PEER REVIEW REPORT

Status Review Report for Alewife (*Alosa pseudoharengus*) and Blueback herring (*Alosa aestivalis*)

Background

On August 5, 2011, the Natural Resources Defense Council (NRDC) petitioned NMFS to list alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) under the Endangered Species Act (ESA) as threatened throughout all or a significant portion of their ranges. In the alternative, the petitioner requested that NMFS designate Distinct Population Segments (DPSs) of alewife and blueback herring as specified in the petition (Central New England, Long Island Sound, Chesapeake Bay, and Carolina for alewives and Central New England, Long Island Sound, and Chesapeake Bay for blueback herring). Under the ESA, if a petition is found to present substantial scientific or commercial information that the petitioned action may be warranted, a status review shall be promptly commenced (16 U.S.C. 1533(b)(3)(A)). In response to the petition, NMFS published a positive 90-day finding on November 2, 2011, concluding that listing these species under the ESA may be warranted and initiated a status review (76 FR 67652).

On August 12, 2013, NMFS determined that listing alewife and blueback herring as threatened or endangered under the Endangered Species Act (ESA) (16 U.S.C. 1531 *et seq.*) was not warranted (78 FR 48943). At that time, NMFS committed to revisiting the status of both species in 3 to 5 years. The 3- to 5-year timeframe equated to approximately one generation time for these species, and allowed for time to complete ongoing scientific studies, including a river herring stock assessment update that was completed by the Atlantic States Marine Fisheries Commission in August, 2017.

The Natural Resources Defense Council and Earthjustice (the Plaintiffs) filed suit against NMFS on February 10, 2015, in the U.S. District Court in Washington, D.C, challenging our decision not to list blueback herring as threatened or endangered. The Plaintiffs also challenged our determination that the Mid-Atlantic stock complex of blueback herring is not a distinct population segment (DPS). On March 25, 2017, the court vacated the blueback herring listing determination and remanded the listing determination to us (*Natural Resources Defense Council, Inc., et al.* v. *Samuel D. Rauch, National Marine Fisheries Services, 1:15-cv-00198 (D.D.C)).* As part of a negotiated agreement with the Plaintiffs and ordered by the court,, NMFS committed to publish a revised listing determination for blueback herring.

NMFS announced the initiation of an alewife and blueback herring status review in the Federal Register on August 15, 2017 (82 FR 38672, August 15, 2017). At that time, we also opened a 60-day solicitation period for new scientific and commercial data on alewife and blueback herring to ensure that we were informed by the best available scientific and commercial information. A Status Review Team (SRT) was tasked to conduct this review. The Status Review Report was reviewed by three independent reviewers through the Center for Independent Experts. A number of minor, editorial comments were received and addressed directly in the Status Review Report. Below we provide accounts of comments not requiring a response and our response to other comments. The Status Review Report was revised, after taking into consideration reviewers comments, and released in June 2019.

Reviewers:

- **Dr. Joseph Hightower, North Carolina University, Jefferson, N.C.**
- **Dr. Jeffrey Hutchings, Dalhousie University, Halifax, N.S.**
- **Dr. Kim de Mutsert, George Mason University, Fairfax, VA**

General comments not requiring a specific response

Reviewer comments:

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.

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.

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* species.

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.

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.

Comments with Responses

Reviewer comment on *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.

"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."

Response to reviewer comment on per capita population growth rate (r):

Additional text was added to the Status Review Report to clarify reporting of the MARSS modeling related to r'. The growth rate estimated in each MARSS model represents a population growth rate (in contrast to a per-capita (i.e. per individual fish) rate). In Holmes et al. (2019), the growth rate estimated in the MARSS model is described as "the average long-term population growth rate." Whether the estimated growth rate is an average population or per-capita population growth rate, it still is representative of the average trends of the population, which is what the MARRS analysis sought to quantify. The estimated growth rates (r) represents a 'realized r' not a 'maximum r'.

SRT (SRT) members reviewed the rmax values provided by the peer reviewer (the review cited Hutchings et al 2012 where alewife rmax = 0.85 and blueback = 0.56) but the SRT decided that this new information did not impact their interpretation of the MARSS results in their qualitative threats assessment.

Reviewer comment on t*otal 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.

Response to reviewer comment on t*otal mortality (Z):*

Text in the draft status review on p. 32 contained excerpts from the ASMFC Stock Assessment (ASMFC 2017). As such, we did not alter text cited directly from the report. However, the SRT considered comments related to trends in mortality and additional text was added to address the uncertainty associated with this point.

Reviewer comment on taxonomy:

> 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'.

Response to reviewer comment on taxonomy:

The Status Review Report was edited to reflect the proper taxonomy for both alewife and blueback herring.

Reviewer comment on figures:

> 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.
>
> The information regarding the life history and population dynamics of the species is based on the best science available. I would advise against using the maps from Fishbase to indicate the range of river herring in the Status Review Report (Figures 1 and 2, page 9). While the text correctly describes the range (page 8), Figures 1 and 2 do not reflect the range that is described in the text. The text states: "Blueback herring range from Nova Scotia south to the St. John's River, Florida (Figure 2), and alewife range from Labrador and Newfoundland south to North Carolina (Figure 3)". St. John's River is on the Atlantic side of north Florida, while Figure 1 indicates blueback herring occurrence in the Gulf of Mexico. Also, while the text indicates the northern end of the range of blueback herring is Nova Scotia, the figure shows the range end at Cape Cod, Massachusetts.

Response to reviewer comment on figures:

Figures of alewife and blueback herring distribution have been replaced to more accurately reflect both species' rangewide extent.

Reviewer comment on 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).

Response to reviewer comment on IUCN:

The International Union for the Conservation of Nature uses a quantitative rule-based approach for listing species on its Red Lists since 1994. The approach contains both quantitative elements and qualitative elements (e.g., in addition to quantitatively defining a restricted extent of occurrence, at least two of the following three factors must pertain: severe fragmentation, continuing decline in population size or area of distribution, or extreme fluctuations in population size or area of distribution). The SRT did not use the IUCN approach nor compare results to the IUCN approach. The team followed the NMFS (2017) status review guidance which addresses the following demographic criteria: abundance, growth rate, spatial distribution, and genetic diversity.

Reviewer comment on river herring data:

> Minimize use of river herring data (species combined). The two species have different distributions, reported abundance levels, regional genetic structures, and inferred risks of extinction.

Response to reviewer comment on river herring data:

Where available, information pertaining to individual species was used in the Status Review Report. Separate sections were created for alewife and blueback herring analyses. Datasets still remain in the report that contained information collected on "river herring," as these represent the best available information if species specific information was not available.

Reviewer comment on spring NEFSC trawl survey data:

> "obtain species-specific rangewide indicators of population trends, using spring NEFSC trawl survey data"

Response to reviewer comment on spring NEFSC trawl survey data:

Relative abundance estimates from the NEFSC spring bottom trawl survey were used in MARSS models to assess population trends and in particular estimate species-specific growth rates at the range-wide level. Additionally, length composition information from the NEFSC trawl survey was used in analyses of trends in mean length in the ASMFC's 2017 assessment (section 2.3). This assessment document was considered by the SRT during its review of both species.

Reviewer comment requesting DPS MARSS modeling:

> Where sufficient data are available, evaluate population growth by DPS and evaluate within-DPS variation using MARSS.

Response to reviewer comment requesting DPS MARSS modeling:

The SRT unanimously opted not to update the MARSS models for each stock complex from the 2013 status review. SRT members did not rely on the results heavily in their qualitative assessment of the species range-wide and did not find that this data point informative for considering productivity for each DPS.

Reviewer comments related to population structure and DPS analysis:

> Provide more support for conclusions regarding recolonization of regions that currently support a unique genetic structure.
>
> 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.

Response to reviewer comments related to population structure and DPS analysis:

The SRT was required to consider a "gap" in the species range to assess the "significance" criteria in accordance with the DPS policy. Due to the straying behavior demonstrated by these species, the SRT chose to also include a time component when considering whether an area might qualify as a "significant gap" in the range should a discrete stock complex be lost. In response to these reviewer comments, text was added to the Status Review Report to reflect that this exercise was a qualitative conceptual analysis and not a modeling exercise. However, additional text and citations were also added to support information provided about alewife and blueback herring migration and straying potential as well as the SRT's consideration regarding the necessary size of recolonized populations. The SRT selected their timeframe sizes after discussing the biology of these species and time periods over which a gap in the range may alter connectivity in the range. The SRT also considered what constitutes a recovered population for other similar species (e.g., Atlantic salmon) as a proxy for determining a recolonized gap. While these timeframes and population sizes were considered for this qualitative exercise, the SRT primarily relied upon the geographic size (overall area in size, taking into consideration both distance spanned and the overall watershed size) for this determination.

Reviewer comment on Swept Area:

> The 2017 ASMFC report included minimum swept-area estimates of total river herring biomass from the NEFSC bottom-trawl survey. Those estimates are valuable in that they extend from 1976 to 2015, cover most of the U.S. range of both species, and are based on a survey with consistent methods (so are unaffected by fishery closures). The analysis was done only for river herring (presumably for comparison with river herring landings data) but should also be done separately by species. Species-specific estimates would not address DPS-level questions (other than perhaps serving as a lower bound for risk) but should be valuable for judging status and extinction risk at the species level.

Response to reviewer comment on Swept Area:

The minimum swept area and relative exploitation rates analyses were obtained from the 2017 ASMFC assessment update and were not modified by the SRT. Because species-specific landings were not available for the full time series, minimum swept-area estimates were developed for total river herring (both species combined) in order to calculate a relative exploitation rate. Relative abundance indices from both the spring and fall NEFSC bottom trawl surveys were developed for each species, evaluated by the SRT, and used in the MARSS analysis. Relative abundance and minimum swept biomass depict the same temporal trends; estimation of minimum swept biomass makes the added assumption that catchability is equal to one.

Reviewer comment on Swept Area and exploitation rates:

> 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.

Response to reviewer comment on Swept Area and exploitation rates:

When analyzing temporal trends in fishery-independent time series, assumptions must be made regarding catchability and availability. In particular, it is generally assumed that both catchability of the gear (net efficiency) and availability to the gear (for example, proportion of the species within the survey footprint) are constant over the time series. By assuming that these factors are constant, any changes in relative abundance are representative of true changes in the population size, not changes in performance of the fishing gear or the distribution of the species. These assumptions are regularly made in the stock assessments of fish species. For both river herring species, the NEFSC bottom trawl survey represents the fishery-independent survey with the greatest geographic scope and consistent methodology for over 40 years. Accordingly, it is one of the most comprehensive and best available datasets. Thus, assumptions made in analyzing temporal trends from these datasets are typical of those made in stock assessments.

The SRT discussed that improved fisheries management efforts in recent years have reduced directed fishing mortality rates on alewife and blueback herring stocks and hundreds of completed restoration projects in the last 20 years have improved access to freshwater habitat; however, the available alewife and blueback herring mortality estimates in the stock assessment (ASMFC 2017a) largely show little change in the trend over the entire time series. In discussing this information the SRT noted that no apparent change in mortality could indicate that the recent efforts to mitigate directed exploitation have not reduced all of the dominant threats facing certain individual populations. Alternatively, little change in mortality estimates rangewide could also represent unaccounted mortality from an existing or unknown threat affecting certain populations. However as noted in the Status Review Report, the relative exploitation index was developed for the coastwide population rather than regional populations because estimates of total incidental catch could not be partitioned among regions or discrete river stocks. s. More work is needed to understand the lack of a detectable rangewide population response following management actions.

Mortality was one consideration among others in the SRT's review when evaluating growth rate (one of the four factors assessed for demographic risks to the species). The SRT considered all four demographic factors as well as the threats when determining the overall level of extinction risk to these species. The SRT noted the uncertainty associated with this information in their ranking process by distributing their likelihood points when evaluating the threats and the overall level of extinction risk for these species.

Based on the best available data, the SRT concluded that alewife and blueback herring are at a low risk of extinction rangewide and in each DPS in the foreseeable future. SRT members attributed some likelihood points to the high extinction risk category in response to concerns associated with the species' complex anadromous fish life history, uncertainty in climate change and vulnerability, incidental catch, potential habitat modification (e.g. increased coastal development and water use), and concern about the adequacy of current and future regulatory mechanisms, including fisheries rangewide.