Peer Review Comments Received from:

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Comments Received from Peer Reviewers:

1. **A reviewer had comments on the scientific basis for how the metrics are applied to assess adult returns and effective population size for DPS viability and reclassification. The assessment of the current and projected viability of the DPS recognizes a need to consider both census size and genetic effective size (Ne). The reviewer noted that consideration of both metrics is appropriate given that they capture two different components of potential risk, demographic and genetic respectively. Indeed, joint assessment of this sort is consistent with long-standing precedent for other species of concern.**

   In regards to the Precision and Application of N_e/N relationships the reviewer noted that estimating both N and Ne in real world populations is non-trivial and especially so for Ne. The reviewer appreciated the pragmatic desire to base reclassification and recovery criteria on annual returns (census size = 500). However, he had some concerns with assumptions used in the current numerical exploration of the relationship between annual returns and N_e, and question whether current scientific knowledge is adequate at this time to use returns (N) alone in assessing population viability. Specifically, as the review team notes, ratios of N_e to N can vary extremely widely in wild salmon populations (0.03-0.71: Palstra et al. 2009. Genetics). Thus the scientific assessment's use a ratio of 0.2 for their computations appears somewhat arbitrary, even if the intent was to provide for a convenient equating of Ne to the annual return numbers under an assumed generation length of 5 years. The reviewer suspects that generation time is likewise a crude estimate, and age structure is an important factor in determining Ne. The key question thus becomes one of whether that 0.2 ratio and a 5 year cohort generation length are too high or too low, as that will determine whether the current proposed adult return criteria are adequate to also meet Ne goals for sustainability (i.e., $N_e > 500$ per Franklin 1980). The reviewer noted that there are two reasons why he suspects that Ne might be quite a bit lower than suggested from the current assessment. First, Ne/N ratios from the literature may not be ideally suited for evaluation at the SHRUs scale of viability assessment. While this treatment might be approximate for the Penobscot SHRU, the Downeast SHRU consists of many separate populations for which odds of interbreeding are much lower than within in a single population. Because of this, the most pertinent N_e values apply more locally and the effective N_e/N across the SHRU may be much lower than implied by applying a simple literature-based N_e/N ratio to total number of SHRU returns. Second, the reviewer believes there may be an error in how the above 0.2 ratio was applied. The values presented by Palstra et al. (2009) and the 0.2 value identified by the scientific review represent N_e/N ratios but the current computation relating Ne to adult returns appears to treat this ratio as equivalent to the ratio of the annual effective number of breeders to returns (i.e., Nb/returns), or treats the cohort census size (N) as the sum of 5 years of adult returns. Either way, if an error of this sort was included in the computations that would tend to inflate the apparent N_e estimate. Finally, it is perhaps worth noting that even if Ne/N and generation values were very well defined under current conditions, it is feasible these values would change somewhat as the population status changes in the future given their dependence on demography etc.

   Given all these uncertainties, and the feasibility of estimating N_e with much more precision in the future (e.g., using methods outlined in Palstra et al. 2009 and elsewhere), the reviewer suggested that abundance criteria for reclassification or delisting that specify both minimum return AND minimum N_e thresholds may be more scientifically justifiable than criteria that assume poorly characterized relationships between these viability criteria. Indeed, adopting dual criteria that also specifies a N_e target might be easier to apply within the new recovery planning framework since doing so could avoid a major revision to recovery criteria if future studies of Ne show the current assessment assumptions were inadequate.

2. **A reviewer had comments in regards to sustained Population Growth particularly with the seemingly inconsistent consideration of hatchery produced parr when determining growth. These parr are a small component of hatchery stocking, limited to only some DPS populations, but their inclusion or exclusion could have potentially strong influence on estimates of return/replacement rates if their performance is closer to that of smolts than fry, so it is important they be accounted for consistently, particularly in assessing reclassification (they are excluded either way in delisting evaluations).**

   For downlisting criteria from Endangered to Threatened we indicated that Wild Fish along with Hatchery origin Eggs, Fry and Parr will be considered in evaluating population growth rate. Hatchery origin eggs and fry are often lumped in with wild origin fish because we are not able to easily determine their origin through fin erosion (something often associated with hatchery reared fish) or through reading of growth rings on scales where hatchery reared fish often have faster, more consistent growth than wild origin fish. Hatchery origin parr fall somewhere in the middle between those fish that can often be easily grouped with hatchery origin fish and fish that cannot. Today we make some assumptions about how much parr actually contribute to adult returns and we tend to lump the parr contributions with the hatchery reared component of adult returns upon making these assumptions.

   After considerable discussion about how to consider parr in downlisting criteria with have decided that, for the purposes of downlisting alone, that we believe parr should remain grouped in with naturally reared fish that include wild origin fish, and hatchery origin eggs and fry. The reason for this decision is because all of these life stages experience the most significant threats identified at the time of listing, particularly the threat of dams and the threat of marine survival. In contrast, hatchery smolts are often stocked below most or all dams in an effort to avoid the adverse effects associated with them. For this reason, we believe that if we see increased population growth rate among wild fish, or hatchery origin eggs, fry or parr we can reasonably assume that there has been progress made in addressing the significant threats identified at the time of listing which should warrant consideration in our decision to downlist from endangered to threatened.

3. **A reviewer noted that in the details on population viability analysis, the plan indicates that both trap count and red-survey data will be 'totaled' to estimate returns in a given SHRU. This statement makes it sound as if there is potential for the same fish be counted twice if/when there is both trap and red-survey data for a given system. The process to exclude such double counting should be noted.**

   Thanks for the comment on this and we have clarified this statement recognizing that redd counts and trap counts will be used in conjunction with one another to estimate adult returns, but will not be "totaled" to estimate adult returns.

4. **A reviewer noted that sustained population growth is based on the geometric mean replacement rate over 10 years being larger 1.0. D ependence on any measure of central tendency alone, without respect to measurement error and confidence in the value, is inferentially risky. A value greater 1.0 is not enough on its own to discern a sustained growth trend from chance without somehow also accounting for effect sizes and/or confidence in that value. The reviewer recommends using actual and simulated returns data for GOM salmon populations to assess power and type 1 and 2 error rates surrounding this 10-year metric, or alternative metrics, for ascertaining sustained growth.**

   After review we agree with this comment and amended the criteria by removing the "Geometric mean" from the growth rate criteria for downlisting and delisting. Removing the word "geometric mean" gives us the flexibility to consider the best methods for calculating growth rate. As such we are investigated the best methods used for calculating growth rate of critically endangered species, and are looking into aligning our methods with those used on the West Coast for calculating growth rate of Pacific salmon populations.

5. **A reviewer felt the weight of current scientific evidence would merit an increase in the relative threat level associated with artificial propagation. Artificial propagation is a necessary support system for the DPS at this time, but the reviewers assessment is that the risks inherent to that support system also make it a 'significant threat', as opposed to a 'secondary stressor'.**

   There are known risks associated with supportive breeding and captive propagation programs. Adaptation to the captive environment and subsequent decreased fitness to the wild has been documented in other salmonids (Araki et al. 2007, Christie et al. 2012).

   However, populations that are small in number are at greater risk for loss of genetic diversity through small number of breeding individuals and an increased potential of inbreeding. This can be further magnified by isolation among populations. Loss of diversity can allow for expression of recessive deleterious traits which would normally be removed without consequence to the population in populations of greater number. Loss of diversity can also limit the ability for the populations to adapt to changing environmental conditions, reduce the expression of varying traits or behaviors such as diverse run timing, or reduce the habitation of a variety of niches, all of which help to provide resiliency to the population as a whole.

   Without the historic and current supplementation of the Maine Atlantic salmon DPS by hatchery support, the population, especially in the smaller coastal rivers, as not self-sustaining, and would likely be extirpated (USFWS and NOAA 2016). For example, Cove Brook, a small tributary to the Penobscot River, previously maintained a genetically differentiated population (Spidle et al. 2003) that is now thought to be locally extirpated aside from a few periodic stray individuals from the Penobscot River.

   The current hatchery program is managed adaptively as much as possible, and information obtained from genetic and life history parameter monitoring is used to adjust practices when possible in order to minimize management-induced artificial selection. For example, genetic data has been used to inform stocking practices to evaluate familial contribution to river-specific broodstock parr recaptures (Bartron et al. 2006). Genetic data has also been used to evaluate the contribution of pre-spawn stocked adults to determine if they were able to successfully reproduce in the wild following multiple years in captivity. These actions are examples of different methods hatcheries have implemented for Atlantic salmon to increase exposure of captive reared individuals to the wild environment in order to help offset adaptation to captive environments.

Hatchery management for Atlantic salmon in Maine should continue to use best practices and revisit management strategies to minimize potential negative impacts resulting from captive rearing, although recognizing that not all impacts can be avoided. However, use of hatcheries also enables larger census and spawning populations to be maintained than what would be present in the wild given current adult returns. The use of hatcheries is not meant to replace self-sustaining populations, but in the interim they are viewed as a tool to help maintain genetic diversity until populations can demonstrate sustainable reproduction and survival in the wild.

Although we completely agree that there are significant risks associated with the Atlantic salmon conservation hatchery program, we also recognize that ending the conservation hatchery program would constitute an even greater significant risk to the species as the population would likely go extinct within 20 years of the last stocking event (Legault 2005; Nieland et al. 2015). With this information we continue to maintain the current risk status of the conservation hatchery program as its described in the final listing rule (74 FR 29344, 2009), but we did strengthen several of the conservation hatchery recovery actions to address the risks associated with hatchery programs. .

6. **A reviewer expressed concern over the use of the Ne/N ratio of 0.2. Although we review Ne/N ratios for Atlantic salmon we did not include the Ne/N ratio as part of the reclassification and recovery criteria because of the confounding issues in being able to assess the ratio for wild populations. The reviewer also recommended that minimum Ne estimates, in addition to census numbers, be incorporated into the reclassification and delisting criteria.**

Estimates of effective population (N_e) size are useful metrics to managers to understand the estimated number of individuals successfully reproducing and contributing to the next generation, or the number of individuals required to maintain similar allele frequencies between generations, depending on the specific definition of effective population size being targeted. It can be a useful metric in providing insight into what is typically a smaller number of individuals successfully reproducing within a larger census population size. See Palstra et al. (2009) for an example.

Variability in estimates of effective population size can be significant depending on the method used to estimate effective population size. Palstra et al. (2009) evaluated a number of Atlantic salmon populations, and identified a range of both N_e and N_e/N ratios for a number of populations over time. Palstra et al. (2009) also identified that the metric used to estimate Ne can result in large variance in the estimate itself. Although methods to calculate Ne have greatly improved over time (Do et al. 2014), these methods require genetic assessment to obtain allele frequencies to calculate N_e, and still serve as an estimate of a parameter about the population.

Currently, obtaining N_e estimates is a critical component of the ongoing genetic assessment of the Atlantic salmon conservation hatchery program. Genetic samples are gathered from parr or adults that are captured and maintained at the hatchery for use as broodstock. Obtaining genetic samples from fish in the wild to evaluate Ne of the Gulf of Maine DPS would be considerably more difficult. This would require capturing a substantial number of returning adult salmon to gather genetic samples from all representative populations that constitute the GOM DPS. We believe this would constitute a considerable increase in adult salmon that we would need to capture in order to gather these samples; something we hope to minimize to the extent possible as we move closer towards recovery. Absent the ability to capture and handle salmon from all representative populations in each SHRU, we believe it would be very difficult to monitor progress to specific N_e delisting or reclassification targets at the SHRU-specific level.

Furthermore, current monitoring efforts of Ne for some of the populations is useful, however populations not supported directly through hatchery stocking would be expected to have much smaller numbers of spawning individuals, and Ne would likely be much different (or at least the N_e/N ratio) from hatchery supported rivers. Because not all SHRUs are equally supported by hatchery supplementation, use of those populations to estimate N_e accurately SHRU-wide would likely be highly variable and therefore not as useful as a representative metric for an entire SHRU (consisting of both hatchery-supported and wild populations). Although Ne estimates are useful to assess when able to be obtained, use of N as a recovery or delisting criteria is a more easily monitored threshold, either through direct counts of adult individuals or redd counts from spawning adults.

7. **A Reviewer noted that the background discussion on the LIS and Central New England DPS's is confusing where it seems to imply the Connecticut River is in the Central New England DPS.** We agree with the comments and have modified the wording to read as follows:

   "All native Atlantic salmon populations in the Long Island Sound and Central New England population segments have been extirpated. As of 2014, non-native Atlantic salmon were still present in the Central New England and Long Island Sound population segments as an artifact of a reintroduction program that existed in the Connecticut and Merrimack Rivers from 1967 to 2012. In 2013the USFWS discontinued the federally supported programs to rebuild these stocks. However, Atlantic salmon persist in some rivers in the Long Island Sound and Central New England DPS as a result of state supported efforts to maintain Atlantic salmon presence in some rivers. These include the State of Connecticut's Atlantic Salmon Legacy program that supports a small stocking program in the Connecticut River, and the Saco River Salmon Club's hatchery program supported by Maine DMR that continues to maintained a small stocking program in the Saco River. The Atlantic salmon used to support these programs are not part of the listed entity and therefor, are not protected under the Endangered Species Act. Only the GOM population segment supports native wild salmon populations, all of which are at extremely low population size, leading to the designation of this population segment as a DPS."

8. **A reviewer stated that the discussion of the governance would be helped by the inclusion of a flow chart showing the different bodies and listing (either in the flow chart or the text) examples of who would serve on each board.** We agree with the comment, although at this time some modifications to the governance structure are currently underway. Once there is

agreement on the modifications to the governance structure a more detailed outline along with a flow chart will be made available on the website.

9. **A Reviewer noted that the discussion of the Penobscot River Project (Veazie, Great Works, Milford, etc.) would benefit from the inclusion of dates, which are currently missing.** We agree with the comment and we modified the text to include the dates for the removal of Veazie and Great works and the construction of the bypass channel at Milford.

10. **A reviewer raised concerns over identifying Maine's glass eel fishery as an indicator of fishery success. He recommended that we remove this reference from the text.** We agree with comment and the eel fishery reference has been removed.

11. **A reviewer recommended clarification of the wording of the threats abatement criteria pertaining to Competition by non-native species as it was unclear. In the draft plan, the text read as follows: "Plans for the stocking, introduction, and management of nonindigenous species that compete with Atlantic salmon support a recovered GOM DPS of Atlantic salmon and are implemented."** We agree with the comment and we reworded the text to read as follows:
"*Develop and implement plans for the stocking, introduction, and management of nonindigenous species that compete with Atlantic salmon to ensure they support a recovered GOM DPS of Atlantic salmon*"

12. **A reviewer strongly disagreed with the statement that post barrier removal monitoring activities are essential in the context that we don't have to do extensive monitoring for all removals. He recommended modifying the wording to say that some post removal monitoring may be helpful.** We agree with the comment and modified the action to read:
"*As needed Conduct pre- and post- barrier removal and fish passage improvement monitoring using up-to-date methods"*

13. **A reviewer remarked that he has concerns over our fry stocking program and that he worries it may not always be done in the most effective means possible.** We acknowledge the reviewers concerns. Although in this recovery plan we do not get into a considerable amount of detail about the stocking and broodstock program or the methods that are employed in implementing these programs. We do recognize these concerns and acknowledge that how broodstock management and stocking programs are conducted vary considerably based on what the goals of the stocking program are. Currently these goals are not explicit for each of the phases of recovery nor are the methods for achieving these goals clearly defined. We purposefully did not undertake this challenge in the recovery plan recognizing the complexity of the issues surrounding this. Rather we have organized a team to work on addressing these issues separately in which ultimately a separate management plan will be developed that addresses the broodstock and stocking program in the context of the 4 phases of recovery.

14. **A reviewer had comments on many of the recovery actions in the draft plan**. Since the review and in response to many comments on the recovery actions by the expert reviewers as well as the public reviewers, we have invested considerable effort to clarify each of the recovery actions, further define each actions specific purpose, and to ensure that each action was trackable to the extent possible.

15. **A reviewer raised concerns over some of the costs of recovery actions particularly the cost estimates being too low for many actions, but specifically in respect to the costs to address the threat of dams.** Similar concerns were also raised during the public review of the recovery plan. While updating the recovery actions to clarify their purpose and to ensure each action was actionable, we also took a closer look at the cost of each action. One change to the plan that we made to help clarify the cost of recovery was to identify all those actions that we anticipate will be implemented under the agencies current baseline cost. This assumes Fiscal year 2017 budgets for NOAA-Fisheries, USFWS as well as pass through money to Maine's Department of Marine Resources, building leases and other expenses. For actions that cannot be covered under current baseline costs we provide a cost estimate that is either calculated based on the best available information or is estimated based on expert opinion.