Independent Peer Review by the Center for Independent Experts (CIE)

Status Review Report: Alewife (*Alosa pseudoharengus*) and Blueback Herring (*Alosa aestivalis*)

by

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November 2018

EXECUTIVE SUMMARY

Purpose

The purpose of this independent review is to conduct a scientific peer review of 'Status Review Report: Alewife (*Alosa pseudoharengus*) and Blueback Herring (*Alosa aestivalis*)' which is intended to provide information necessary for NMFS to make a determination on the potential listing of these species, or their Distinct Populations Segments, under the Endangered Species Act (ESA).

Comments and Recommendations

1. The Status Review Report incorporates the best scientific information available on river herring catch statistics, exploitation rate, abundance estimates, life history, distribution, behaviour, and genetics. All scientific findings are reasonable and well founded.

2. The risk assessment analysis considers all of the best available scientific and commercial data. The conclusions regarding extinction risk for alewife and blueback herring are sound, interpreted appropriately (excepting deliberations regarding r), and scientifically defensible.

3. The Status Report does an excellent job in collating and interpreting multiple sources of abundance data; many have unknown levels of bias and uncertainty. However, this variable data quality magnifies the importance of swept-area biomass and relative exploitation rate estimates. The Status Report should fully address all caveats and uncertainties regarding interpretation of swept-area biomass and exploitation rate.

4. The analytical assessment of 'Significance', as it relates to delineation of DPSs, would benefit from the provision of a scientifically defensible basis for the apparently arbitrary values of '10 generations' and '1,000 fish'.

5. The estimates of per capita population growth (r) in the Status Report do not provide strong support for the conclusions that river herring are neither endangered nor threatened. These conclusions can be strengthened by citing estimates of r_{max} from other sources, identified herein.

6. There is a 'disconnect' between some elements of the extinction risk analysis. Conclusions drawn from one analysis are not always examined to see if they are consistent with the conclusions of a separate analysis. Two elements of the extinction risk analysis (detailed herein) that can be afforded greater emphasis and clarity include: trends in total mortality (Z) – particularly *stability* – and per capita population growth rate, r.

REVIEWER REPORT

I. BACKGROUND

The Status Review Report (hereafter, the Status Report) was prepared in direct response to a judicial finding of 'vacancy' for the 12 August 2013 determination that blueback herring did not warrant a listing as 'threatened' under the ESA. The listing determination was remanded back to NMFS on 25 March 2017. On 15 August 2017, NMFS published a notice that initiated a status review for both alewife and blueback herring. The Status Report is intended to (i) comprehensively review the best available scientific information on the status of alewife and blueback herring, (ii) evaluate the factors contributing to the species' status, (iii) assess whether either species comprises Distinct Population Segments, and (iv) include an assessment of the species' risk of extinction.

II. DESCRIPTION OF THE INDIVIDUAL REVIEWER'S ROLE IN THE REVIEW ACTIVITIES

I received the "Status Review Report: Alewife (*Alosa pseudoharengus*) and Blueback Herring (*Alosa aestivalis*)" from Mark Chandler, NMFS CIE Program Coordinator, Office of Science and Technology, on 28 September 2018. I received the background documents for the CIE River Herring ESA Status Review on 24 September 2018, via a link to a Google Drive. I began my review on 28 September 2018 and completed it on 9 October 2018. My review was submitted to the Center for Independent Experts (CIE) on 9 October 2018.

III. SUMMARY OF FINDINGS IN ACCORDANCE WITH THE TERMS OF REFERENCE

1. Is the information regarding the life history and population dynamics of the species the best scientific information available? If not, please indicate what information is missing and if possible, provide sources.

Life History: To the best of my knowledge, the information regarding the life history of the two species represents the best scientific information available. I base this conclusion on my own knowledge of the species and on the considerable range of expertise on the life history of alewife and blueback herring that has been presented in published NMFS Working Group and Stock Assessment reports on river herring.

Population Dynamics: There was relatively little information on population dynamics *per se* in the Status Report and in the documents available for review. From a population dynamics perspective, the primary information in the Report pertained to (i) estimates of per capita population growth rate (*r*), (ii) estimates of total mortality (Z), and (iii) qualitative analyses undertaken to determine what would constitute a 'significant gap' in sections dealing with the element of 'Significance' as it pertains to the identification of DPSs. The first two points are discussed here; the third is discussed in more detail later in this review.

Per capita population growth rate (r): The Status Report identifies values of *r* that are quite close to 0 (0.038 for alewife and 0.050 for blueback herring on pages 102 and 125, respectively). With respect to the question of whether the information on *r* is the best available, the text lacks sufficient clarity and there is some additional information that is neither mentioned nor explicitly considered in the Status Report.

Firstly, the values of *r* in the Status Report do not represent 'population growth rate' but '*per capita* population growth rate'. The differences between the two are non-trivial. Secondly, although the text does not state this, I am assuming that the estimates of *r* represent 'realized *r*' as opposed to 'maximum *r*' or r_{max}. Again, the distinction is quite important.

Thirdly, information not used in the Status Report pertains to information on r_{max}. According to Table 2.29 in the ASMFC's 2012 'River Herring Stock Assessment Update Volume 1: Coastwide Summary', r_{max} – r(m) in Table 2.29 – for alewife is reported to average 0.32 (14 populations) and the single estimate for blueback herring is 0.55. In an independent analysis, Hutchings et al. (2012; supplementary information) reports an average value of r_{max} of 0.85 (3 populations) and 0.56 (4 populations) for blueback herring and alewife, respectively.

Total mortality (Z): The assessment-based estimates of total mortality (Z) are particularly informative, compared to others. That said, it would have been helpful for the Status Report to state explicitly the reasons why the River Herring Stock Assessment Subcommittee and peer-review panel favoured the reference points with the higher natural mortality estimate of 0.7 rather than 0.3. Admittedly, the latter does seem too low, given the life history of river herring, but inclusion of the text "reference points calculated with the lower natural mortality can be considered more precautionary" (page 32) implies that acceptance of the higher level of M is <u>not</u> precautionary. Perhaps some rewording here would be helpful to improve clarity. Trends in Z as they relate to perceived extinction risk are discussed further below.

2. Does the information on river herring genetics, physiological, behavioral, and/or morphological variation presented for the species' range represent the best scientific information available? If not, please indicate what information is missing and if possible, provide sources.

Compared to many other anadromous species, there appears to be relatively little information available on river herring physiological, behavioural, and/or morphological variation. When considered throughout the range of the two species, the genetic information appears to be the most substantive and the most robust. This is rather unfortunate, and surprising, given the historical and present commercial importance of the species in question.

Ideally, there would be comparative life-history data available on traits such as age and size at maturity, fecundity, and individual growth rates. One might also have hoped for some age-specific data on survival that would allow for estimates of per capita population growth rate (among other things). But, based on the documents available for review, it would appear that relatively little of this information is available, and that the information in the Status Report represents the best scientific information available.

The genetics data would seem to be among the best of the available data. The Status Report includes information from regional and coast-wide analyses of alewife and blueback herring, including those of Bentzen et al. (2012), Palkovacs *et al.* (2014), McBride et al. (2014), Hasselman et al. (2016), Ogburn et al. (2017), Baetsher et al. (2017), and especially Reid et al. (2018). These analyses seem to have been competently undertaken by acknowledged experts in genetics and on the biology and life history of *Alosa* spp.

Thus, the information on river herring genetics, physiological, behavioural, and/or morphological variation presented for the species' ranges represents, in all likelihood, the best scientific information available.

3. Based on the scientific information presented, are the conclusions regarding species, subspecies, or distinct population segment delineations supported by the information presented? If not, please indicate what scientific information is missing and if possible, provide sources.

Distinct Population Segments (DPSs): The DPS Analysis in the Status Report provides considerable detail with respect to the question of whether river herring should be recognized as DPSs or not. The studies that have contributed to an understanding of the genetic structure of river herring, such as McBride et al. (2014), Ogburn et al. (2017), Baetsher et al. (2017), and Reid et al. (2018), provide an empirically strong and scientifically defensible basis for evaluation of the two key elements to consider in a decision as to whether a population/stock, or a group of populations/stocks, qualifies as a DPS: discreteness and significance of the segment(s) to the species as a whole. These studies, in conjunction with Palkovacs et al. (2014) and NMFS (2012a), have settled upon the conclusion that alewife and blueback herring are structured to such an extent that each species is likely to be distinguished by 2 or more (but not more than 5) putative DPSs. Specifically, the report distinguishes 4 DPSs for alewife and 3 DPSs for blueback herring.

The sections on *Significance* for alewife (p89) and blueback herring (p92) include text on the degree to which the proposed DPSs match geographically the terrestrial ecoregions identified by The Nature Conservancy. While I concede that inclusion of the TNC in the Status Review is likely necessary, I feel that it provides a very weak tool for discerning significance.

Minor Comments: Page 8 of the Status Report includes errors in the information on taxonomy. Both species are in the Class Actinopterygii (not Chondrichthyes) and the Subclass is spelled 'Teleostei'. Figures 1 and 2 are rather poor depictions of the distributional ranges of the two species. Figure 1 is particularly poor as it is inconsistent with the text on page 8 which states that Blueback Herring are found as far north as Nova Scotia; see Figure 1B in Reid et al. (2018) for a better figure. Also, I believe 'Reid et al. (unpublished)' cited on page 91 is intended to be 'Reid et al. (2018)'.

4. Based on the scientific information presented in the extinction risk assessment report, does this analysis consider all of the best available data and are the conclusions appropriate and scientifically sound? If not, please indicate what information is missing and if possible, provide sources.

The extinction-risk section of the Status Review comprises three sections: Distinct Population Segments; Extinction Risk Analysis; and Significant Portion of its Range Analysis. The DPSs were addressed above in Term of Reference (TOR) 3 and the determination of 'Significant Portion' is addressed below in TOR 6. In this TOR, I will focus on elements of the Extinction Risk Analysis that I think could be strengthened.

IUCN: As an overall comment, it might have been helpful if the Status Report had drawn, to some extent, upon the IUCN's criteria for assessing risk of extinction. I appreciate the fact that doing so can be contentious, but the fact is that they are widely used (e.g., for forming the basis of scientific advice on species listing in Canada; Waples et al. 2013) and objectively these criteria offer an additional 'lens' through which extinction probability can be evaluated. For example, the percentage reductions in habitat reported on pages 39 and 42 could have been used as a proxy for estimating declines in population size, in accordance with the IUCN's Criterion A (http://cmsdocs.s3.amazonaws.com/RedListGuidelines.pdf).

Another aspect of the IUCN's population-decline criterion is that it applies only if the decline has occurred within the longer of three generations or ten years (page 60 in http://cmsdocs.s3.amazonaws.com/RedListGuidelines.pdf). For river herring, this would mean that if the greatest declines occured more than 12-18 years ago (i.e., three generations), and that stability has been experienced since, that the IUCN decline criterion would not trigger an assessment of endangered or threatened. This would be consistent with the Status Report's conclusion that river herring are neither endangered nor threatened. (Interestingly, the Status Report does draw upon the IUCN criteria indirectly in its use of a three-generation frame to define 'foreseeable future'.) Some clarity would be helpful.

More problematic, however, is an apparent 'disconnect' that exists between various elements of the extinction risk analysis. By 'disconnect', I mean that the conclusions drawn from one analysis are not always examined to see if they are consistent with the conclusions of a separate analysis. One example is provided here. The other (on per capita population growth rate, *r*) is presented in TOR 5, where I perceived it to represent a germane response to TOR 5.

Total Mortality (Z): The estimates of total mortality (Z) comprise a very important element of the assessment of extinction probability of river herring. Trends in Z are presented in Table 3. The text tends to focus on the question of whether Z has been increasing in recent years, this type of trend being quite relevant when assessing extinction probability. As one example, page 32 includes the statement that, "There have been no increasing trends in empirical total mortality estimates over the last ten years of the updated data time series." If one is interested solely in increasing trends in Z, this is clearly something to draw attention to.

However, the report should also draw attention to the fact that simple *stability* in Z during the past decade (or longer) is also of concern, especially if the threat of direct exploitation has been mitigated. Trends that are stable are of concern because such stability suggests that the threats or factors responsible for stock declines in the past have not changed appreciably *in toto*. Put another way, if a stock experienced declining abundance at a given level of Z, and that level of Z has not changed, then at a minimum this would suggest that recovery has low probability and that further decline might occur.

Examining the stock-by-stock trends in Z in Table 3 of the Status Report, it seems reasonable to conclude that the vast majority of stocks have experienced stable trends in Z. This would suggest that recent efforts to mitigate threats have largely had minimal effect.

Somewhat paradoxically, four stocks with stable trends in Z are apparently increasing in population size (the column labelled 'Updated Recent Trends'), even though Z is *above* the benchmarks (Androscoggin, Sebasticook, Monument, Nemasket). Something here is discordant, perhaps reflective of the very considerable uncertainty that exists in discerning population trends, trends in Z, and (or) the Z-based benchmarks, at least for some rivers.

Thus, although the relative exploitation rate of river herring (Figure 11) is estimated to have declined since the mid-1970s, and to currently be at its lowest level since then, the stability in Z since 2006 for most stocks suggests that the mortality experienced by river herring attributable to direct exploitation has been supplanted by increases in mortality caused by other potential threats, such as incidental or unreported catches by commercial and recreational fishing.

Allee Effects/Depensation: Page 69 makes reference to how predation might influence river herring decline. This is reiterated on Page 70 in the last line of the paragraph entitled '*Conclusions*' ("…unless their abundance becomes suppressed at very low levels"). Of course, predation can also influence probability of recovery through Allee effects (or depensation). Predator-driven Allee effects are thought to be the primary reason for continuing declines or slow recovery in some fish species, including Atlantic cod, in the Southern Gulf of St. Lawrence, resulting in elevated levels of natural mortality and negatively affecting probability of population increase (e.g., Neuenhoff et al. 2018. CJFAS. https://doi.org/10.1139/cjfas-2017-0190).

Other:

(1) Upper table on page 96 and table on page 97: Does 'near future' mean 'foreseeable future'? Does 'long-term' mean longer than the 'foreseeable future'? The text should be very clear. And what is a VP descriptor? Is PV ('population viability') perhaps intended?

(2) Page 98, second line: Does "individual stock complexes" mean "DPSs"? If so, the text should state the latter.

(3) Page 110, paragraph 4, last line (and elsewhere in the report): Should '*Moderate'* be '*Medium'* to be consistent with the wording in the table on page 97?

(4) Page 120 and page 142: I do not understand what the relevance is of the fact that team members "addressed the inadequacy of the Endangered Species Act to respond to fish species with high fecundity rates". What does high fecundity have to do with the assessment of extinction probability, given that high fecundity does not positively influence recovery potential or resilience (Cole 1954; Hutchings et al. 2012)?

(5) It is interesting to see the very high uncertainty among the experts associated with the influence of 'incidental catch' as a threat to alewife (p14) and blueback herring (p25). For both species, it is the threat with the highest range of variability. Might this warrant greater emphasis?

5. In general, is the best scientific and commercial data available for the status review and extinction risk analysis of river herring presented in the report? If not, please indicate or provide sources of information on which to rely.

As far as I can ascertain, with perhaps one exception, the best available scientific and commercial data have been considered in the extinction risk analysis of river herring in the Status Report. The exception pertains to per capita population growth rate (*r*), a key correlate of extinction probability. Discrepancies are evident in the growth rate/productivity analyses on pages 102 and 125 for alewife and blueback herring, respectively.

Beginning with what might seem to be a minor issue, the text is not referring to 'population growth rate' but *per capita* population growth rate. The former growth parameter has units of 'numbers of individuals per unit of time' whereas *r* (which is what is evidently being used in the Status Report) has units of '*numbers of individuals per individual* per unit of time'. It is an important distinction.

The estimates of *r* presented in the Status Review do not provide particularly strong support for the (later) stated conclusions that river herring are neither endangered nor threatened. Although MARSS modelling is cited as the basis for the analyses here (pp 102 and 125), it is difficult to discern precisely how the estimates of *r* were made, even after consulting the River Herring Extinction Risk Analysis Working Group Report (NMFS 2012b).

The estimated values of *r* for alewife (0.038; confidence interval [are they 95%???]: 0.005 to 0.071) and blueback herring (0.05; confidence interval [95%??]: −0.03 to 0.13) are actually quite low for species that have the life history exhibited by river herring (early age at maturity, short lifespan). (I will add that the observation that the confidence interval for alewife does not encompass '0' does not exude confidence).

Although the text does not state this, I am assuming that the estimates of *r* represent 'realized *r*' as opposed to 'maximum *r*' or r_{max}. Again, the text does not make this clear. According to Table 2.29 in the ASMFC's 2012 'River Herring Stock Assessment Update Volume 1: Coastwide Summary', r_{max} – I am assuming that r(m) means r_{max} in this table – for alewife is reported to average 0.32 (14 populations) and the single estimate for blueback herring is 0.55. In an independent analysis, Hutchings et al. (2012; supplementary information) reported an average value of r_{max} of 0.85 (3 populations) and 0.56 (4 populations) for blueback herring and alewife, respectively.

My point is that r_{max} is generally thought to be a defensible metric of rate of recovery or resilience for depleted populations/species. The values of r_{max} in

ASMFC (2012; Table 2.29) and Hutchings et al. (2012) would support conclusions that depleted river herring would be predicted to respond well, and rapidly, to threat mitigation. On the other hand, the estimates of realized *r* presented on pages 102 and 125 are so close to '0' that they raise legitimate questions as to whether river herring can sustain an increase in the magnitude of any of the multiple threats currently facing the two species.

6. In general, are the scientific conclusions in the reports sound and interpreted appropriately from the information? If not, please indicate why not and if possible, provide sources of information on which to rely.

It is my opinion that the scientific conclusions in the Status Report are sound and interpreted appropriately from the best available information. That said, there remains room for strengthening these conclusions.

Significant Gap Analysis: A prominent example can be illustrated with the text associated with the question of what would constitute a 'significant gap' in the sections on *Significance* for both species. Such a gap is defined to be an area that would not likely be recolonized with self-sustaining populations within 10 generations (40-60 years). A self-sustaining population is defined to be 1,000 fish annually in currently occupied rivers within the area.

The values of '10 generations' and '1,000 fish' would appear to be entirely arbitrary. If they are not, the Status Review provides no information as to what their empirical basis might be. Questions arise: How were the values selected? Were any simulations undertaken to determine how sensitive one's perceptions of recolonization probability might be to changes in the 10-generation time frame or to changes in the number of individuals constituting a self-sustaining population? The Status Review would be considerably strengthened if such analyses were undertaken or if the '10' and '1,000' values could be scientifically justified.

On another point, interpretations of the degree to which conclusions are considered to be scientifically sound can, depending on the reader, depend on whether the analyses were quantitative or qualitative.

In this regard, it would seem that the analysis described in paragraph 4 of page 92 is not a quantitative analysis. The analysis appears to have comprised a verbal discussion only, with the outcome(s) of the analysis reflecting expert opinion, rather than the outcome of simulation modelling. (Use of the word 'felt' in two places on page 93 lead me to believe that the conclusions were the result of personal opinions only). If this is the case, it would strengthen the Status Report's transparency if it was made clear that the analysis was based solely on expert opinion. If this was not the case, then the text should identify the quantitative modelling that was undertaken.

Evaluation of the Inadequacy of Existing Regulatory Mechanisms: The information on Canada in the second paragraph on page 71 appears to be outdated. The text states that there currently exists an integrated fishery management plan for river herring in eastern New Brunswick. However, it seems that this management plan was terminated in 2012 (http://www.inter.dfo-mpo.gc.ca/Gulf/FAM/IMFP/2007-2012-Alewives-ENB). Based on the information here (http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/ifmp-gmp/index-eng.htm), Canada currently does not have an integrated fisheries management plan (IFMP) for river herring.

Page 74 includes a section entitled "Updated". A key element of this section is to make the case that, although Essential Fish Habitat (EFH) has not been designated for river herring, its EFH is likely to be covered by existing EFH designations for Atlantic salmon from Connecticut to the Canadian border and for Atlantic herring from Cape Hatteras to the Canadian border. As the text states, "EFH has been designated for numerous…species in the Northwest Atlantic. Measures to improve habitats and reduce impacts resulting from those EFH designations may directly or indirectly benefit river herring."

Among the different types of habitat that can be deemed 'essential' for an anadromous fish, the most limiting is almost always spawning habitat. Page 14 describes the preferred spawning substrate for river herring as including "gravel, detritus, and submerged aquatic vegetation". Atlantic salmon do not spawn over detritus or vegetation. Page 14 also states that alewife "prefer spawning over sand or gravel bottoms, usually in quiet waters of ponds and coves". Again, this is not where Atlantic salmon spawn.

I recommend that the text on page 74 be far more circumspect with respect to the probability that existing EFH designated for Atlantic salmon will truly benefit river herring, especially alewife.

Landlocked Forms: Regarding landlocked forms, there are numerous examples of a lack of differentiation between anadromous and non-anadromous forms of the same species inhabiting the same watershed in salmonids (*e.g.,* Atlantic salmon, Arctic char, brook trout, brown trout, rainbow trout/steelhead). The Status Review might be strictly correct in stating that "At this time, there is no substantive information that would suggest that landlocked populations can or would revert back to an anadromous life history if they had the opportunity to do so". However, for those of us who have worked on landlocked Atlantic salmon, many populations that became landlocked for tens of generations because of man-made barriers to seaward migration have been found to resume their anadromous life style once the barrier has been removed. Indirect evidence of this can also be discerned from the observation that landlocked salmon smolts, on their migration to a lake, will often take on the silvery colouration characteristic of their anadromous counterparts. Admittedly, the evidence of this resumption of an anadromous life style has been poorly documented in the scientific literature.

7. Where available, are opposing scientific studies or theories acknowledged and discussed? If not, please indicate why not and if possible, provide sources of information on which to rely.

It is not clear to me that opposing scientific explanations have been articulated with respect to two key components of the Status Review: (i) minimum swept-area estimates of biomass and (ii) relative exploitation rate. It is important to draw attention to these because of their undeniable importance in perceptions of the threat posed by directed fishing mortality and of the extinction probability for river herring. In addition to the accuracy of catch estimates, the trend in exploitation rate is heavily dependent on the veracity of the trend in minimum swept-area estimates of total river herring biomass from the NEFSC spring bottom trawl surveys (Figure 10). The estimates of relative exploitation rate (Figure 11) represent a key component of the report, insofar as they arguably provide the most compelling reason for concluding that directed fishing mortality has been declining, particularly in recent years.

The minimum swept-area estimates show a dramatic increase in river herring biomass in recent years that seems to be inconsistent with most of the temporal data on Z which largely suggest temporal stability (Table 3). Further to this point, neither the Status Review nor the stock assessment report (ASFMC 2017) identifies sources of error in the swept-error biomass estimates, except to draw attention to the fact that these swept-area biomass estimates were sometimes exceeded by the catch estimates (leading to exploitation rates greater than 1 in Figure 11) and to note that the NEFSC survey does not cover the entire marine area used by river herring.

The very low relative exploitation rates in recent years are heavily influenced by the very high estimates of swept-area biomass. (I am also aware that directed catches have almost certainly declined considerably in recent years because of fishing moratoria; this will also lead to lower exploitation rates). If swept-area biomass has been over-estimated, then the exploitation rates will have been under-estimated. My primary concern in this regard is the question of whether the rapid increase in biomass suggested by Figure 10 in recent years is biologically defensible. What is the rate of per capita population growth (*r*) necessary for such an increase to occur? And is it reasonable for river herring? If the estimates of *r* on pages 102 and 125 are accurate, it would be very surprising if river herring could attain a 5-fold increase in a single generation. The increase could well be a product of increased catchability, to take one example.

In sum, more text on caveats and cautionary interpretation of both Figures 10 and 11 is warranted, given the primary influence that these estimates have on one's perception of recent changes in directed exploitation and the degree to which this does or does not pose a substantive threat to river herring.

IV. CONCLUSIONS AND RECOMMENDATIONS

1. For the most part (possible exceptions indicated below), the River Herring Status Review Report contains the best available information on the life history, population dynamics, genetics, physiology, behaviour, and morphology of alewife and blueback herring.

2. The conclusions regarding Distinct Population Segment delineations are supported by the information and are scientifically defensible.

3. The general scientific conclusions regarding extinction risk for alewife and blueback herring are supported by the best available information and are scientifically defensible.

4. The report can be strengthened and made more transparent if the text was more circumspect on the question of whether existing Essential Fish Habitat designated for Atlantic salmon will truly benefit river herring, especially alewife, and especially spawning habitat.

5. Information on population dynamics is relatively sparse. There is additional information on maximum per capita population growth rate that could be included in the report and that would strengthen the report's scientific conclusions pertaining to extinction risk.

6. The extinction risk analysis and discussion would be strengthened by explicit consideration of the IUCN's criterion for population decline (Criterion A) and by explicit consideration of the IUCN's three-generation time for assessing extinction risk.

7. The 'Significant Gap' analysis would be considerably strengthened if scientific justification was provided for the 10-generation time frame and 1,000 population-size threshold used in the analysis. The report would also benefit from a discussion of how perception of what constitutes a 'significant gap' can be affected by a consideration of alternative generation-time and population-size values.

8. Opposing scientific explanations have not been fully articulated with respect to two key components of the Status Review: (i) minimum swept-area estimates of biomass and (ii) relative exploitation rate. The interpretation of swept-area biomass and its influence on estimates of relative exploitation rate could be strengthened considerably by fully articulating the caveats and uncertainties associated with these estimates.

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APPENDIX 1:
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Turner, S. M., Limburg, K. E., & Palkovacs, E. P. 2015. Can different combinations of natural tags identify river herring natal origin at different levels of stock structure?. Canadian Journal of Fisheries and Aquatic Sciences, 72(6), 845-854.

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APPENDIX 2:
STATEMENT OF WORK FOR DR. JEFFREY HUTCHINGS

Performance Work Statement (PWS)

National Oceanic and Atmospheric Administration (NOAA)
National Marine Fisheries Service (NMFS)
Center for Independent Experts (CIE) Program
External Independent Peer Review

Endangered Species Act (ESA) Status Review and Extinction Risk Assessment of River Herring (Alewife and Blueback Herring)

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards[1]. Further information on the Center for Independent Experts (CIE) program may be obtained from www.ciereviews.org.

Scope

NMFS is required to use the best available scientific and commercial data in making determinations and decisions under the ESA. We conduct a review of the species through a process known as the status review. The status review is used to prepare a determination on whether listing under the ESA is warranted. The status review synthesizes the best available scientific and commercial information regarding the

[1] http://www.cio.noaa.gov/services_programs/pdfs/OMB_Peer_Review_Bulletin_m05-03.pdf

species status, which includes its life history, demographic trends and susceptibility threats. Following the assessment of threats to the species, an extinction risk assessment is conducted to project the health of the populations into the future.

We are currently conducting a status review of alewife and blueback herring to determine whether listing either species as endangered or threatened under the ESA is warranted. On August 12, 2013, based on a previous status review, we determined that listing alewife and blueback herring as threatened or endangered under the ESA was not warranted. The Natural Resources Defense Council and Earthjustice filed suit on February 10, 2015 challenging this decision. On March 25, 2017, the court vacated the blueback herring listing determination and remanded the listing determination back to us. As part of a negotiated agreement in this case, we are required to publish a revised listing determination for blueback herring no later than January 31, 2019. Alewife and blueback herring are included in our current review.

The information and analysis contained in these reports will include essential factual elements upon which the agency may base its ESA-listing determination. Accordingly, it is critical that these reports contain the best available information on the status of alewife and blueback herring, species delineation and extinction risk of the species, and that all scientific findings be both reasonable and supported by valid information contained in the documents. Therefore, the CIE reviewers will conduct a peer review of the scientific information in the two reports on river herring based on the Terms of Reference (ToRs) to be developed. The CIE reviewers will ensure an independent, scientific review of information for a management process that is likely to be highly controversial regardless of our listing decision. Given the public interest in river herring, it will be important for NMFS to have a transparent and independent review process for the status report and extinction risk assessment.

Requirements

NMFS requires three reviewers to conduct an impartial and independent peer review in accordance with the PWS, OMB Guidelines, and the TORs below. The reviewers shall have working knowledge and recent experience in one or all of the following: 1) fisheries population dynamics, expertise in stock assessment and life history of anadromous species; 2) expertise in extinction risk analysis and population modeling; and/or 3) expertise in stock structure and genetics analysis. It is desirable that as part of the extinction risk analysis expertise, reviewers should be familiar with applications in fisheries, particularly anadromous species.

Tasks for reviewers

Each CIE reviewers shall complete the following tasks in accordance with the PWS and Schedule of Milestones and Deliverables.

- Pre-review Background Documents: Review the following background materials and reports prior to the review:

Required Pre-review Documents

ASMFC, 2017. River Herring Stock Assessment Update. Volume I. Coastwide Summary. Arlington, VA. 193 pp.

ASMFC, 2017. River Herring Stock Assessment Update. Volume II. State Specific Reports. Arlington, VA. 682 pp.

NMFS. 2011. 90-Day Finding on a Petition To List Alewife and Blueback Herring as Threatened Under the Endangered Species Act. Federal Register, Volume 76, No. 212. Wednesday, November 2, 2011.

NMFS. 2012. River Herring Stock Structure Working Group Report. Report to the National Marine Fisheries Service, Northeast Regional Office. August 13, 2012, 60pp. Appendices A and B

NMFS, 2013. Endangered and Threatened Wildlife and Plants; Endangered Species Act Listing Determination for Alewife and Blueback Herring. Federal Register, Volume 78, No. 155. Monday, August 12, 2013.

NRDC, 2011. Petition to List Alewife (*Alosa pseudoharengus*) and Blueback Herring (A*losa aestivalis*) as Threatened Species and to Designate Critical Habitat.

Recommended Pre-review Documents

characterization of single nucleotide polymorphisms in two anadromous alosine fishes of conservation concern. Ecology and Evolustion 1:1-11, doi:10.5061/dryad.v4q83

Bethoney, N.D., B.P. Schondelmeier, K.D.E. Stokesbury, and W.S. Hoffman. 2013. Developing a fine scale system to address river herring (Alosa pseudoharengus, A. aestivalis) and American shad (A. sapidissima) bycatch in the U.S. Northwest Atlantic mid-water trawl fishery. Fisheries Research 141:79-87, doi: 10.1016/j.fishres.2012.09.003

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Turner, S. M., Limburg, K. E., & Palkovacs, E. P. 2015. Can different combinations of natural tags identify river herring natal origin at different levels of stock structure?. Canadian Journal of Fisheries and Aquatic Sciences, 72(6), 845-854.

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Turner, S.M, J.A. Hare, D.E. Richardson and J.P. Manderson. 2017 Trends and Potential Drivers of Distribution Overlap of River Herring and Commercially Exploited Pelagic Marine Fishes on the Northeast U.S. Continental Shelf, Marine and Coastal Fisheries, 9(1):13-22, DOI: 10.1080/19425120.2016.1255683

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- Desk Review: Each CIE reviewer shall conduct the independent peer review in accordance with the PWS and TORs, and shall not serve in any other role unless specified herein. Modifications to the PWS and TORs can not be made during the peer review, and any PWS or TORs modifications prior to the peer review shall be approved by the NMFS Project Contact.

- Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the PWS. Each CIE reviewer shall complete the independent peer review according to required format and content as described in **Annex 1**. Each CIE reviewer shall complete the independent peer review addressing each TOR as described in **Annex 2**.

Place of Performance
Each CIE reviewer shall conduct an independent peer review as a desk review, therefore no travel is required.

Period of Performance
The period of performance shall be from the time of award through August 2018. Each reviewer's duties shall not exceed 10 days to complete all required tasks.

Schedule of Milestones and Deliverables: The contractor shall complete the tasks and deliverables in accordance with the following schedule.

Within two weeks of award	Contractor selects and confirms reviewers
No later than two weeks prior to the review	Contractor provides the pre-review documents to the reviewers
June 2018	Each reviewer conducts an independent peer review as a desk review
Within two weeks after review	Contractor receives draft reports
Within two weeks of receiving draft reports	Contractor submits final reports to the Government

Applicable Performance Standards
The acceptance of the contract deliverables shall be based on three performance standards:
(1) The reports shall be completed in accordance with the required formatting and content; (2) The reports shall address each TOR as specified; and (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel
Since this is a desk review travel is neither required nor authorized for this contract.

Restricted or Limited Use of Data
The contractors may be required to sign and adhere to a non-disclosure agreement.

NMFS Project Contact:
Tara Trinko Lake
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NMFS, Greater Atlantic Region
55 Great Republic Drive, Gloucester, MA 01930

Annex 1: Peer Review Report Requirements

1. The report must be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether or not the science reviewed is the best scientific information available.

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the TORs.

3. The reviewer report shall include the following appendices:
    a. Appendix 1: Bibliography of materials provided for review
    b. Appendix 2: A copy of the CIE Statement of Work

Annex 2: Terms of Reference for the Peer Review

Endangered Species Act (ESA) Status Review and Extinction Risk Assessment of River Herring (Alewife and Blueback Herring)

1. Is the information regarding the life history and population dynamics of the species the best scientific information available? If not, please indicate what information is missing and if possible, provide sources.
2. Does the information on river herring genetics, physiological, behavioral, and/or morphological variation presented for the species' range represent the best scientific information available? If not, please indicate what information is missing and if possible, provide sources.
3. Based on the scientific information presented, are the conclusions regarding species, subspecies, or distinct population segment delineations supported by the information presented? If not, please indicate what scientific information is missing and if possible, provide sources.
4. Based on the scientific information presented in the extinction risk assessment report, does this analysis consider all of the best available data and are the conclusions appropriate and scientifically sound? If not, please indicate what information is missing and if possible, provide sources.
5. In general, is the best scientific and commercial data available for the status review and extinction risk analysis of river herring presented in the report? If not, please indicate or provide sources of information on which to rely.
6. In general, are the scientific conclusions in the reports sound and interpreted appropriately from the information? If not, please indicate why not and if possible, provide sources of information on which to rely.
7. Where available, are opposing scientific studies or theories acknowledged and discussed? If not, please indicate why not and if possible, provide sources of information on which to rely.