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19 March 2009

Mr. Frank Blount, Chairman
Herring Committee
New England Fishery Management Council
50 Water Street, Mill 2
Newburyport, MA 01950

RE: AMENDMENT 4 – PROTECTING ECOSYSTEM FORAGE BASE

Dear Mr. Blount and members of the Herring Committee:

We write to ask that the Herring Committee continue work to strengthen Amendment 4 to the Atlantic Herring Fishery Management Plan (FMP) as it pertains to the role of Atlantic herring as prey in the ecosystem. The Amendment 4 Draft Discussion Document describes the efforts of the Plan Development Team (PDT) to account for the role of herring as a forage fish when setting catch limits, and we commend the PDT and the committee for this work. Nevertheless, we feel that additional improvements must be made to meet the goals and objectives of the amendment and to follow the new guidance on special considerations for forage fish described in the National Standard 1 (NS1) Guidelines Final Rule. With this letter we ask that the committee (1) add a new alternative in the ACL/AM section of the amendment, and (2) add a list of Management and Research Needs pertaining to herring as forage.

We request that the committee consider introducing a new alternative in Amendment 4 that outlines the process for considering the importance of herring as a forage fish when setting ACLs, consistent with objective 6 of the amendment. We believe the current process of accounting for forage described by the PDT, in particular, the forage buffer between MSY and OY, could be adapted as an alternative as follows:

(1) <u>Alternative</u>: Accounting for the Atlantic Herring as a Forage Fish when establishing ACLs

- A goal of the Atlantic herring specifications should be established to maintain the stock above B_{msy}, consistent with the NS1 Guidelines. This should include an evaluation of the biological reference points (biomass targets and thresholds) used to inform the setting of ACLs.
- In its review of the Herring PDT's recommendations and subsequent determination of ABC, the Scientific and Statistical Committee (SSC) shall quantify predation to the extent practicable. The SSC will then include in its recommended buffer, between the OFL and the ABC, a set-aside based on uncertainty in predation needs and/or the forage needed for rebuilding of predator populations to optimum levels. The PDT will revise its ACL recommendations to be consistent with the SSC's advice, factoring in management uncertainty. The final ACL recommendation should reflect an appropriate and explicit forage buffer to account for ecosystem needs.

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The inclusion of the above forage alternative under ACLs/AMs would serve three important purposes: 1) Comply with the NS1 Guidelines; 2) Improve the transparency of how forage is accounted for in the FMP, an issue of great importance to stakeholders; 3) Establish a template that encourages accuracy and more explicit predation considerations in future specifications.

Compliance with the NS1 Guidelines of the Magnuson-Stevens Reauthorization Act
More conservative management of the herring resource is reinforced by the law. The recently finalized National Standard One (NS1) guidelines on complying with the Magnuson-Stevens Reauthorization Act (MSRA) are unambiguous on the need to consider the benefits of protection afforded to marine ecosystems resulting from maintaining adequate forage for all components of the ecosystem[1]. This need is acknowledged in the Amendment 4 goal statement and objectives, but the draft discussion document itself (23 January 2009) needs to go further.[2] On 9 February 2009, the New England Fisheries Management Council (NEFMC; *Council*) voted (16:1) to make the setting of Annual Catch Limits (ACLs), and associated Accountability measures (AMs), its highest priority.

Improving Transparency; Building Stakeholder Confidence
An overwhelming majority of the comments received during Amendment 4 scoping (90% of the 10,000 written comments, or 8,912 comments) attest to the fact that stakeholders do not believe the importance of herring as a forage fish is accounted for in the Atlantic Herring Fishery Management Plan. The process must be made more transparent to foster understanding by concerned stakeholders. If the process is not clarified and formalized in Amendment 4, the Committee will have missed an important opportunity to build stakeholder confidence and demonstrate progress on this issue.

Explicit Consideration of Predation
Finally, the process of accounting for predation in stock assessments and establishing the buffer around the ABC needs to be developed with a more rigorous treatment of the known ecosystem needs of predators and the uncertainty that stems from the complexities of predator and prey population dynamics. An SSC review of predation information contained in the stock assessment and specifications coupled with an explicit buffer will promote progress in this important area.

The inadequacies surrounding the implicit consideration of predation in forage fish stock assessments are well documented, yet the Atlantic herring stock assessment currently relies on a static natural mortality rate to ensure predator needs are addressed. This is a risky approach to managing such a critical prey source for the New England region, where many predators are on a course of rebuilding.

Recent research produced by the Northeast Fisheries Science Center and the Food Web Dynamics Program (Overholtz et al., 2008, Tyrrell et al 2008, Overholtz and Link 2007, Moustahfid et al., 2009) is outstanding and emphasizes the benefits of explicitly considering predation mortality in forage fish stock assessments as well as the economic and ecological benefits of doing so.

[1] NS01; 50 CFR Part 600 Magnuson-Stevens Act Provisions; Annual Catch Limits; National Standard Guidelines; Final Rule; Federal Register / Vol. 74, No. 11 / Friday, January 16, 2009 / Rules and Regulations.
[2] http://www.nefmc.org/herring/index.html; draft Amendment 4 discussion document, dated 23 January 2009.

The Council should encourage the use of stock assessment models that do explicitly account for predation. In addition to the ACL alternative described above, the following items should be included in Amendment 4, minimally as a list of Management and Research Needs.

(2) Management and Research Needs Pertaining to Herring as Forage

- Improve the quality of predation estimates in stock assessments and specifications.
  - Update the treatment of natural mortality in the stock assessment to reflect the best available data and new research indicating the risks of assuming that natural mortality is static and independent of prey age and predator population dynamics.
  - Utilize models that explicitly account for predation and incorporate new data on predator needs.

- Request annual progress reports from the PDT on the development of stock assessment models that explicitly quantify and incorporate predation mortality until these models are fully utilized in the official stock assessment for Atlantic herring. These models should take into account population dynamics for the suite of prey species targeted by Atlantic herring predators (e.g., mackerel, sandlance, menhaden, river herring).

- Request annual progress reports on the data needs to accomplish the above, emphasizing major herring predator groups (e.g., large pelagic fish, marine mammals, seabirds) for which there is scant or outdated consumption data. Data needs should include determining the functional feeding responses (e.g., linear or density dependent) of herring predators to improve the accuracy of models.

- Actively support research to address data gaps identified by the above, such as through the research set-aside program.

- Actively support research and models that advance ecosystem-based management of the New England forage base as a whole, so managers have the appropriate tools to ensure a sufficient quantity and diversity of forages species is available to maintain ecosystem function and productivity.

We have appended additional discussion of the herring as a key food source in the ecosystem and a list of source materials. Thank you for considering the requests presented in this letter.

Sincerely,

John D. Crawford, PhD
Pew Environment Group – New England

Pam Lyons Gromen, Executive Director
National Coalition for Marine Conservation

cc: Paul Howard, Executive Director - NEFMC
John Pappalardo, Chairman - NEFMC
Lori Steele, Chair, Herring Plan Development Team - NEFMC

ADDITIONAL DISCUSSION and SOURCES

RE: AMENDMENT 4 – PROTECTING ECOSYSTEM FORAGE BASE

Challenges and Deficiencies in the Current Process of Accounting for Herring

Explicit vs. implicit recognition of the quantity of food needed by predators. The predator populations that rely on herring include prized large pelagic fishes, groundfish, and protected and endangered marine mammals. These populations require a certain quantity of herring as food each year, and this depends upon how many of these predators there are, the abundance of the full suite of prey species they utilize, and other variables that demand caution in assessing their consumption of herring.

Much of the discussion of predator needs revolves around the incorporation of natural mortality in assessment models. Predation is considered to be ***implicitly*** addressed in the natural mortality rate estimate. However, natural mortality is a *rate* and the prey biomass associated with it depends upon the starting biomass of the prey population in any given year, or time period. If natural mortality is assumed to be fixed from year to year, and the herring population declines, then the food available for predators will be less. Thus, the needs of predators for prey are not determined by a static natural mortality rate but are determined by the population size of the predators relative to the available biomass of prey. The amount of herring needed by predators (weight) must be recognized ***explicitly*** in the FMP for Atlantic herring.

In addition, the amount of herring that predators consume in a given year cannot simply be assumed to be the amount that must left in the water for the predators – predator-prey interactions are more complicated than that. The PDT, with guidance from the SSC, should be directed to examine predator-prey interactions in order to better understand the prey-densities required to ensure that the predators will be able to successfully locate and consume the amount of prey they need to satisfy their energetic demands.

Specific concerns about natural mortality and the herring FMP. Natural mortality (M) is routinely included in stock assessment models and was used for the most recent Atlantic herring stock assessment (TRAC 2006)[3]. Natural mortality was assumed to be fixed for all age groups, and across years (M=0.2).

The herring PDT has argued that in fixing natural mortality at 0.2, the needs of predators have been addressed. At best, this natural mortality rate can only reveal what portion of the herring population is expected to be removed by predators or other natural causes. Natural mortality rate cannot reveal whether predator food-needs are satisfied adequately, nor can it tell you if herring is available to predators in the times and places they need it. With natural mortality held constant, and the standing biomass of herring fluctuating from year to year, strongly influenced by fishing as well as other variables, the amount of food available for predators will also vary from year to year. Based on the considerations outlined here, and a number of scientific

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[3] Transboundry Resource Assessment Committee (TRAC). 2006. Gulf of Maine-Georges Bank Herring Stock complex. TRAC Status Report 2006.
www.mar.dfo-mpo.gc.ca/science/trac/TSRs%5CTSR_2006_01_E.pdf

publications (e.g., Read and Brownstein 2003; Overholtz et al., 2008; Moustahfid et al., 2009) we are concerned about the static natural mortality assumptions for Atlantic herring. Specifically we are concerned that the needs of predators and the ecosystems will not be sufficiently safeguarded without more explicitly accounting for predator needs in Amendment 4 to the herring FMP.

Predator populations are dynamic. There are a host of predators whose populations are known to be increasing, with some of these under specific federal management plans aimed at growing these populations (e.g., rebuilding plans for groundfish and bluefin tuna, protection under the endangered species act for whales). Despite expected increases in predator populations, the same assumption about the natural mortality has been used for many years without being updated based on new empirical data. It is reasonable to suppose that the growth of the predator populations has, or will, produce a corresponding increase in the natural mortality rate unless this growth is offset by corresponding increases in the population of Atlantic herring (Overholtz et al., 2008; Moustahfid et al., 2009). Natural mortality for Atlantic herring has fluctuated considerably over the years with rates well above 0.2 reported in the literature (Overholtz et al., 1998). Even the recent TRAC (2006) called the assumed mortality rate into question: *An investigation of natural mortality rates used in the model indicated that a rate higher than the assumed M=0.2 (i.e., M=0.3-0.4) was more consistent with the available data* (*Special Considerations*, p 4).

A number of recent papers have discussed the consequences of assuming a static natural mortality rate when in fact natural predation rates are dynamic. When predator biomass is dynamic, the assumption of constant natural mortality will usually be invalid and MSY-related reference points will be misleading (Overholtz et al., 2008).[4] In a recent paper on another forage species in the same ecosystem (Atlantic mackerel), Moustahfid et al (2009) concluded that *the assumption of constant natural mortality made in conventional mackerel stock assessments is likely inappropriate.*[5] Additionally, the assumption that natural mortality is constant across age classes is also incorrect, with much higher mortality on fish in the youngest class (Tyrrell et al 2008).[6]

Predation on Atlantic herring is influenced by other prey populations. While Atlantic herring is widely recognized for its critical role as a major forage species in the New England region, predators that consume Atlantic herring likely fulfill part of their diets with alternative prey species such as Atlantic mackerel, sandlance, and menhaden, and the abundance and seasonality of these populations will thus influence predation on Atlantic herring (see Tyrell et al., 2007). For example, herring becomes more important to predators when sandlance abundance is low (Overholtz et al., 2000). These interactions between predator and prey populations are not yet recognized in assessments and are a source of uncertainty about consumption of herring and natural mortality. These are issues that the PDT should begin to address, and should consider while developing precautionary buffers for prey species.

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[4] Overholtz
[5] Moustahfid et al 2009
[6] Tyrrell et al., 2008

Temporal and spatial variation in predation rates and prey populations. The current approach to management of Atlantic herring does not take into account complications that could stem from assuming heterogeneity in predator-prey relationships across space and time. For example, discrete components of the herring population (sub-populations) may be subject to relatively high rates of predation, and fishing, in some areas due to the abundance distributions of predators, including people. This could put at risk eradication of components of the herring population (c.f., in shore cod) and / or cause short-term localized depletion of forage (Bearzia et al., 2006; Cardinale et al., 2004). These are difficult but important issues that need to be examined by the SSC and PDT, and addressed for incorporation in the herring FMP in the future.

Solutions to Improve Upon the Status Quo

Establishing explicit precautionary buffers for herring as prey. To explicitly account for predation, the amount of herring needed by predators (weight, number, age-class) must be estimated and buffered appropriately to ensure that these needs are met, and this should be established as a priority in the Herring FMP through Amendment 4. Among other things, this amounts to recognizing the value that stakeholders place on the food (i.e., herring) required by the ecosystem predators they use.

NS1 (p 3208) recommends that *species interactions that have not been explicitly taken into account when estimating MSY (through a stock assessment) should be considered as relevant factors for setting OY below MSY.* That is, the estimated consumption needs of predators should be explicitly included in a buffer calculation when these needs are not fully incorporated into the stock assessment. The sources of uncertainty around estimating predator demands for Atlantic herring are many, as reviewed above, and must be carefully considered in setting an appropriate buffer. For example, the rate of herring consumption by upper trophic level predators is variable (Overholtz et al., 2008; draft Amendment 4 Figure 1, p 46) and may exceed the natural mortality rate assumed in stock assessment models by fourfold or more (Read and Brownstein 2003).[7]

Based on work of the herring PDT, the draft Amendment 4 document (p 41) includes a buffer of 29,000 mt to address uncertainty stemming from (1) overestimation of spawning stock biomass (SSB) in the stock assessment model, (2) the influence of environmental variability on recruitment, and (3) providing a level of confidence that ecosystem needs are addressed.

In our view, insufficient detail has been provided on how precisely the PDT calculated this particular buffer. We urge the committee to seek further explanation of this issue and to make the buffer calculations explicit and transparent. The determination of predator needs should be developed separately, and in detail, and identified as a discrete portion of the buffer. The needs of predators, and the allocation of herring to predators in the buffer, should be included in Amendment 4 to the FMP for herring.

Periodic updating of natural mortality rate (M). The introduction of a natural mortality rate (s) based on more current data (i.e., appropriate for the biomass required for current predator needs) would be a significant step toward improving the Atlantic herring FMP, and would help address stakeholder concerns about predator needs. As a first step, Amendment 4 should include a

[7] Read and Brownstein 2003; Overholtz et al 2008

provision for periodic updates of natural mortality, with a maximum cycle time of 3 years. A sensitivity analysis should also be conducted and presented in the amendment (see Overholtz et al., 2008), showing how assessment results (e.g., estimates of B_{msy}), and estimates of prey availability, vary with different values of natural mortality (M). VPA assessment models (previous TRAC assessment for herring) are known to be sensitive to errors in natural mortality estimates.[8] Nevertheless, even with updates to the estimates of natural mortality rate problems will persist with the traditional assessment approach as it relates to allocating herring as forage for the ecosystem.

A new approach: modeling predators as a competing "fishery." Moustahfid et al (2009) have presented a promising approach to the assessment of small pelagic fishes that serve as prey in the ecosystem (see also Hollowed at al., 2000; Overholtz et al., 2008). In their important paper Moustahfid et al (2009) demonstrate the use of an age-structured assessment program (ASAP) that explicitly incorporates predation mortality. Predatory removals were modeled in the same manner as fishing mortality, with a comparable set of time-series, to produce estimates of predation mortality-at-age and for each year. Predators were essentially treated as another "fishing fleet", with predation mortality explicitly modeled in the same manner as fishing mortality.

Moustahfid et al (2009) focused on Atlantic mackerel, but this approach could readily be applied to Atlantic herring. We strongly urge the committee to consider this approach during the upcoming TRAC and to identify this or a similar method in Amendment 4 as an objective for future assessments of Atlantic herring.

Precautionary reference points for key prey species. National Standard 1, under the section on optimum yield (p 3208), advises caution in setting reference points for prey species such as Atlantic herring: ... *consideration should be given to managing forage stocks for higher biomass than B_{msy} to enhance and protect the marine ecosystem...* We urge the committee to follow this advice as it develops Amendment 4. It should be noted that one of the potential pitfalls of the assumption of a static natural mortality rate (discussed above) is the risk of substantially underestimating where spawning biomass should be (B_{msy}).[9] Overholtz et al 2008 demonstrated that B_{msy} increased by a factor of 1.6, from 896 kt to 1,452 kt when predation was explicitly considered. These findings underscore the importance of exercising caution in the management of the herring resource.

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[8] Cooper, AH (2006) *A Guide to Fisheries Stock Assessment - from data to recommendations,* p36.
[9] Moustahfid et al (2009)

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