to its inclusion
- Recently calculated CPUE data from NEFSC scientists indicate that CPUE has been consistently and drastically increasing since 2000 with large decreases in effort and increases in cod landings, however NEFSC refuses to attempt any exploratory runs with this data set due to the 'difficulty' in incorporating CPUE data
    - If old CPUE data sets were possible to incorporate there should be no reason that new data cannot be used
    - The data shows that the increasing CPUE trend is robust to multiple effort statistics and greatly contradicts the notion that the stock is decreasing as demonstrated by recent survey data
    - NEFSC argue that this data supports the stock contraction theory (because CPUE will increase as fish concentrate together at smaller population sizes making them easier to catch) and thus do not want to include it because it would inherently force the model to estimate higher biomass
    - However, taken in context with observations from around New England that cod are being caught in locations that they have not been seen for decades, it indicates the opposite of what the NEFSC is portraying; cod appear to be expanding and higher CPUE is due to an enormous cod biomass throughout the region and not just at small, concentrated locales

## Historical VPA Bridge Assessment

- Updated data used from the previous assessment (i.e., new length-weight equation, updated weight-at-age, updated catch-at-age, inclusion of discards-at-age, and a revised maturity schedule) have caused a complete change in stock status from the GARM III assessment without changing any of the model formulation or adding new data since 2007 (i.e., the change in historic data since 2007 has changed stock status without adding the last 3 years of data or changing any of the model framework)
        - F in 2007 has increased by .1 (21.7%) to F=.56 and SSB has decreased by 14,428mt (42.6%) to SSB=19,445

## Final ASAP Model Results

- Current estimates of fishing mortality and spawning stock biomass go against all information from the fishery (decreasing effort and increasing CPUE) and management actions (increasingly stringent measures over the last 2 decades)
- Current instantaneous fishing mortality rates on fully selected fish of 1.14 indicates that 68% of these age classes are harvested in a given year and total mortality (i.e., including a natural mortality of 0.2) indicates that almost 74% of these age classes die
    - Such estimates are absurd and if correct this stock should have collapsed long ago
    - Under this mortality regime only .056% of fish live to age-9, which means that the 2010 age-class of 4.286 million fish would yield only 2418 age-9 fish
    - Such results are difficult to believe in the face of current catch compositions and catch rates
- Lack of diagnostics (coefficient of variations) for all model parameters makes it impossible to objectively assess model fit and performance; only CVs are given for selectivity parameters and indicate the model is poorly estimating these parameters
- The use of incremental sensitivity analysis to look at how changing a single assumption at a time affects stock status does not necessarily portray these affects accurately
    - In reality the base assessment has a number of assumptions that go against the basic biology of the fishery and results should be given showing the effects of changing multiple assumptions simultaneously
        - For example, what is the effect of allowing domed survey selectivity, bounding catchability at reasonable levels, calculating age-structure out to ~age-16, splitting commercial and recreational catch, incorporating CPUE data, decreasing discard mortality, and decreasing unrealistic recreational catch levels?
        - No single change will greatly alter the output of a model, however when numerous assumptions do not reflect reality it makes sense to change all simultaneously and see how the model responds, something that was never considered in the development of the Gulf of Maine cod assessment
- Biological Reference Points are based on an ASAP run back to 1970 (longer timeseries than the actual assessment) assuming a Beverton and Holt stock-recruit function
    - However, analysis by Butterworth and Raddenmeyer (2011) demonstrate that if the model is extended into the late 1960s a decline in recruitment at extremely high stock sizes is present (possibly due to cannibalism on juveniles by adult cod, etc...) indicating that a Ricker style stock-recruit curve is more appropriate and model estimates indicate that GoM cod is NOT overfished

## Summary

- Observations throughout New England indicate cod are expanding their range and not contracting as NEFSC hypothesize
- Under-sampling of catch has led to a perceived age-structure truncation that does not match large numbers of old, large cod being caught by commercial fishermen
- Recreational catch is highly overestimated by MRFSS data
- Flat topped survey selectivity is unrealistic and allowing the model to estimate domed selectivity causes a large increase in biomass and SSB

- The purposeful avoidance of exploratory analysis of recent NEFSC CPUE data within the assessment indicates a lack of objectivity by the assessment scientists as this data clearly counters recent trends in NEFSC survey abundance and indicates an expansion of cod biomass in the Gulf of Maine
- Model results go against all recent management actions and observed biology and are based solely on noisy, unreliable surveys (since catch trends do not reflect the biomass under a hard total allowable catch system, they simply reflect management expectations regarding stock abundance assuming the TAC is fully harvested; CPUE is the only real indication of biomass levels that can be garnered from catch data in this instance)
- Tradeoffs between biological realism and statistical assumptions must be made, however this assessment always errs on the side of statistical fit instead of actual, proven biology resulting in many biologically unrealistic modeling assumptions often causing a more pessimistic view of stock status

Captain David Waldrip
Charter Fishing Vessel RELENTLESS
80 Green Street
Rockland, MA 02370



Mr. Paul Howard
Executive Director, NEFMC
50 Water Street, Mill 2
Newburyport, MA
01950

Dear Mr. Howard:

I am writing to you as the owner and operator of the Charter Fishing Vessel RELENTLESS fishing out of Green Harbor, Massachusetts which conducts charters for Northeast Multi Species, primarily codfish in the Gulf of Maine (GOM). I am very alarmed by the latest results of the stock analysis regarding the Gulf of Maine cod stock assessment and find it hard to believe the low biomass estimates. I feel that the possible stringent measures including additional seasonal closures, size limit increases, bag limits and a closure to the Western Gulf of Maine closed area will have a detrimental effect on the Charter and Party Boat industry.

Charter and party boats along with recreational anglers have been abiding by strict regulations making sacrifices with a ten fish bag limit imposed through Amendment 13 to the Northeast Multispecies Management Plan in 2003. Additional measures were put into place severely affecting our opportunity to make a living during 2006 when the minimum size of GOM codfish was increased from 22" to 24" and a closed season on GOM cod was instituted from April 1st – Nov 1st reducing the charter/party cod fishing season by forty two percent. In 2009 this seasonal closure was increased by action put in place under Framework 42 by increasing the closed season on codfish for charter party vessels during the first fifteen days in April.

I read the Groundfish Plan Development Team's letter to the Groundfish Oversight Committee dated January 12th. In this letter some of the recreational measures suggested included reducing the daily bag limit for GOM cod to five fish per angler and reducing the minimum size to nineteen inches. Also mentioned was closing the entire Western Gulf of Maine to all groundfishing. By closing the Western GOM to all groundfishing it will eliminate the chance for recreational anglers to fish for other species such as pollock, redfish, cusk, haddock and other species in the deeper water. Once the middle of June arrives there are no groundfish in the shallower water which is less than 240'. The NEFMC will be doing an injustice by not allowing anglers to have a reasonable chance to fish for other multi species by rod and reel. Both of these actions would cause severe impacts to the charter party industry which is already prohibited from retaining GOM codfish for five and a half months. Anglers will not travel and fish for GOM cod with a

cc: tn, ah, ck.

very low bag limit, it is a meat fishery where anglers HOPE to have a banner day after traveling from as far away as MD, PA, OH and other areas of the country. Without a bag limit of ten cod per person, anglers will not fish with charter or party boats that are home ported north of Cape Cod. We are already at the end of our line with the financial constraints due to the closed seasons and any additional reductions or restrictions. This is will result in the end of a traditional fishery which allows anglers to enjoy the day on the water and go home with reasonable amounts of fillets for friends and family members.

The charter party industry urges you to investigate all possible options to allow for the extension date of the rebuilding period of the GOM cod fish stocks. Without an extension, it will be the last straw for many hard working fishermen who have sacrificed over the years doing their part to help rebuild the GOM cod stocks. They have invested hundreds of thousands of dollars in vessels, safety gear, tackle, maintenance and advertising over the years. If restrictions are so severe and the government distributes emergency funding to those effected we demand that we are included in the process and receive funding equal in percentage to our allocation of GOM cod.

In summary I greatly appreciate your time and look forward to working with you and the members of your staff in fabricating a solution which will allow the charter party industry to continue in a traditional fishery in the GOM for codfish and other species which will still attract anglers. If you have any questions please contact me anytime at the above number or email at captdave@relentlesscharters.com

Sincerely,
David Waldrip
Captain David Waldrip

Copy: United States Senator, John Kerry
United States Senator, Scott Brown
United States Congressman, John Tierney
United States Congressman William Keating
Mr. Paul Diodati, Director, Massachusetts Division of Marine Fisheries
Mr. Robert Zales, President, National Association of Charter Boat Operators
Mr. James Donorio, Chairman Recreational Fishing Alliance
Mr. Barry Gibson, NEFMC, Chairman Recreational Fishing Advisory Panel

91 FAIRVIEW AVE
PORSTMOUTH NH 03801



**NORTHEAST HOOK FISHERMAN'S ASSOCIATION**

January 9, 2012

**New England Fishery Management Council**
50 Water Street, Mill 2
Newburyport, MA 01950
Phone: (978) 465-0492
Fax: (978) 465-3116

Dear NEFMC Council Members:

We represent a group of Commercial Fishermen with the Limited Access Handgear HA Permits, employing the use Rod and Reel or Hand lines to catch Cod, Haddock and Pollock along with small quantities of other regulated and non-regulated marine fish.

We are extremely concerned with the latest stock assessment conducted on GOM cod. We believe that the assessment failed to consider the best available science with regard to tagging studies and the latest information pertaining to stock boundaries. The problem is the eastern GOM cod & Eastern Georges bank stocks are not rebuilding while the western GOM and Western Georges bank stock is. Until a new stock assessment can be conducted to consider the most recent scientific research on GOM cod, the GOM cod ACL for the 2012 fishing year should remain fixed at the same level as 2011.

Below is some of the most recent work on GOM cod that was not considered in the latest stock assessment.

1. ***Exploring Fine-scale Ecology for Groundfish in the Gulf of Maine and Georges Bank, Genetic Insights into the Stock Structure of Atlantic Cod in US Waters,* Adrienne Kovach**

   **http://www.gmri.org/community/seastate/Kovach_Adrienne/Kovach_Adrienne_Abstract.pdf**

   "The current management models are typically based on the "old dogma" of panmictic populations, and do not consider fine-scale population structure. Stocks encompass large geographic regions with multiple oceanographic features and may be comprised of individuals with potentially different life history histories. As such, their boundaries may not have a biological basis. This may be true for cod in U.S. waters, which are currently managed according to a two stock model, consisting of (1) a Gulf of Maine stock and (2) a stock comprised of Georges Bank and areas southward, from southern New England to the mid-Atlantic coast. Evidence inconsistent with the current management model includes movement data from recent tagging studies (Tallack and Whitford 2008) and genetic data (Lage et al. 2004, Wirgin et al. 2007). "

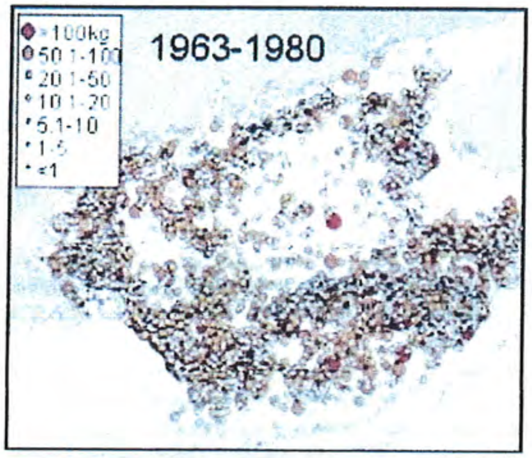
   In conclusion, we found strong evidence for population genetic structure that is not consistent with the 2-stock management model. Cod in US waters are broadly structured into 3 groups: 1) a northern spring spawning coastal complex in the GOM, 2) a southern complex consisting of winter-spawning inshore GOM, offshore GOM and sites south of Cape Cod, and 3) a Georges Bank population....

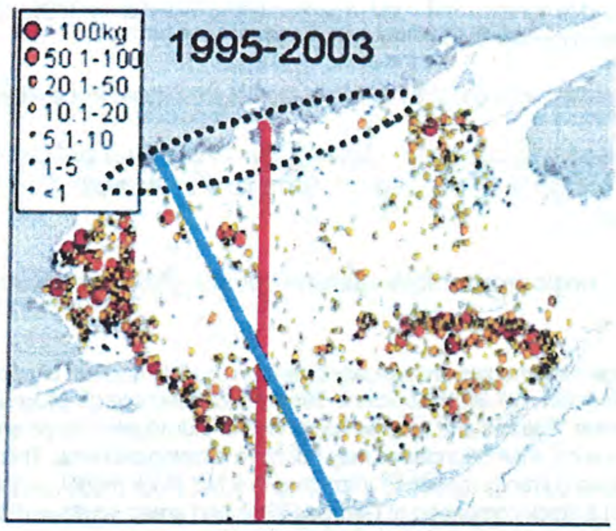
2. **"Workshop on Reconciling Spatial Scales and Stock Structures for Fisheries Science and Management" 2011**

# NEW COD STOCKS DEFINED BY WGOM AND EGOM

*WGOM WEST OF BLUE OR RED LINE**

*EGOM EAST OF BLUE OR RED LINE**




*Exact boundaries (maybe 3) derived by best available science to include tagging studies, genetics, etc.

**There will be no longer a commercial cod jig fishery in the GOM if no action is taken.** The cod jig fishery was the first in New England and if nothing is done it will be the first to be eliminated if the cuts proposed are made to the GOM cod stocks.

**Respectfully,**

**Marc Stettner**

NEHFA MEMBERS: Christopher DiPilato, Paul Hoffman, Hilary Dombrowski, Scott Rice, Ed Snell, Marc Stettner

***If you are a holder of a groundfish HA permit and wish to join the NEHFA, please contact the NEHFA at the address above.***

# Exploring Fine-scale Ecology for Groundfish in the Gulf of Maine and Georges Bank



## ABSTRACTS

*Genetic Insights into the Stock Structure of Atlantic Cod in US Waters*. Adrienne Kovach
*Collaborators*: Adrienne Kovach[1*], Timothy Breton[2], & David Berlinsky[3], Isaac Wirgin[3], Lorraine Maceda[3], University of New Hampshire, Departments of Natural Resources[1] and Biological Sciences[2], Durham NH, [3]New York University School of Medicine, Dept. of Environmental Medicine, Tuxedo, NY

Marine species have long been viewed as open, panmictic populations with high connectivity, owing to their vagile, pelagic larval stages and the high migratory potential of adults. This classical view of marine species was supported by tagging studies, which demonstrated long distance migrations, and by early genetic studies that revealed high levels of gene flow, as expected for a marine environment considered to be free of dispersal barriers.

Recently, there has been a paradigm shift in the view of the population structure of marine species, articulated by a review by Hauser & Carvalho (2008). Overwhelming evidence now points toward the existence of population structure on fine geographic and temporal scales. A growing body of literature emphasizes the importance of process, such as sedentary life history strategies, spawning site fidelity, natal homing, adaptations to local environmental conditions, and ocean currents and bathymetric features promoting egg and larval retention; the effect of these processes is to limit dispersal and promote self-replenishment of local populations, leading to subdivision and potentially reproductive isolation. Additionally, evidence of multiple life history strategies within a population, such as temporally divergent spawning behaviors or inshore *vs.* offshore migration patterns, have also been linked to fine-scale population structuring in cod, herring and other marine species.

The implications of the different paradigms are significant for management. The current management models are typically based on the "old dogma" of panmictic populations, and do not consider fine-scale population structure. Stocks encompass large geographic regions with multiple oceanographic features and may be comprised of individuals with potentially different life history histories. As such, their boundaries may not have a biological basis. This may be true for cod in U.S. waters, which are currently managed according to a two stock model, consisting of (1) a Gulf of Maine stock and (2) a stock comprised of Georges Bank and areas southward, from southern New England to the mid-Atlantic coast. Evidence inconsistent with the current management model includes movement data from recent tagging studies (Tallack and Whitford 2008) and genetic data (Lage et al. 2004, Wirgin et al. 2007).

In our previous work (Wirgin et al. 2007), we found heterogeneity within the Gulf of Maine, stemming from temporally divergent inshore spawning populations. A spring spawning population in Ipswich Bay was genetically



Received from H. Skttner – NE Hook Fisherman's Assoc.

distinct from winter-spawning cod from all other sites within the Gulf of Maine (including the same bay), Georges Bank and sites in southern New England. We also found that cod spawning on the northeast peak of Georges Bank are differentiated from populations south of Cape Cod, consistent with an earlier finding by Lage et al. (2004). Whether these differences were stable over time, or merely reflected variation among cohorts or plasticity in spawning behaviors, remained an open question.

In the current study, we expand on our previous efforts with increased and replicated sampling over time, in order to develop a model of population genetic structure of cod in US waters. *Our objectives were to 1) identify and sample all current spawning aggregates, 2) characterize the fine-scale population structure of spatially and temporally separated spawning aggregates, 3) investigate the temporal stability of the genetic structure, using replicate samples collected over a 2-5 year period, and 4) determine whether young of the year fish sampled on juvenile nurseries could be assigned definitively to their populations of origin.*

This research was truly collaborative in nature, not only with respect to contributions to the genetic analyses from both UNH and NYU, but also with respect to the sample collection. The latter involved numerous commercial fisherman, supported by the collaborative research program of the Northeast Consortium, recreational fisherman, and fisheries biologists from the Massachusetts Division of Marine Fisheries, Canadian Department of Fisheries and Oceans, and also a partnership with the University of Massachusetts-Dartmouth School for Marine Science and Technology.

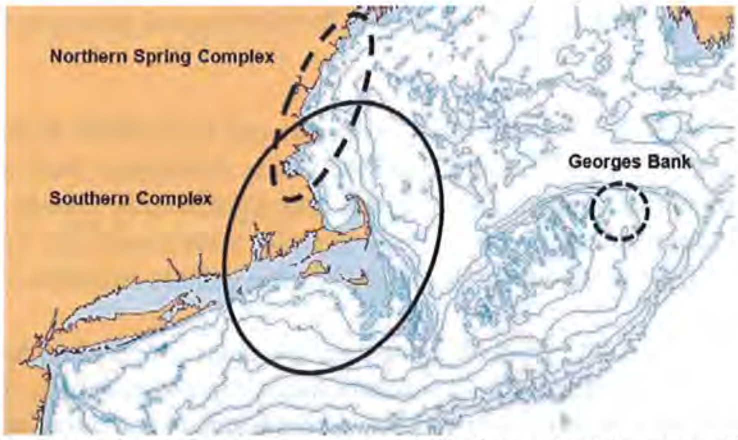
During December 2005 – July 2008, 1488 adult cod were captured via otter trawl, gill net or hook and line; a fin clip was taken for genetic analysis. We targeted spawning fish from the following sites: northeast peak of Georges Bank, the inshore Gulf of Maine in Ipswich Bay, Massachusetts Bay, and Bigelow Bight, ME, the offshore Gulf of Maine at Jeffrey's Ledge and Stellwagen Bank, and south of Cape Cod from Nantucket Shoals, and Cox Ledge. At Ipswich Bay, Massachusetts Bay and Coxes Ledge, distinct spawning aggregates were identified and sampled in both the spring and winter. Additionally, adult fish not in spawning condition were sampled from Ipswich Bay, Platts Bank (offshore ME) and New York Bight. Six of the spawning aggregates were sampled in 2 subsequent years, enabling a test for stability in the structure.

Genetic analysis of the fin clip-extracted DNA was performed using a panel of 10 microsatellite markers (*Gmo*02, *Gmo*132, Brooker et al. 1994; *Gmo*19, *Gmo*35, *Gmo*36, *Gmo*37, Miller et al. 2000; P*Gmo*32, P*Gmo*34, P*Gmo*38, and P*Gmo*58, Jakobsdóttir et al. 2006), and 6 SNPs (Pantophysin I (*Pan* I), Pogson et al. 2001, *AHR6*, *ARNT8*, Wirgin et al. 2007, *and ARNT1*, *CYP5*, and *K ras*, characterized in this study). Several statistical population genetic methods were employed to analyze the genotypic data, including F-statistics ($F_{ST}$, a measure of genetic variation among populations), allelic differentiation exact tests, and molecular analysis of variance (AMOVA), to test for hierarchical structure and temporal variability.

Results of pair-wise population $F_{ST}$ comparisons and AMOVA indicated there was no significant variation between the yearly collections from the same sample locations and that variation among sites was significantly greater than annual variation within sites; therefore, these samples were pooled for further analysis. These findings are evidence for stability in the genetic structure over time.

When the pooled data from all spawning aggregates were compared by pair-wise $F_{ST}$ analysis, 16 of 45 population comparisons were significant. The primary source of differentiation occurred between the spring spawning coastal aggregates of the inshore Gulf of Maine (Ipswich Bay, Massachusetts Bay and Bigelow Bight) and sites in the offshore Gulf of Maine, winter spawning inshore Gulf of Maine and southern New England sites (Nantucket and Cox Ledge). Additionally, Georges Bank was strongly differentiated from the southern sites. The significant $F_{ST}$ values ($P<0.001$, following Bonferroni adjustment) ranged from 0.0071 – 0.0156, consistent with findings from other studies reporting weak, but significant differentiation for cod in European and Canadian waters (Beacham et al. 2002, Westgard & Fevolden 20007) over similar small geographic scales. Evaluation with the less conservative $p < 0.01$ and the exact tests yielded 13 additional, significant comparisons for $F_{ST}$ values in the range of 0.0017 – 0.0076, consistent with the level of fine-scale structuring documented among adjacent fjords in Norway (Jorde et al. 2007). Visualization of results with a principle coordinate analysis (PCA) demonstrated that the spring spawning inshore GOM sites clustered separately from the winter spawning inshore GOM, offshore GOM and southern sites, with Georges Bank positioned somewhat intermediately. Comparison with our data from 2003-2005 of Wirgin et al. (2007) showed consistency in the genetic composition of sites sampled in both studies, further supporting the temporal stability of the population genetic structure we identified.

The majority of the genetic variation in this study can be explained by three major groupings: a <u>northern spring coastal complex</u> that consists of spring spawners in coastal GOM, a <u>southern complex</u> that consists of winter spawners in coastal GOM and winter and spring spawners in the offshore GOM and southern New England, and the <u>northeastern Georges Bank</u> spawners (see figure). The Georges Bank population was strongly differentiated from the southern sites, and only weakly so from the inshore GOM and similar to the offshore GOM. In addition to the significant variation among the complexes, we also found significant variation within complexes ($p<0.0001$, using AMOVA, molecular analysis of variance), indicating the presence of finer scale population differentiation.




We consider several mechanisms as potentially important in generating the fine-scale genetic population structure that we observed. 1) Temporal differences in spawning may have a genetic component, rather than being plastic (Bekkevold et al. 2007); this is further supported by studies of captive populations that continue to spawn at divergent times, despite similar environmental conditions (Ottera et al. 2006). 2) The genetically divergent populations may exhibit alternate resident and migrant strategies (Robichaud & Rose 2004). Howell et al. (2008) recently showed that most spring-spawning cod in Ipswich Bay are sedentary residents. The winter spawning and offshore populations may be more migratory. 3) Spawning site fidelity may be common, but some individuals may exhibit natal homing, which facilitates reproductive isolation, while others may behave like "adopted migrants" (McQuinn 1997), whereby they follow the migratory behaviors of nearby populations to which they disperse and recruit as juveniles. 4) Environmental forces that affect the dispersal of early life stages or the migrations of adults may differ among seasons or for inshore *vs.* offshore. For example, larval dispersion models have shown that wind patterns in the GOM in the spring and summer favor local retention, while those in the winter may force larvae to drift with the currents offshore (Jim Churchill, Woods Hole Oceanographic Institute, personal communication). 5) Lastly, the genetic structure revealed by the markers today reflects a historical signal in the data set, such as postglacial population expansion; the low genetic differentiation in general may reflect a relatively recent history of Atlantic cod populations (Pampoulie et al. 2008).

The majority of the genetic differentiation in this study can be attributed to 2 highly informative markers, *Pan* I and *Gmo*132, which had much higher per locus $F_{ST}$ values than the other markers (0.038 - 0.109 and 0.028 – 0.043 for *Pan* I and *Gmo*132, respectively, in comparison to 0.0012 for the mean of the other loci combined). These two markers have been previously shown to be under selection (Nielsen et al. 2006, Pogson 2001), in contrast to most genetic markers used in

population studies, which are presumed neutral. Results of $F_{ST}$ outlier selection tests confirmed that these loci were under selection in our study as well. The differentiation of the major spawning groups could be explained by differing allele frequencies of the *Pan* I A allele, which was higher in the northern spring complex than the southern complex or Georges Bank, and the *Gmo*132- 117 and 135 alleles, which differed in the southern complex relative to the northern spring complex and Georges Bank.

It is suspected that *Gmo*132 is linked to a gene with unknown function ("hitch-hiking selection"; Nielsen 2006). *Pan* I is located in a gene that codes for a protein found in the membranes of microvesicles (Pogson 2001), but its relevant function in fish is unknown. *Pan* I A & B allele frequencies follow different patterns across the range of cod. Variation at *Pan* I has been correlated with numerous factors, including temperature, salinity, depth, growth and migratory behaviors. The covariates, however, differ among geographic locations; for example, while the *Pan* I A allele has been linked to warm waters in Norway (Westgard & Fevolden 2007), in Iceland it's the Pan B allele that dominates under those conditions (Pampoulie et al. 06). In our study, no consistent pattern was evident for temperature, salinity or depth in relation to the observed genetic variation, and the variation in these potential factors was small among our populations. A correlation of the *Pan* I B allele with offshore migrations or spawning has been found in populations in Norway, Iceland and Canada. This relationship is consistent for our study, in that populations with the highest *Pan* I B allele are found in the southern complex and Georges Bank, the populations that spawn offshore or are most likely to undertake offshore migrations. However, the differences in allele frequencies were small, with the frequency of the *Pan* I B allele occurring at 0.85-0.90 in the northern complex and near fixation in the southern complex and Georges Bank. A correlation with growth cannot be ruled out, as size differences have been documented for the GOM vs. other populations (Tallack & Whitlock 2008), however, to our knowledge growth data do not exist for the seasonally divergent spawning groups.

In conclusion, we found strong evidence for population genetic structure that is not consistent with the 2-stock management model. Cod in US waters are broadly structured into 3 groups: 1) a northern spring spawning coastal complex in the GOM, 2) a southern complex consisting of winter-spawning inshore GOM, offshore GOM and sites south of Cape Cod, and 3) a Georges Bank population. These groups are temporally stable and the magnitude of genetic differentiation, while not large, is sufficient to assign juveniles to their population of origin via mixture modeling. Genetically distinct groups overlap spatially in the inshore GOM, but are separated by temporal divergence in spawning behavior. We also found evidence of finer-scale structuring within the southern complex. Our results also support earlier findings that the Great South Channel may be influential in separating populations on the northeast Georges Bank from those south of Cape Cod. We suggest that several mechanisms are operating simultaneously to produce the population structure. Our finding that the majority of the differentiation is attributed to two non-neutral loci, points to the importance of local ecological adaptations. The particular selective forces shaping the adaptive divergence, however, are yet unknown and warrant further study.

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*A report on the workshop:*

# Reconciling Spatial Scales and Stock Structures for Fisheries Science and Management








June 27-28, 2011
Sheraton Harborside Hotel
Portsmouth, N.H.

This report is a summary of the workshop "Reconciling Spatial Scales and Stock Structures for Fisheries Science and Management" held in Portsmouth, New Hampshire, on June 27-28, 2011. The workshop was convened by New Hampshire Sea Grant and the Northeast Consortium as a public forum to discuss how emerging data on fish stocks might be used to better manage fisheries. Rather than summarize each talk, poster and discussion session individually, this report organizes outcomes within the three key questions that participants focused on. This document should not, however, be considered a consensus statement of all presenters and attendees.

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## Report Preparation:

This summary report was compiled and edited by Rachel Gallant Feeney and Dr. Ken J. La Valley in consultation with the Organizing Committee and several workshop participants. Report design and layout are by Rebecca Zeiber, New Hampshire Sea Grant.

# Introduction

Photo credit: Rebecca Zeiber/NHSG

Photo credit: Rebecca Zeiber/NHSG

*Capt. Paul Howard, Executive Director, New England Fishery Management Council*

Marine spatial management has been an essential tool for fisheries conservation, stock rebuilding and gear conflict resolution in the Northeast. However, the National Ocean Policy, the Bureau of Energy Management, Regulation and Enforcement (BOEMRE) Task Force, and the movement towards ecosystem-based fisheries management (EBM) are driving fishery managers, scientists, fishermen and other stakeholders to better coordinate efforts and consider systems more holistically.

The National Ocean Policy, adopted July 2010, established, among other things, the National Ocean Council (NOC), regional planning bodies to coordinate ocean management, and priority objectives towards ecosystem-based management. Recently established by the governors of the five New England states, the Northeast Regional Ocean Council (NROC) will likely be charged by the NOC to develop and implement a coastal marine spatial management plan for our area. This plan is to be submitted to the NOC for certification by 2015.

The fishery management councils can add tremendous value to regional planning under the National Ocean Policy due to their 30-year history of marine resources management mandated by federal law, including use of best-available science, inclusion of public input, representation of stakeholders and, more recently, movement towards ecosystem-based fisheries management. However, the NOC has denied the requests of the regional councils to be members of the regional planning bodies, citing a need for "more thoughtful consideration and analysis." Having only a consultative role for such an important ocean use — commercial and recreational fisheries — is not adequate.

The National Ocean Policy was designed to coordinate federal activities. However, agencies are still striking out on their own. For example, the BOEMRE Task Force is looking at the spatial needs for a single ocean use — offshore wind energy. Due to the Federal Advisory Committee Act, federal entities can only receive advice from other federal entities. Therefore, the New England Fishery Management Council cannot be members of the BOEMRE Task Force. Nevertheless, the NEFMC is actively consulting with them about the areas being considered for wind development.

There are several benefits to the NEFMC to move towards EBM. First, it would simplify the current nine fishery management plans into potentially three based on ecosystem production units (Gulf of Maine, Georges Bank and Southern New England). A more comprehensive and coordinated approach to fishery interactions and ecosystem constraints on rebuilding stocks can be afforded by EBM. Smaller scale fisheries management can also enhance stewardship and the understanding and credibility of scientific data. A transition strategy and vision for this very difficult task of implementing ecosystem-based fisheries management is currently under consideration by the NEFMC, so this workshop could not have come at a more opportune time.

# Overview

Fishermen and scientists are continually learning that stock boundaries of marine species are not always what was once thought. Fishery managers often face dilemmas when ecological and management boundaries do not coincide. This public workshop explored how fisheries managers can better use data on stock structure and ecological processes in achieving sustainable fishery resources. Costs and benefits of using increasingly detailed data in management were discussed. Events such as this afford opportunities to take a step back, examine the progress made to date, identify future needs as fisheries and management approaches continue to change, and determine how to best meet present and future needs.

In addition to this final report, documentation of the workshop includes the posting of presentation slides with audio recordings on the Internet, linkable from the websites of the Northeast Consortium and New Hampshire Sea Grant. Also, preparations are under way for a special issue of the journal *Fisheries Research* to feature about 12 articles on the topics submitted by the oral and poster presenters from the workshop. We aim for these to be helpful tools for the region as stakeholders seek to continually improve fishing, research and resource management.

## Key Questions

Q1: *What do we know and what progress has been made?*

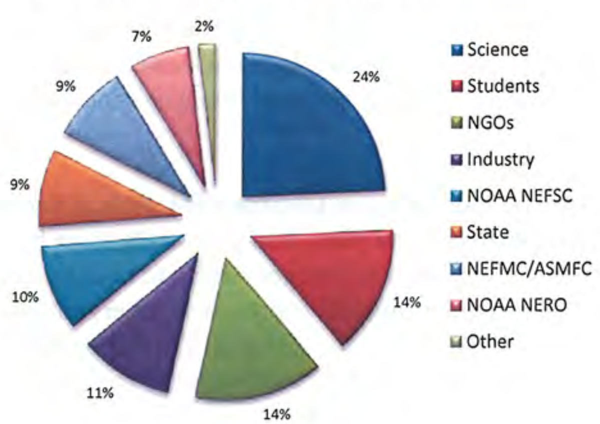
Q2: *What do we need to know and how will we get there?*

Q3: *What are the social incentives, benefits and risks of alternative management scales?*

## Participants

More than 115 fisheries stakeholders attended the two-day workshop. Attendees included commercial fishermen, fishing sector managers, government and academic scientists, fishery managers, students and representatives of non-governmental organizations.

**Affiliation of Workshop Attendees**




**Geographic Distribution of Workshop Attendees**

| | | |
|---|---|---|
| **U.S.** | | |
| | Massachusetts | 46% |
| | Maine | 28% |
| | New Hampshire | 14% |
| | Rhode Island | 3% |
| | Washington, D.C. | 2% |
| | California | 1% |
| | Connecticut | 1% |
| | Maryland | 1% |
| | Michigan | 1% |
| | New Jersey | 1% |
| | North Carolina | 1% |
| **Argentina** | | 1% |

# Q1: What do we know and what progress has been made?

Photo credit: Rebecca Zeiber/NHSG

*"The burden of proof is on the fisheries scientists for proving that changing the scale of management is warranted. There needs to be careful evaluation to identify when adding resolution will improve the assessment and sustainability of the resource."*
*– federal scientist*

***Identify evidence of spatial scale structure of populations and ecosystems and provide examples where such spatial scales have been successfully incorporated within a management context.***

The assumed paradigms about the patterns of fish populations in northeast U.S. waters are changing as fisheries science matures. The spawning site fidelity of Atlantic salmon, once considered the exception, is becoming the rule as we better understand the life history parameters of more species. Stocks of several species intermix, particularly while feeding, and the Great South Channel seems to be where the boundaries of many stocks converge. Although we now see evidence of population connectivity, the challenge is to measure it quantifiably.

When the modern era of fisheries management began in the 1970s, administrations, jurisdictions and data collection systems were designed based on the prevailing theory of the day — that species' distributions were broad and homogeneous. With improvements in stock identification, there are increasing examples of mismatches between the scale of biological population structure and the management units. Assessing and managing several independent populations as a metapopulation (or the reverse) can lead to biases in stock assessment, resulting in reduced stock biomass estimates and a high probability of overexploitation. However, it is very difficult to fit fine-scale data into a system that is based on a broad theory. The resulting mismatch can lead to misperceptions of the magnitude and distribution of population productivity.

Stock unit definitions are not set through the fishery management plans, but rather they come out of the stock assessment process. The management plans in New England tend to not consider interrelationships among species other than technological (bycatch), because those relationships have been difficult to quantify in the assessment process. A few attempts have been made to use dynamic management, such as a flexible area access system adopted in 1992, but there have been difficulties in implementation, such as assimilating near real-time biological and fishery data.

Why do we manage at the scales that we do? The Magnuson-Stevens Fishery Conservation and Management Act mandates that a stock will be managed as a unit throughout its range. Just because finer-scale stock structures are emerging from the data, the whole science and management system does not necessarily need to be overhauled. Careful evaluations of the costs and benefits of incorporating new information are needed. Simulation models are a useful tool for exploring the potential consequences of having a mismatch between biological and management scales.

Fisheries management can be best described as an experiment. There is a tremendous amount that we have learned and mistakes have been made along the way, but we need to learn more. It is a collective enterprise and we have to think about how we design the experiment as carefully as possible. The following are a few case examples highlighted at the workshop of how our knowledge of the spatial structure of fish populations is being refined and how that information is (or is not) being used to more effectively manage fisheries.

# Q1: Case Examples

## Atlantic Cod

The solution to rebuilding depleted cod stocks in New England has been evasive, but persistent research using a broad range of approaches is beginning to shed new light on finer-scale population dynamics than were once accepted. More evidence is emerging that cod express spawning site fidelity, such that the preservation of the remaining spawning activity might be critical to the long-term productivity and sustainability of the stocks. As a result, there is heightened concern today about local extirpation of cod populations.

The "cod problem" is no more evident than in the eastern waters of the Gulf of Maine, where despite virtually no fishing for cod in about two decades, cod have yet to recover. Formerly, the inshore Gulf of Maine was a mosaic of spawning areas, but today spawning areas are concentrated in southwestern areas. The prevailing paradigm has been that cod from the Western Gulf of Maine would re-populate eastern areas, but tagging, genetics, oceanographic and other studies suggest that the eastern area is more connected with the Bay of Fundy. It may take a longer time frame to rebuild this area than was once hoped due to natural oceanographic and biological processes.

Some cod stocks are rebuilding, particularly in southern New England and Western Gulf of Maine waters. Tagging combined with genetic analyses show more connectivity of cod between these two areas than with Georges Bank. Rolling closures that were established in the late 1990s to reduce fishing mortality have incidentally protected cod spawning aggregations in several federal areas. However, recreational vessels and state waters are exempt from the rolling closures. As cod stocks rebuild, there is a resurgence of spawning areas that become very attractive areas to fish on. Massachusetts has implemented small-scale closures within state waters for spawning protection in addition to what the federal rolling closures provide. The transition to sector management for groundfish has raised discussion about relaxing the rolling closures. From a mortality point of view, this makes sense because mortality is now controlled by hard quotas, but we need to be mindful about the implications for spawning protection.

*"Targeted closures to protect spawning will benefit us all. Cod and haddock need to be left alone, else the spawning is interrupted."*

*– fisherman*

Photo credit: Rachel Feeney/NEC

*"In general, fishermen think that there are more fish in the ocean than the scientific community has defined. Today, the catch per unit effort for cod and pollock in the Western Gulf of Maine is as high as they can remember. That wasn't the case 10 years ago."*

*– sector manager*

# Q1: Case Examples

*"Management units should be consistent with biological processes. The spatial structure of populations affects how they respond to management and harvest."*
*– state biologist*

*"We currently have a patchwork of spatial and temporal management actions."*
*– manager*

*"There was a great longline fishery for haddock and cod from 1980 to 2002 off of Chatham involving 40-50 boats. Today, there are only four boats. Also, the Area 1 haddock SAP [Special Access Program] let us have an experimental fishery. The first year was really good, but the next year we caught half as much, and just a few fishermen are now fishing there. I see fish come, go and change a lot. The fish move up and down the coast."*
*– fisherman*

## Herring

In general, there are greater dispersal barriers and genetic distinctions in fresh water and anadromous environments than in marine systems; such is the case for river herring and Atlantic herring. For management purposes, the total allowable catch of Atlantic herring is allocated into four management areas, roughly reflecting the inshore and offshore composition of the herring stock complex. In addition, inshore seasonal spawning closures in state waters restrict fishing activities to protect spawning herring. New management strategies under development for coast-wide river herring stocks also attempt to capture the underlying seasonal spatial distribution of the species. River herring is listed federally as a "Species of Concern," so managers must minimize bycatch of these stocks to aid in their recovery. To understand where river herring bycatch has occurred at sea in the Atlantic herring fishery, a spatial analysis of fishery-dependent data has defined smaller units than the statistical areas to manage. Bottom trawl data from NMFS surveys are being used to find other areas where river herring could be encountered. Spatial and temporal options are being developed to monitor and avoid river herring based on local abundance thresholds.

## Lobster

Lobster management is anything but simple. There are seven Lobster Conservation Management Areas that are designed to maintain the culture and history of lobster management, but there are three stock units that are based on statistical areas that do not necessarily match the population dynamics. The potential for mismanagement is high with so many jurisdictional and biological boundaries crossing each other. The 2009 stock assessment concluded that there is lobster recruitment failure in southern New England, which contains part or all of six of the seven management areas. Managers are now considering a five-year moratorium on the fishery in the south. Managers have been warned about the southern stock for nearly a decade, but limited progress has occurred. Another misalignment is the offshore management area, which contains three stock units. How do you craft one set of regulations to account for the varying conditions over the range?

## Striped Bass

One fishery where the biological and management units are aligned is striped bass, and it is likely no coincidence that it is a fairly successful fishery. The Atlantic States Marine Fisheries Commission formed in 1942 out of the need to better coordinate the spatial management of migratory coastal stocks. The Commission manages striped bass as one stock with individual production areas from North Carolina to the Canadian border. The bulk of the stock (75-80%) is based in the Chesapeake Bay, and there are unique harvest restrictions for the Bay because of the degree of resident fish. Striped bass is one of the most successful fishery rebuilding efforts in recent history based on catch rates and young of the year indices.

# Q1: Case Examples

## Rainbow Smelt

Genetic data can improve our understanding of biological structure and help converge the spatial scales of populations and management units. Anadromous fish tend to be philopatric, characterized by local larvae retention and natal homing that can lead to population structuring on scales local to rivers or estuarine retention zones. Population divergence results from lack of gene flow in philopatric systems, but can be homogenized by straying. The challenge is identifying the level of philopatry relative to straying, which varies among species, populations and geographic regions. Rainbow smelt is a "Species of Concern" in the Northeast U.S., only found from Downeast Maine to Buzzard's Bay, Mass. A recent NMFS Proactive Species Conservation Program has focused on increasing our understanding of smelt population status and structure, including genetic diversity and variation. Rainbow smelt do not spend much time in freshwater. Adults spawn just above the head of the tide and larva are swept downstream to develop in near-coastal waters. In this study of smelt from 18 rivers in the Northeast, genetic differentiation was found to be on the low end for andromous fish, potentially as a result of the short amount of time spent in natal rivers and retention zones, and on a scale larger than that of individual estuaries or bays. Five genetically distinct groups of smelt were identified, with genetic differentiation overall strongly correlated with geographic distance. Weak river-level structuring was also evident with high gene flow among adjacent rivers, suggesting widespread straying. The most genetically unique smelt were located within topographically distinct features, such as capes or enclosed bays, suggesting that geomorphic features influence larval retention. Genetically divergent populations are important to identify for proactive management as they may be more susceptible to perturbations. Understanding the factors that influence the population structure aids our ability to manage spatially appropriate population units.

## Winter Flounder

Although winter flounder exhibits fine-scale population patterns, this species is managed and assessed broadly as three unit stocks: Gulf of Maine, Georges Bank and Southern New England/Mid-Atlantic. In 2008, the biomass of winter flounder in the southern New England stock was estimated to be at a record low, and the fishery in this region has been closed since 2009. Despite the closure, rebuilding has been slower than expected in many regions of Southern New England. However, results from a recent industry-based survey suggest that a large biomass of winter flounder is present in this area, indicating that winter flounder in the Great South Channel are exhibiting much greater productivity than elsewhere in the Southern New England stock. From fishermen's knowledge and historical tagging studies, we understand that the winter flounder in the Great South Channel likely represent a mix of stocks, adults that migrate in seasonally and resident spawning fish. Fishermen have advocated that winter flounder in the Great South Channel should be managed as a distinct stock. This may benefit fishermen and improve management.

*"Fish have changed their migratory patterns. Yellowtail are more concentrated in deeper water. Winter flounder spawn near shore, but not in estuaries like we thought. Haddock have pulled away from shore. About 30 fathoms is the shallowest you'll see them."*

*– fisherman*

Photo credit: Jason Goldstein/UNH

*"In fisheries management, identifying conservation units based on the scale of biological processes is of critical importance because spatial structure affects how populations respond to management actions."*

*– university scientist*

# Keynote Speaker

## Dr. Simon Thorrold, Senior Scientist, Woods Hole Oceanographic Institution
### *"Population connectivity and the spatial scales of population structure in marine fishes"*

The more we look, the more we find in terms of fine scale population structures. Understanding population structure is a necessary prerequisite for effective spatial management of marine fish. However, the spatial extent of an entire meta-population may be of less significance to spatial management than connectivity rates among geographically isolated sub-populations. Spatial management of marine fish populations depends on the following fundamental questions: Where did spawning occur? Where did the population grow up? Is there natal homing? We can understand connectivity intuitively, but it depends on the life history of the fish itself, and the problem is that we cannot track individuals through their full life history. The question we are beginning to address is where on the larval settlement continuum a population exists, between closed (natal homing) or open (random settlement).

Mathematically, we can create models that calculate the probability matrix of settlement, but the challenge is to test their accuracy by measuring connectivity in the field. To provide direct estimates of population connectivity, either through natal homing or larval dispersal, two studies are shedding new light on the degree of fine-scale population structure in the ocean. In the first, we used otolith geochemistry as a natural tag to retrospectively determine natal origins of spawning weakfish (*Cynoscion regalis*) collected from five major estuaries along the U.S. East Coast. There is much more population structure, as evidenced by natal homing, than was implied by any of the conventional genetic approaches. Adults spawn and larvae are retained in estuaries and embayments throughout its range from Florida to Maine. There is no genetic differentiation among adult weakfish, but isotopes from otoliths have identified natal homing areas. For managers, these results help confirm that the actions taken to protect spawning in a particular area will pay off for that same area in the long-run. Juvenile weakfish spend several months in natal estuaries, so it is not far-fetched to imagine that they can find their way back. This type of finding generates momentum for actions at local levels.

The second study examined larval dispersal of coral reef fish in Kimbe Bay, Papua New Guinea using TRAnsgenerational Isotope Labeling (TRAIL) and DNA parentage analysis. Mature females were injected with a barium solution that had a unique isotopic ratio, which was then incorporated into the eggs and thus the embryonic otoliths. This produces hundreds of thousands of tagged larvae. Fin clips have also been used for DNA parentage analysis and for identifying movement rates. Estimates of self-recruitment within a small marine reserve for both clownfish (*Amphiprion percula)* and butterflyfish (*Chaetodon vagabundus*) were similar (~50%), despite the fact that clownfish spawn demersal eggs with a pelagic larval duration of 10-14 days compared to 30-40 days for the butterflyfish. We have also tracked larvae of both species for distances up to 30 km from their natal reef, suggesting that at least some individuals do indeed disperse long distances. It was determined that the marine protected areas are large enough to sustain populations and that fish from those areas were traveling to open areas. About 60% of fish in the fishing zones are coming from the no-activity zones. This information is being used to inform and empower local stakeholders in the design and implementation of a comprehensive management strategy for the diverse coral reefs of Kimbe Bay. The fishermen are now seeing the benefits of protecting certain areas.

Taken together, these studies suggest that optimal spatial scales for most marine fish stocks are likely to be significantly smaller than those used currently in fisheries management. We still know remarkably little about fish movements, and comprehensive spatial management cannot occur without a basic understanding of movements. We also need to be aware of the limitations to data. Philopatry seems to be a defining characteristic of many marine fish. The more we use techniques to identify movements, the more homing patterns we see. The increasing evidence of homing patterns in fish populations is empowering local communities to make a difference, averting the "tragedy of the commons."

# Q2: What do we need to know and how will we get there?

***Identify critical information, processes, and scientific and managerial requirements needed to achieve fisheries management at appropriate ecological scales.***

Alignment of fish population management with natural ecological processes may be an improvement upon traditional approaches and more appropriate within an ecosystem-based management context. However, moving from single species management — something that has been in place for several decades of evolving management plans — into more complex system governance is not a trivial proposal. Ecosystem-based management takes into account the interactions among the components of the ecosystem, which includes humans as one integral component. With limited available data and resources, how can we move in the direction of finer scale management or at least manage at more appropriate ecological scales? Do we understand the socioeconomic implications of doing so? Workshop participants were asked to identify critical information, processes, and scientific and managerial requirements needed to achieve fisheries management at appropriate ecological scales. Comments and individual perceptions were recorded and synthesized into three common themes: Fundamental Concerns, Data Requirements and Management.

## Fundamental Concerns

Spatial management of marine fish populations depends on several fundamental questions: Where did spawning occur? Where did the population grow up? Is there natal homing? The problem becomes immediately clear — the science of today is unable to track the full life history of marine species. Intuitively, fisheries scientists understand that connectivity between spawning aggregations and current stock delineations are happening, but are currently unable to clearly identify these critical linkages. From these fundamental questions, common concerns were brought to light, questioning the need to manage at finer scales and if so, at what level (spawning aggregation, geographically and/or genetically separated units, etc.). What is the "point of diminishing returns" between gathering more data and taking a management action? There are trade-offs between precision with finer scale science versus meeting biological and management goals.

***"We know remarkably little about fish movements, and comprehensive spatial management can't occur without a basic understanding of movements. Estimating connectivity is the biggest hurdle in spatial management."***

***– university scientist***

***"The question fisheries scientists can begin to address is where on the larval settlement continuum a population exists, between closed (natal homing) or open (random settlement)."***

***– university scientist***

***"When there is a mismatch in scale between biological and management units, a sustainable resource model is difficult to attain. We need to weigh the potential costs of changing assessment units with the costs of not doing so."***

***– federal scientist***

# Q2: What do we need to know and how will we get there?

*"Genetic and isotopic techniques to identify population connectivity are expensive and time-consuming. We don't need this data on every species. We should be developing larval dispersal models on select and commercially important species."*
*– federal scientist*

*"We need to identify and protect additional spawning aggregations. The industry-based cod survey has produced several years of valuable data but has not yet been sufficiently used."*
*– state scientist*

*"We need to understand the relative contributions of spawning areas as a first step to determining the level of fine-scale management required for a given stock."*
*– state scientist*

## Data Requirements

Collaborative fisheries research has been a strong component of fisheries science in the Northwest Atlantic for more than a decade. Over this time, significant investments have been made in understanding fish movement and distribution patterns through tagging programs, fleet monitoring efforts and genetic analyses. In addition, bio-oceanographic analysis of primary productivity, larval dispersal and nutrient uptake has improved understanding of the dynamics of the Gulf of Maine ecosystem. In addition, substantial efforts have been undertaken to improve our understanding of historical spawning aggregations, fishing effort and changes in natal homing regions.

When asked "What do we need to know?" to manage at appropriate ecological scales, participants were quick to point out that rich data is available and that scientists need to re-visit and better utilize this data pool to consider finer scale systems approaches to management. However, critical "gaps" in our understanding of ecosystem processes were identified. More investment is needed to understand trophic level relationships, feeding and spawning linkages, source populations and mixing (connectivity). In addition, better tracking of commercial fishing effort on both spatial and temporal scales would improve biologists' understanding of stock movement and would greatly facilitate adaptive management approaches. Single-species management is counter to how multi-species fisheries function. Additional research to improve understanding of how fishing gear operates and how it impacts species, both individually and as a heterogeneous population, is needed.

Photo credit: Rebecca Zeiber/NHSG

# Q2: What do we need to know and how will we get there?

## Management

Ecosystem-based management (EBM) is an innovative management approach that considers the whole ecosystem, including humans and the environment, rather than managing resources in isolation. This differs substantially from the current or traditional management system. In light of recent changes from the days-at-sea paradigm to resource allocation, fisheries scientists' understanding of stock connectivity and trophic level dynamics will be important for the sustainable management of Northwest Atlantic fisheries to move forward. In fact, the 2010 National Ocean Policy identified EBM and marine spatial planning as the primary tools for ocean resource management. In order to move towards finer-scale or ecologically appropriate controlling units, managers must have clearly articulated and evaluatable goals. What is management trying to manage — a population, a stock or a spawning component? With clarity, assessments can be tailored and reflective of a more dynamic system. Participants were concerned that, when faced with immediate concerns, management and science may ignore complex population structure in lieu of a more practical homogeneous stock assumption. Another common discussion point was the need for a more flexible management structure that would allow for adaptation to dynamic ocean processes.


Photo credit: Rebecca Zeiber/NHSG

*"When the multispecies plan was adopted in the mid-1980s, it was an effort to move away from the single species management box; we do multispecies management with single-stock constraints. Those constraints aren't going away, but only increasing with finer scale information."*
*– management staff*

*"We need a clear vision and leadership from the New England Fisheries Management Council."*
*– fisherman*

*"There needs to be regular strategic evaluation of spatial management as part of biological, social and economic impact assessments."*
*– management staff*

# Keynote Speaker

## Dr. Michael J. Fogarty, Research Fish Biologist, NOAA Fisheries Northeast Fisheries Science Center

## *"Spatial considerations for ecosystem-based fishery management on the Northeast U.S. Continental Shelf"*

The National Ocean Policy (2010) puts ecosystem-based management and marine spatial planning as primary tools for ocean resource management, and the Northeast Fisheries Science Center is designing a "roadmap" toward that end. One step is to identify spatial management units based on the ecological production units of the Northeast Continental Shelf. We currently have geographically specified stock structures that remain at the heart of management plans, but there are a large number of potentially different definitions of the geographical extent of stocks. For the historical catch data, the finest spatial scale we have is 10 minute squares (~100 square miles), but these boundaries are not ecologically relevant; there is strong evidence of finer scale processes. We need to consider nested or hierarchical spatial scales that would take into account the protection of concentrations of vulnerable species (e.g., cold water corals, sea turtles, etc.).

For a more integrated approach to defining spatial management units, a number of variables need to be incorporated. The physiographic variables include bathymetry and surficial sediments. The physical oceanographic and hydrographic measurements include sea surface temperature, annual temperature span and temperature gradients. The biotic measurements include satellite-derived estimates of chlorophyll-a and primary production. Chlorophyll gradient metrics are included to capture frontal zone positions. We employed principle components and K-means cluster analyses to define spatial units, and the results showed seven major ecological production units on the shelf including: Eastern Gulf of Maine-Scotian Shelf, Western-Central Gulf of Maine, Inshore Gulf of Maine, Georges Bank-Nantucket Shoals, Intermediate Mid-Atlantic Bight, Inshore Mid-Atlantic Bight and Continental Slope (Cape Hatteras to Georges Bank).

We suggest a spatial management structure that consolidates ecological subareas so that nearshore regions are considered special zones nested within the adjacent shelf regions and have similar treatments as the continental slope regions. This leads to four major units that could form the base of management plans: Mid-Atlantic Bight, Georges Bank, Western-Central Gulf of Maine and Scotian Shelf-Eastern Gulf of Maine. A transition to place-based management strategies under the tenets of ecosystem-based fishery management will also require harmonizing the emerging perspectives on population structures with the broader context of ecological production units that may serve as potential spatial management units.

With the increasing ability to track and map where fleets are operating, we can better integrate the human and ecological aspects of the situation. We need to find common spatial frames of reference that would meet multiple objectives together, such as combining right whale exclusion zones and fishery closed areas. We need to consider how gear operates and how it impacts species, both individually and as a heterogeneous population. Single-species management runs counter to the way that the fisheries operate — on a mix of species. We need a multispecies perspective right from the start. If sectors operate as cooperatives and share information, they can help identify where choke species occur and help avoid them. We can take advantage of fishermen's wisdom to avoid problems.

# Q3: What are the social incentives, benefits and risks of alternative management scales?

***Given fine-scale stock structure patterns, what types of fisheries management approaches will maximize our knowledge about ecosystem structure and function? Specifically consider consequences of management units that are too large vs. those that are too small. Identify the potential impacts on access and utilization of catch allocations by the fishing community.***

We are discovering a wide range of fish processes that occur at scales much smaller than the fish stock units as presently defined, and that when the spatial scale that restrains fishing exceeds the fish population scale, there can be local extirpation of population components. This leads one to ask if management needs to occur at finer scales than at present and how governance should be organized to accurately account for the structure of the ecosystem. Can fisheries management be redefined to understand the system better? Over the years, a tremendous web of governing bodies, governance processes and boundaries has been created, driven by the U.S. Constitution down to local, community norms. We are continually searching for ways to govern ourselves more efficiently and economically. The major problem that fine-scale science is raising is a governance problem.

Matching ecological and management scales can create incentives for harvesters to participate in the science and decision-making to steward local resources for both present and future use. However, managing at too fine a scale may increase the governance system complexity such that its effectiveness is reduced. The potential is great for social and economic costs to the fishing industry from changing management boundaries and scales. There needs to be a careful balance between over- and under-managing resources. Keeping data collection as simple and efficient as possible will be key to incentivizing the industry to participate. In some cases, the science does not yet justify new management paradigms. There need to be clear benefits of new governance systems that outweigh deficiencies in present governance systems. For example, lowering the fishing mortality rate may produce the desired results more efficiently than managing at a finer scale. What follows are a few examples highlighted at the workshop of the social implications of fishery scales.

Photo credit: Rachel Feeney/NEC

*"When does our practical experience or our science tell us that we have to change? What is the tipping point?"*
*- anthropologist*

*"Fishermen haven't fished using their minds since 1996. The only challenge now is to avoid bycatch."*
*- fisherman*

*"Organizations are typically nested hierarchies, but there are informal structures of information flow to serve interests. When you have a degree of independence at the local level, self interest drives people to find information that solves problems. It can lead to more efficient organizations."*
*- university faculty*

# Q3: Case Examples

*"Some boundaries are culturally or belief-driven and if we try to change them, we'll be banging our heads against the wall."*
*– state biologist*

Photo credit: Rebecca Zeiber/NHSG

*"We can't prosecute the TAC [total allowable catch] because of the rolling closures. The fish are only here at certain times a year. It's useless to have a TAC."*
*– fisherman*

## American Lobster

In many ways, the American lobster fishery in Maine is considered to be a collective action success. The laws, rules and norms are largely supported by the lobstermen due to the high level of participation in management. Lobster zones were established in 1996 and have the authority to limit the number of traps, the time of day that fishing can occur and entry into the fishery. The state commissioner must adopt the zone regulations unless deemed unreasonable, so the power is really within the seven elected zone councils. Lobster zones have restrained the spatial extent of fishing and slowed down fishing pressure to where the scale of fishing is similar to the scale of the population. Since 1996, landings have doubled as the resource has increased, but there has also been a 15% decline in the number of licenses.

The Atlantic States Marine Fisheries Commission is currently recommending trap reductions to help limit landings, but this is unlikely to have a significant effect unless the number of traps is severely reduced. Trap density reductions have effects at the local level, such as increasing catch per trap, less gear conflicts and edge effects. In 2008, a survey of lobstermen showed a broad concern about the number of traps and a willingness to reduce traps. There was a general belief that the resource was either stable or declining and there were concerns about the cost of bait. A proposal for trap reductions was then created, but was spectacularly shut down due to distributional concerns. At the district (sub-zone) level, the survey showed very strong agreement about reductions. Thus, scale at which agreements about reductions will occur may need to be at very local levels.

# Q3: Case Examples

## Atlantic Cod

Although Atlantic cod in the Gulf of Maine are managed as a single stock, recent evidence suggests the existence of at least two genetically distinct stocks and a mosaic of spawning aggregations that are temporally and spatially distinct. Many of these spawning aggregations, particularly along mid-coast and eastern Maine, have been extirpated through fishing activities. Increasing exploitation of spawning aggregations in the southern Gulf of Maine by both the recreational and commercial fleets has raised concerns over the future viability of these aggregations. A call to close these areas to protect spawning activities came from the active recreational and commercial participants in these fisheries. In response to these concerns, three small-scale spawning closures have been implemented in recent years, two in Massachusetts state waters and one in the federal waters off New Hampshire. The boundaries and timing of these closures were designed using information provided by commercial and recreational fishermen and through observations of fleet activities.

Continued rebuilding of the Gulf of Maine Atlantic cod stock(s) and the realization of future economic gains are predicated on the preservation of recruitment from existing spawning activity. Preservation of spawning diversity will likely result in greater stability of the exploited cod stocks that could reduce dramatic swings in allowable harvest, benefiting fishermen, processors and fishing communities. Spawning closures cause a significant short-term hardship for fishermen, but the understanding within the fleets is that they will result in long-term gains. The negative effects of the closures may be greater for commercial and recreational fishermen who are constrained to fishing nearshore because of vessel limitations because most of the spawning cod disperse offshore when the spawning activities cease.

## Surf Clams

The surf clam assessments have consistently determined that the stock is not overfished and overfishing is not occurring, yet recruitment has been dropping since 1999. However, commercial fishing is not considered the primary cause. The warming of Atlantic waters and paralytic shellfish poisoning from pollution is constraining the surf clam fishery to Mid-Atlantic areas relative to its traditional range (Virginia to New Bedford, Mass.). These stressors heighten the importance of re-examining the scale of management. An alternative stock structure should be considered in the next assessment because variability within the stock area is increasing. The industry, scientists and managers have been cooperating to manage this fishery since well before the Magnuson-Stevens Act. This fishery began in Long Island, but has expanded throughout its range, and so the definition of community has grown with it. There are organizations that form and disappear (via radio, cell phone, texting) as they compete and cooperate with each other. This history of collaboration strengthens current efforts to preserve the resource for sustainable harvests.

Photo credit: Graham Sherwood/GMRI

*"What are the management objectives? Local management? Maximum sustainable yield? And/or the National Ocean Policy?"*
*– lawyer*

Photo credit: Rebecca Zeiber/NHSG

# Q3: Case Examples

*"Do federal laws need to be revised further to better facilitate ecosystem-based management?"*

*– lawyer*

Photo credit: B. Beal/UMM

Photo credit: Rachel Feeney/NEC

## Sea Scallops

Sea scallops are managed as a single stock throughout their range and occur in discrete offshore fishing grounds from Georges Bank to Cape Hatteras, N.C. The fishery is managed under an area rotation scheme, a spatially-explicit strategy that closes areas to fishing for variable lengths of time to promote scallop growth, reduce bycatch of finfish and mitigate habitat impacts. This strategy resulted in $400 million dockside revenues in 2010 from a fleet of 350 vessels. However, bycatch of yellowtail flounder in the scallop fishery has constrained scallop harvest resulting in economic losses. Recently, regulated accountability measures for yellowtail flounder bycatch in the scallop fishery have imposed time and area fishing closures that do not incorporate social and economic incentives for the fleet to avoid bycatch. In 2010, a yellowtail flounder bycatch avoidance system that uses fishery-dependent, spatially specific information in real-time to avoid bycatch hotspots was introduced. The voluntary program incorporates incentives to maximize scallop yield, maintain traditional fishing grounds and participate in self-enforcement. The spatial and temporal scales for yellowtail avoidance are designed to provide useful information to the fleet without negatively impacting normal fishing operations. Suggested movements to facilitate bycatch avoidance are on the scale of three miles or less and updates are provided daily. These fine-scale adjustments incorporate the social and economic objectives for scallop harvest, and the program has been successful, creating incentives for fishermen to share catch information. Results include reduced catch of overfished yellowtail flounder stocks and extended access to lucrative scallop grounds.

## Sea Urchins

The urchin fishery in Maine is a classic boom-and-bust fishery, and its demise is largely because the scale of management has been too large. Asian markets were opened to Maine urchins in 1987, and by 1993 the urchin fishery had peaked as the second most valuable fishery in the state. Modest management began in 1992 with a license requirement, and regulations increased over time. The co-management system was created in 1996 with two zones and an advisory panel of industry members and scientists. Regulations were enacted at the state level but the relevant biological dynamics appear to occur at the scale of individual ledges. On each ledge, as urchins were removed by harvesting, kelp and other seaweeds grew and urchin predators like crabs moved in, thus extirpating them. The scale of the zones maintained an open access environment on each ledge; fishermen had no incentives to be selective or cooperate to conserve the resource. In Nova Scotia, leaseholds for urchins have been tried, but with mixed success. The resource was hit by disease, leaving little incentive for fishermen to invest in conservation practices. The zones were too big for harvesters to manage and harvest the entire area. Some ledges shifted to urchin barrens. If Maine went to a quota system to prevent overfishing, a total allowable catch would need to be set for each ledge, which would be exceedingly difficult or impossible. Leaseholds, however, may work more effectively than they did in Nova Scotia because urchins in the colder shallow waters found in Maine are less prone to disease. More research is needed to assess the feasibility of such a system for the Maine fishery. The size of individual leaseholds should be matched to the scale of harvesting to avoid overfishing.

# Keynote Speaker


## Dr. Ana M. Parma, Research Scientist, Centro Nacional Patagónico, Puerto Madryn, Chubut, Argentina


## *"Balancing scales — Opportunities and challenges in the management of spatially structured fisheries"*

In artisanal, small-scale fisheries, experience shows that fisheries management approaches that rely on centralized assessments and top-down enforcement of regulations are doomed to fail because of ineffective enforcement and prohibitive costs of monitoring fish resources and landings. Command-and-control approaches can be ineffective when landing sites are spread out along the coasts, often in remote places without any port infrastructure. Furthermore, persistent gradients in regional productivity may require data at fine spatial resolution to adjust harvesting controls and reference points to local conditions. This is most evident in benthic shellfish fisheries that target stocks of sedentary organisms, for which the assumptions of conventional fisheries models do not hold. Fishermen's participation — provided the right incentives are in place — is the only feasible alternative to collect the information needed to make decisions at the appropriate spatial scale and to achieve compliance with regulations.

Territorial Use Rights in Fisheries (TURFs) offer a suitable alternative to command-and-control approaches for fisheries that target relatively sedentary species, such as benthic invertebrates or reef fish. They combine managing at the local scale, allocation of access to the resource by space rather than catch and a community-based governance structure. As such, they provide incentives for fishermen to cooperate in the management of their local resources and allow local experimentation and adjustments of harvest controls to reflect local productivity. This is exemplified by the Chilean loco (*Concholepas concholepas*) fishery, in which the implementation of TURFs stopped the "race to fish." Exclusive access to fishing grounds encouraged fishermen to protect the resources therein and to invest in local enforcement of access rights and self-imposed regulations. Overall, this helped stabilize and rebuild a fishery that had previously collapsed under open access, and for which a program of limited entry and individual quotas proved unenforceable and unable to control harvest rates.

But the design of a TURF system poses significant challenges. Resource assessment programs and management institutions need to be restructured in order to provide technical support at a diversity of nested spatial scales. In the Chilean system, each TURF needs its own procedure for setting catch quotas, so some form of local assessment needs to be conducted. How do institutions provide support at the small scale when there are hundreds of TURFs scattered along the coasts? Simple control rules driven by the results of local participatory surveys offer a practical alternative to centralized full stock assessments. Professionals working at the local level (the "barefoot ecologist" proposed by Jeremy Prince) can facilitate assessments and help organize communities. While TURFs are spatially discrete, they are not biologically, socially or economically independent. This requires standardization of monitoring indicators and regional coordination of surveys, management plans and marketing. In addition, because populations within TURFs are not isolated but are interconnected by larval dispersal, the incentives to protect local resources are not complete and a sort of "tragedy of the larval commons" can develop. Even if local resources are overharvested, larvae can enter from neighboring areas. Therefore, TURF performance improves with regional coordination.

Most critical challenges are those related to the size of TURFs and the distribution of access privileges that need to take into account not only the biology of the target resources but also the social geography and traditional practices of the fishing communities. Differences in local productivity of fishing grounds in Chile created marked contrasts in the economic viability and performance of TURFS along the coast. TURFs have to be big enough to be profitable and buffer the spatial variability of recruitment, but small enough to be enforceable.

# Keynote Speaker

Are TURFS always best? No. TURFS will be unsuitable when the spatial dynamics of the fishery is variable and the spatial scale of feasible TURFs is too small to buffer the variability of local recruitment. When the fleet is dynamic, following the pulses of productivity, it is unwise to assign access rights to small stretches of coast because fishermen would be locked into territories that are too small to be viable. What are the alternatives? Where global stock assessments and enforcement of catch allocation are possible, quotas may be more suitable than territorial rights. This is the case in the tehuelche scallop (*Aequipecten tehuelchus*) fishery of Peninsula Valdes, Argentina — an artisanal diving fishery currently managed under limited entry and individual quotas assigned to permit holders. Where global stock assessments are not feasible, centralized enforcement is ineffective and fishing practices are nomadic — such as in the Chilean macha (*Mesodesma donacium*) fishery — local management with the flexibility of access at larger spatial scales may be most appropriate.

Clearly, one size does not fit all in terms of management strategies. The search for solutions to the global fishery crisis has been marked by a tendency to oversell management tools. But solutions need to be tailored to the specifics of the fishery, following some general guidelines. Management systems need to encourage responsible behavior in all sectors by clarifying access rights, ensuring transparency and accountability, and addressing enforcement problems. The latter is perhaps the most pervasive Achilles heel in small-scale fisheries. Compliance with rules needs to be encouraged by self-interest but also by strong penalties on rule violations. We need both carrot and stick approaches. The stick does not need to be just in the hand of the management authority, but in the local community as well.

Photo credit: Rebecca Zeiber/NHSG

# Conclusions

When the modern era of fisheries management began in the 1970s, administrations, jurisdictions and data collection systems were designed based on the prevailing theory of the day: species' distributions were broad and homogeneous. The assumptions are changing as fisheries science matures. With improvements in stock identification, tracking and molecular genetics, there are increasing examples of mismatches between the scale of biological population structure and management units. When the spatial scale that restrains fishing exceeds the fish population scale of resident habitat, there can be local extirpation of population components (e.g., Maine urchin). It is likely no coincidence that fisheries are fairly successful where the biological and management units are well-aligned (e.g., striped bass). Evidence is growing that more and more species express spawning site fidelity (e.g., cod), such that the preservation of the remaining spawning activity might be critical to the long-term productivity and sustainability of the stocks.

Rich data sets are available that scientists need to revisit and better utilize. However, critical "gaps" remain in our understanding of ecosystem processes. Although we now see more discrete population processes and evidence of population connectivity, the challenge is to make robust quantitative measurements that track the full life history of marine species. More investment is needed in understanding trophic relationships, feeding and spawning linkages, source populations and mixing. Genetic data are improving our understanding of biological structure and helping to converge the spatial scales of populations and management units. As science continues to improve our understanding of fish population structure, managers will be faced with determining what "scale" is appropriate for a given species. This will involve more than biological considerations, but the societal and economic impacts of scale change to local, state and regional fishing communities. In some cases, the science does not yet justify new management paradigms.

The movement towards ecosystem-based fisheries management and marine spatial planning, driven in part by the 2010 National Ocean Policy, is challenging fishery managers, scientists, fishermen and other stakeholders to better coordinate efforts and consider systems more holistically. However, moving from single species management — something that has been in place for several decades of evolving management plans — into more complex system governance is not a trivial proposal. The potential for mismanagement is high with so many jurisdictional and biological boundaries crossing each other. We have a tremendous web of governance, and what we are continually searching for is a way to govern ourselves more efficiently and economically. There need to be clear benefits of new governance systems that outweigh deficiencies in present governance systems to justify change.

The workshop made clear that management units should be consistent with biological processes, and that the major problem that finer-scale science is raising is a governance problem. Ecosystem-based management is uncomfortable because the nuances are obscure, but we need to keep pushing fisheries science, management and stakeholder dialogue forward towards more sustainable solutions.

*"If fisheries management was easy, we would have solved the problems by now. It is a difficult enterprise."*
*– federal scientist*

Photo credit: Rebecca Zeiber/NHSG

*"If we make more mistakes with the science, we won't have a fishery. The biggest depletion is in fishermen. We are not the industry. The scientists have good jobs, normal, civilized lives. Now that you are the industry, you need to do good science and management to keep us guys working. I hope you know what you are talking about."*
*– fisherman*

# Workshop Contributors

## Oral presentations

Karen Alexander, University of New Hampshire
"Catch density and the spatial distribution of fisheries"

Michael A. Armstrong, Massachusetts Division of Marine Fisheries
"The application of small scale fishery closures to protect Atlantic cod spawning aggregations"

Robert Beal, Atlantic States Marine Fisheries Commission
"Relationship of political boundaries, stock structure and the interstate management process"

Yong Chen, University of Maine
"Spatial scale and population structure in modeling fisheries population dynamics"

Jamie Cournane, University of New Hampshire
"Spatial and temporal patterns of river herring bycatch in the directed Atlantic herring fishery"

Carolyn Creed, Rutgers University
"Climate change and scale issues in Atlantic surfclam management"

Greg DeCelles, University of Massachusetts Dartmouth
"Reconsidering the spatial scale of winter flounder management in southern New England"

Denise Desautels, NOAA Fisheries Northeast Regional Office
"Legal considerations and implications of reconciling stock and management boundaries"

Daniel Goethel, University of Massachusetts Dartmouth
"Modeling spatially structured populations in stock assessments: Trying to keep pace with population ecology"

Teresa Johnson, University of Maine
"Socio-ecological mismatches and the collapse of the Maine sea urchin fishery"

Lisa Kerr, University of Massachusetts Dartmouth
"Ecological and fisheries consequences of a mismatch between biological population structure and management units of Atlantic cod in U.S. waters"

Adrienne Kovach, University of New Hampshire
"Identifying the spatial scale of population structure in anadromous rainbow smelt"

Sean Lucey, Northeast Fisheries Science Center
"Spatially explicit operational fisheries in New England"

David Martins, University of Massachusetts Dartmouth
"Improved management of southern New England cod fisheries based on movement patterns and stock structure"

Tom Nies, New England Fishery Management Council
"Challenges to incorporating fine-scale spatial structure into management of northeast multispecies"

# Workshop Contributors

Cate O'Keefe, University of Massachusetts
**"Incorporating incentives to define spatial and temporal scales for 'Accountability Measures' in the Atlantic sea scallop plan"**

Graham Sherwood, Gulf of Maine Research Institute
**"The downeast cod problem and how to begin to deal with it"**

Carl Wilson, Maine Department of Marine Resources
"Are Maine's Lobster Zones sized appropriately for decisions to be made?"

Jim Wilson, University of Maine
"What does the spatial complexity of ocean ecology mean for the human side of the system?"

## Industry panel

Bill Chaprales, *F/V Rueby*, Marstons Mills, Mass.

David Goethel, *F/V Ellen Dianne,* Hampton, N.H.

Joe Jurek, *F/V Mystique Lady,* Gloucester, Mass.

Mike Walsh, *F/V Tahoma*, Stoughton, Mass.

Josh Wiersma, Northeast Fishery Sectors XI & XII, Inc.

## Poster presentations

Alia Al-Humaidhi and James A. Wilson
**"Scaling down fisheries management: Can we take it too far?"**

Edward P. Ames
"Alewives and the cod family: Insights into their relationship during the 1920s"

N. David Bethoney and Bradley Schondelmeier
**"Alternative scales to address river herring bycatch in U.S. Northwest Atlantic mid-water trawl fisheries"**

Heather Deese, Robert Snyder, Shey Conover and Amanda LaBelle
**"What do maps of fishing grounds tell us about fish, fishermen and fisheries management?"**

Christopher Gurshin, W. Huntting Howell and J. Michael Jech
"Synoptic acoustic and trawl surveys of spring-spawning Atlantic cod in Ipswich Bay"

Anna Henry and Yong Chen
**"Developing a sentinel groundfish survey/fishery in the eastern Gulf of Maine"**

Adrienne I. Kovach, David Berlinsky, Timothy S. Breton and Amanda Clapp
"Fine-scale adaptive genetic variation in Atlantic cod"

William B. Leavenworth, Karen Alexander and Jeff Bolster
**"Comparing spatial distribution of historical and modern fisheries in the Gulf of Maine"**

# Workshop Contributors

Ellen McCann Labbe, Theo Willis, Karen Wilson, Jason Stockwell and Zachary Whitener
"Population genetic structure of river herring in the Gulf of Maine"

Derek Olson and Yong Chen
"Designing surveys to monitor fine-scale dynamics of depleted populations"

Jason D. Stockwell, Zachary Whitener, Ellen McCann Labbe, Theo Willis and Karen Wilson
"Alewife stock structure in the Gulf of Maine"

Douglas Zemeckis, William Hoffman, Michael P. Armstrong and Steven X. Cadrin
"Movements of Atlantic cod from a Massachusetts Bay spring spawning ground"

## Rapporteurs

Sharon Benjamin, Penobscot East Resource Center

Christian Canache, University of New Hampshire

Ben Metcalf, University of New Hampshire

## Resources

To view recordings of presentations made at the workshop, please visit:

http://www.northeastconsortium.org/about/events.shtml

http://extension.unh.edu/marine/FA_FMGMT.htm

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January 6, 2012

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The Honorable John E. Bryson
Secretary of Commerce
U.S. Department of Commerce
1401 Constitution Ave., NW
Washington, D.C. 20230

Dear Secretary Bryson:

I write to express my concern regarding the recent news surrounding the new preliminary stock assessments indicating a dramatic change to the Gulf of Maine (GOM) cod. As you know, cod is both a key symbol of the Commonwealth's natural heritage, and a key component of our fishing industry. Because cod is such an integral part of the groundfishery, any change in its abundance and allocation will have tremendous impacts for the entire Gulf of Maine groundfishery, which has an annual value of $30 million and is central to the livelihoods of hundreds of fishermen and their families. Therefore, I am appreciative that NOAA is taking steps to review additional data, keep stakeholders informed, and explore alternatives to maintain stability in both the groundfishery and the fishing industry.

It is important that we get this right for our fishermen. To that end, I have made the Commonwealth's Division of Marine Fisheries (DMF), through its partnership with the University of Massachusetts Dartmouth's

School of Marine Science and Technology and Marine Fisheries Institute (MFI), available to provide assistance and information to NOAA Fisheries during its review of the current stock assessments and ongoing policies. MFI and DMF have a wealth of institutional knowledge on this topic as they were involved in efforts to address a similar crisis facing the fishery in 1999.

Additionally, I want to urge NOAA Fisheries to adopt maximum flexibility in order to design pragmatic management and restoration policies that maintain stable fisheries and fishing communities.

Finally, I understand the Department is closely reviewing the Commonwealth's November disaster request for the economic loss Massachusetts' fishermen have incurred due to the transition to catch shares. I want to once again urge a favorable response so that we can protect the Commonwealth's historic and economically important groundfish fleet.

Thank you for your consideration, as well as your service to the nation.

Sincerely,

CC: Senator John Kerry
Senator Scott Brown
Representative Barney Frank
Representative Bill Keating
Representative Mike Capuano
Representative John Tierney
Representative Steven Lynch
Eric Schwaab, NMFS Administrator

Rick Sullivan, EEA Secretary
Bill White, EEA Assistant Secretary
Mary Griffin, DFG Commissioner
Paul Diodati, DMF Director
Dr. David Pierce, DMF Deputy Director
Dr. Brian Rothschild, MFI Co-Chair
Paul Howard, NEFMC Executive Director
C.M. Cunningham, NEFMC Chairman

# Commonwealth of Massachusetts
## Division of Marine Fisheries
251 Causeway Street, Suite 400
Boston, Massachusetts 02114
(617)626-1520
fax (617)626-1509

**Paul J. Diodati**
*Director*

**Deval Patrick**
*Governor*
**Timothy P. Murray**
*Lt. Governor*
**Richard K. Sullivan, Jr.**
*Secretary*
**Mary B. Griffin**
*Commissioner*




December 20, 2011

Patricia Kurkul
Northeast Regional Administrator
National Marine Fisheries Service
55 Great Republic Drive
Gloucester, MA 01930

Re: Directed Dogfish Exempted Fishery Request

Dear Pat,

I am writing to urge consideration of an Exempted Fishery Request by the Georges Bank Cod Fixed Gear Sector (Fixed Gear Sector). In a December 6th letter to you the Fixed Gear Sector requests exemptions from certain groundfish monitoring and discard related provisions while fishing on designated spiny dogfish trips.

Recent management actions have underscored the rebuilt status of dogfish and resulted in another annual increase in the spiny dogfish quota, at a time when groundfish sector operations are struggling to break-even. Current information available from the fishery indicates that incidental catch of groundfish is minimal when dogfish are targeted by fixed gear, warranting a sensible approach to management of fishing trips directed on non-groundfish by sector vessels. An exempted fishery (50 CFR 600.745) appears to be the appropriate process for assessing the suitability of amended regulations.

It is my understanding that should you determine the Fixed Gear Sector's application warrants further consideration then a notice will be published in the Federal Register. I look forward to providing more detailed comments on any and all exempted fishery permit requests for directed dogfish trips by groundfish sector vessels at that time.

Sincerely,

Paul J Diodati

Paul J. Diodati, Director

Cc: Eric Brazer, Fixed Gear Sector Manager
John Pappalardo, CCCHFA
Paul Howard, NEFMC Executive Director
Rip Cunningham, NEFMC Chair
Terry Stockwell, NEFMC Groundfish Oversight Committee Chair
Tom Nies, NEFMC Groundfish FMP Analyst
Mark Grant, NMFS Sector Analyst
Melissa Vasquez, NMFS Sector Analyst

cc: Exec Cte (1/4)

# Channel Fish Processing Co., Inc.

RECEIVED
DEC 28 2011
NEW ENGLAND FISHERY MANAGEMENT COUNCIL

December 22nd, 2011

Mr. Colin Cunningham, Chair
New England Fishery Management Council
50 Water Street, Mill 2
Newburyport, MA 01950

Dear Mr. Cunningham:

Channel Fish Processing Co., Inc is a long established, New England based, seafood processor interested in purchasing a steady supply of Redfish from New England groundfish fishermen.

We are encouraged by recent successful experimental fishing for redfish by fishermen enrolled in groundfish sectors, and we are hopeful that this work will lead to increased opportunities for fishermen and processors alike.
We understand that the several groundfish sectors have applied for an exemption from the minimum mesh size restrictions of the multispecies plan in order to efficiently and effectively harvest their allocation of redfish.

We ask for your support for the request for exemption of the minimum mesh size restrictions.

Sincerely,

Steve Atkinson
National Sales Manager
Channel Fish Processing Co., Inc.

Cc Karen Roy – N.E.F.M.C.

18 Foodmart Road Boston, Massachusetts 02118 TEL (617) 464-3366 FAX (617) 464-3377

cc: TN, CBK (1/4)

RECEIVED
DEC 21 2011
NEW ENGLAND FISHERY
MANAGEMENT COUNCIL

16 December 2011

The Honorable John Kerry
One Bowdoin Square, Tenth Floor
Boston, MA 02114

Dear Senator Kerry:

We, the undersigned group of 61 academic scientists, are writing to request your help facilitating a public review of an important marine conservation and management proposal for the waters off the coast of New England. Recently NOAA's Stellwagen Bank National Marine Sanctuary (SBNMS) released a draft proposal to designate a Sanctuary Ecological Research Area (SERA) within its boundaries (http://stellwagen.noaa.gov/library/pdfs/sbnms_sera_proposal.pdf). The rationale for the SERA proposal is to delineate an area to conduct monitoring and research to better understand how human uses of the marine environment affect biological diversity, including those species managed for sustainable harvest. By design, the SERA has three sub-areas and will allow long term studies of marine communities under different fishing regimes as well as a limited area with no-fishing that will serve as a reference site. There currently is no such area in the Gulf of Maine. Without a true research/reference area, understanding the effects of human uses of the oceans, the foundation for ecosystem management, is severely compromised. The SERA will permit such research, the results of which will address the management needs of both SBNMS and New England fisheries.

Scientists and managers contributing to the design of the SERA proposal understood that it would be referred by NOAA to the New England Fishery Management Council (NEFMC) for consideration in an ongoing Essential Fish Habitat amendment process. The referral by NOAA to the NEFMC is the key critical step to initiating an open and public review. Following its own lengthy public process, the SBNMS Sanctuary Advisory Council voted by a wide margin to forward the proposal to the NEFMC. Unfortunately, NOAA has not yet carried out that recommendation leaving the SERA proposal in bureaucratic limbo. Referring this proposal to the NEFMC is not a public notice of impending regulation but simply opens the door for a useful public discussion. Much discussion and analysis would remain once the Council opens that deliberation, with many possible outcomes as the SERA proposal – even in the most positive scenario - is combined with other contemplated management actions such as opening fishery closed areas.

This proposal clearly addresses the needs of SBNMS, the National Marine Fisheries Service, the NEFMC and the fishing community. While it may not be adopted as a result of the NEFMC and public review process, it deserves an appropriate forum to be aired. Unfortunately, it appears that political sensitivity, given the many additional conflicts currently in play in the realm of New England fisheries, may be overriding NOAA's stewardship responsibilities.

**We ask for your support and encourage you to contact the Department of Commerce and NOAA to request they officially forward the SERA proposal to the NEFMC.** This simple action formally initiates a public conversation. If DOC and NOAA are afraid of words, where is natural resource management in our Nation headed? Thank you, in advance, for your consideration.

Sincerely[1],

**Les Kaufman, Ph.D.**
Professor of Biology
Boston University Marine Program
Boston, MA

cc: TN, Council (12/21), Michelle

**Richard F. Ambrose, Ph.D.**
Professor of Environmental Science
University of California
Los Angeles, CA

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Department of Marine Sciences, University of Puerto Rico
Mayaguez, PR

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Living Marine Resources Cooperative Science Center, University of Maryland Eastern Shore
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**Charles Yarish, Ph.D.**
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Departments of Ecol. & Evolutionary Biology and Marine Sciences, University of Connecticut
Stamford, CT

**Phil Yund, Ph.D.**
Director, Marine Science Center & Center for Land-Sea Interactions
University of New England
Biddeford, ME

Cc:
Senator Scott Brown (MA)
Senator Olympia Snowe (ME)
Senator Susan Collins (ME)
Senator Jeanne Shaheen (NH)
Senator Kelly Ayotte (NH)
Senator Richard Blumenthal (CT)
Senator Joseph Lieberman (CT)
Senator SheldonWhitehouse (RI)
Senator Jack Reed (RI)

Representative Joe Courtney (CT)
Representative Rosa DeLauro (CT)
Representative James Himes (CT)
Representative Jim Langevin (RI)
Representative David Cicilline (RI)
Representative Michael Capuano (MA)
Representative Barney Frank (MA)
Representative Edward Markey (MA)

Representative John Tierney (MA)
Representative Stephen Lynch (MA)
Representative Frank Guinta (NH)
Representative Mike Michaud (ME)
Representative Chellie Pingree (ME)

Secretary of Commerce John Bryson
Undersecretary of Commerce for Oceans and Atmosphere Dr. Jane Lubchenco
Assistant Adminstrator for Fisheries Eric Schwaab
Assistant Administrator for Ocean Service David Kennedy
NMFS Regional Administrator Patricia Kurkul
SBNMS Superintendent Craig MacDonald
New England Fisheries Management Council Executive Director Paul Howard
New England Fisheries Management Council Chair Rip Cunningham

[1] - All of the scientists listed here have requested directly that they be included in this letter. Affiliations after each name simply indicate academic affiliations and do not imply that the contents of this letter reflect the policies of those institutions.

**CPF Charters "Perseverance"**
**P.O. Box 732**
**Brant Rock, MA 02020**
**www.cpfcharters.com**

RECEIVED
DEC 19 2011
NEW ENGLAND FISHERY
MANAGEMENT COUNCIL

December 19, 2011

The Honorable John Kerry
218 Russell Building
Second Floor
Washington, DC 20510

**RE: Gulf of Maine Cod Stock Assessment**

Dear Senator Kerry:

As a Charter Boat captain that actively fishes the Stellwagen Bank waters that is located within the Gulf of Maine ("GOM") I am extremely disappointed by the latest results of the GOM cod stock assessment. According to the most recent New England Fishery Management Council ("NEFMC") cod stock assessment, in less than a year, the cod population has gone from a sustainable and highly productive fishery to being on the verge of a complete collapse. This finding is inconsistent with the recent University of Massachusetts ("UMASS") Dartmouth State cod population studies as well as the number of cod and other bottom fish that are being caught in the Gulf of Maine by me and other Charter Boats as well as other recreational fishermen.

I fully support your written request to the National Marine Fisheries Service ("NMFS") to conduct another comprehensive GOM cod stock assessment. The NMFS incorrectly estimated that status of the Pollack stock assessment in the past. I also request that an assessment or evaluation of the means and methods utilized to statically evaluate the status of the cod biomass present in the GOM also be conducted to properly assess the cod biomass.

Additional effort or controls including additional seasonal closures and/or size or bag limits will have a highly detrimental effect on my Charter Boat business. Historically, the GOM Charter/Party Boat Operators have made huge sacrifices in their fishing efforts in order to stay within compliance of the burdensome and overly restrictive Northeast Multi Species regulations. In 2003, Amendment 13 to the Northeast Multispecies Management Plan imposed a Charter/Party boat restriction of just ten codfish as the daily bag limit. Additional limits were implemented in 2006 that included an increase in the minimum size of GOM cod from 22" to 24" and a closed season for GOM cod from Nov 1st – April 1st. This five month closure reduced the Charter/Party cod fishing season by forty two percent. In 2009, this seasonal closure was increased by an additional action implemented under Framework 42 by increasing the closed season on codfish for Charter/Party vessels during the first fifteen days in April. All these measures where intended to increase the sustainable levels of cod biomass in the GOM and up until the most recent GOM cod assessment, appeared to be working. I ask that you pursue all



cc: Council, TN (12/19)

**CPF Charters "Perseverance"**
**P.O. Box 732**
**Brant Rock, MA 02020**
**www.cpfcharters.com**

possible options to allow for the extension date of the rebuilding period of the GOM codfish stocks.

The excitement and adventure of GOM cod fishing draws anglers from all over the country who want to experience deep-sea sport fishing. They come with hopes of taking one of America's finest food fish back home and to spend their vacation and hard earned money with us. They support the local seaside businesses with the purchase of lodging, meals, gasoline, tackle, and supplies which all contributes to our local economy. Without reasonable bag limits and the current season, these anglers will simply fish elsewhere devastating our businesses and local economies.

I greatly appreciate your time and look forward to working with you and the members of your staff in finding a solution which will allow me and my fellow Charter Boat Captains to continue in a traditional fishery in the GOM for codfish.

If you have any questions please contact me at (617) 291-8914 or email at cpfcharters@yahoo.com.

Sincerely,

Capt., Michael J. Pierdinock
CPF Charters
Stellwagen Bank Charter Boat Association
Recreational Fishing Alliance
Mass Striped Bass Association
Green Harbor Tuna Club

Cc: United States Senator, Scott Brown
United States Representative, John Tierney
United States Congressman William Keating
Mr. Eric Schwab, Assistant Director, National Marine Fisheries Service
Mr. Paul Diodati, Director, Massachusetts Division of Marine Fisheries
Mr. Robert Zales, President, National Association of Charter Boat Operators
Mr. James Donofrio, Executive Director Recreational Fishing Alliance
Mr. Paul Howard, Executive Director NEFMC
Mr. Barry Gibson, Chairman NEFMC Recreational Fishing Advisory Panel

Stellwagen Bank Charter Boat Association
P.O. Box 1221
Marshfield, MA 02050

RECEIVED
DEC 16 2011
NEW ENGLAND FISHERY MANAGEMENT COUNCIL

December 16, 2011

CC: Paul Howard NEFMC
978-465-3116

The Honorable John Kerry
218 Russell Building
Second Floor
Washington, DC 20510

Dear Senator Kerry:

On behalf of the Stellwagen Bank Charter Boat Association ("SBCBA"), we are extremely disappointed by the latest results of the Gulf of Maine ("GOM") cod stock assessment. The Stellwagen Bank Charter Boat Association is comprised of over one hundred Charter Boat Captains and Mates that sustain themselves by fishing for Northeast Multi Species and primarily target codfish in the GOM. According to the most recent New England Fishery Management Council ("NEFMC") cod stock assessment, in less than a year, the cod population has gone from a sustainable and highly productive fishery to being on the verge of a complete collapse. This finding is inconsistent with recent UMASS Dartmouth State cod population studies as well as the number of cod and other bottom fish that are being caught in the Gulf of Maine by SBCBA members as well as other recreational fishermen.

We fully support your written request to the National Marine Fisheries Service ("NMFS") to conduct another comprehensive GOM cod stock assessment. Further, we ask for an evaluation of the means and methods utilized to statically evaluate the status of the cod biomass present in the Gulf of Maine. We are very concerned that additional effort controls including additional seasonal closures and/or size or bag limits will have a highly detrimental effect on our struggling businesses and will force the closure of many Charter Boat Operators.

Historically, the GOM Charter/Party Boat Operators have made huge sacrifices in their fishing efforts in order to stay within compliance of the burdensome and overly restrictive Northeast Multi Species regulations. In 2003, Amendment 13 to the Northeast Multispecies Management Plan imposed a Charter/Party boat restriction of just ten codfish as the daily bag limit. Additional limits were implemented in 2006 that included an increase in the minimum size of GOM cod from 22" to 24" and a closed season for GOM cod from Nov 1st – April 1st. This five month closure reduced the Charter/Party cod fishing season by forty two percent. In 2009, this seasonal closure was increased by an additional action implemented under Framework 42 by increasing the closed season on codfish for Charter/Party vessels during the first fifteen days in April. All these measures where intended to increase the sustainable levels of cod biomass in the GOM and up until the most recent GOM cod assessment, appeared to be working.

The GOM Charter/Party fishermen ask that you pursue all possible options to allow for the extension date of the rebuilding period of the GOM codfish stocks. Without an extension, it will be the last straw for many hard working fishermen who have sacrificed

cc: TN (12/19)

Stellwagen Bank Charter Boat Association
P.O. Box 1221
Marshfield, MA 02050

over the years doing their part to help rebuild the GOM cod stocks. If GOM codfish retention restrictions become severe enough as to warrant government authorized permit buyout or distribution of emergency funds, the GOM Charter/Party Operators need to be fully included in any relief funds directed to the region.

The excitement and adventure of GOM cod fishing draws anglers from all over the country who want to experience deep-sea sport fishing. They come with hopes of taking one of America's finest food fish back home and to spend their vacation and hard earned money with us. They support the local seaside businesses with the purchase of lodging, meals, gasoline, tackle, and supplies which all contributes to our local economy. Without reasonable bag limits and the current season, these anglers will simply fish elsewhere devastating our businesses and local economies.

We are asking for your support to make sure that the NMFS invites us to future meetings regarding this matter as stakeholders and whose businesses depend on this fishery. We are no different than the GOM Commercial Fisherman and have just as much a vested interest in the management and access to the resource.

In closing, I greatly appreciate your time and look forward to working with you and the members of your staff in finding a solution which will allow the Charter/Party industry to continue in a traditional fishery in the GOM for codfish.

If you have any questions please contact me at (781) 834-2899 or email at bostonbiggame@hotmail.com

Sincerely,

Steven James, President
Stellwagen Bank Charter Boat Association

Copy: United States Senator, Scott Brown
United States Representative, John Tierney
United States Congressman William Keating
Mr. Eric Schwab, Assistant Director, National Marine Fisheries Service
Mr. Paul Diodati, Director, Massachusetts Division of Marine Fisheries
Mr. Robert Zales, President, National Association of Charter Boat Operators
Mr. James Donofrio, Executive Director Recreational Fishing Alliance
Mr. Paul Howard, Executive Director NEFMC
Mr. Barry Gibson, Chairman NEFMC Recreational Fishing Advisory Panel