# Center for Independent Experts (CIE) Independent Peer Review of the River Herring Stock Structure and Extinction Risk Analysis

**Review of reports:**

NMFS. 2012. River Herring Stock Structure Working Group Report. Report to the National Marine Fisheries Service, Northeast Regional Office. August 13, 2012.

NMFS. 2012. River Herring Extinction Risk Analysis Working Group Report. Report to the National Marine Fisheries Service, Northeast Regional Office. August 13, 2012.

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**by**


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## EXECUTIVE SUMMARY

An impartial and independent peer review was conducted of two reports ("River Herring Stock Structure" and "Extinction Risk Analysis") in support of information gaps on the status of alewife and blueback herring from the eastern seaboard of the US. The review was completed during August 23 to September 4, 2012.

There is a paucity of information on anadromous alewife and blueback herring genetics. The working group report on river herring stock structure provided a synthesis of evidence for and against stock structure options for both species ranging from one stock complex to individual river stocks. The information and interpretation provided in the report are sufficient to support a consideration of four sub-complexes of alewife and blueback herring in the eastern US.

The extinction risk analysis group proposes a way forward in assessing risk of extinction for river herring by species group for either coastwide analyses grouping or for subgroups. All the models explored by the extinction risk analysis working group can be characterized as annual change models, of which the MARSS modelling approach provides the greatest flexibility. These models however do not provide any insights into the causes of population variation, and modelling approaches that make use of the existing age and population characteristics data of alewife and blueback herring available from a number of rivers should be considered.

Both working group reports provide a synthesis of discussions and planning of future work. The stock structure group has considered the single and recent preliminary study on genetics of river herring species on a coast wide basis and the review of available information in the report is complete. The extinction risk analysis working group identified the data sets to be retained for analysis and proposed a modelling approach to further the analyses. Alternative modelling approaches could be considered.

## BACKGROUND

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) was petitioned to list alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), collectively referred to as river herring, under the Endangered Species Act (ESA) on August 5, 2011. The Atlantic States Marine Fisheries Commission (ASMFC) technical committee was scheduled to complete a benchmark assessment for river herring in May 2012. Because the stock assessment does not contain all elements needed to make a listing determination under the ESA, NMFS identified the missing required elements and held specific workshops focused on addressing these information gaps. Two of the workshops addressed the following topics: "River Herring Stock Structure" and "Extinction Risk Analysis".

The extinction risk and stock structure meetings brought together appropriate scientists to discuss the available information and perform the necessary analyses with the purpose of providing individual expert opinions related to stock structure and various methods to determine extinction risk of these two species. The information and analysis in these reports will contain essential factual elements upon which the agency may base its ESA listing determination. Accordingly, a Centre of Independent Experts (CIE) review of the scientific information in the workshop reports on river herring was solicited.

## DESCRIPTION OF THE INDIVIDUAL REVIEWER'S ROLE IN THE REVIEW ACTIVITIES

An impartial and independent peer review in accordance with the Statement of Work (SoW) and Terms of Reference (ToRs) in Appendix 1 was conducted during August 23 to September 3, 2012. This reviewer's expertise was mostly in fisheries population dynamics with expertise in stock assessment and life history of anadromous species, with less direct experience in extinction risk analysis and population modeling, and genetics.

## SUMMARY OF FINDINGS FOR EACH TOR

### 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.

The extensive information presented in ASFMC (2012) covers the life history characteristics of river herring of interest in supporting identification of stock structure and for examining population trends. Of note is the larger amount of information on age distribution, size at age and proportion of repeat spawners available in the last decade relative to the paucity of this information prior to the 2000s.

Very little of this extensive information is brought forward and used in the Stock Structure Report to assist in the analysis of potential stock units along the eastern seaboard. For example, no information is provided on run-timing to rivers nor is any of the information on age structure (maximum age, proportion repeat spawners), size at age by sex and overall, or modal age of spawning runs used to infer stock groupings. It is possible that these characteristics are very similar over the species range and provide no useful information on potential stock groupings. As well, some of the characteristics would be modified by exploitation regimes (for example maximum age and proportion repeat spawners). However, given the differences in climate along the eastern seaboard, I would expect differences in run-timing, differences in size at age associated with variations in spawning time and hence growth opportunities, and possibly a latitudinal gradient in maximum age and the extent of iteroparity, as has been reported for American shad (Leggett and Carscadden 1978). In particular, why are alewife less abundant to absent in the extreme south of the range while blueback herring are less abundant in the northern region (Loesch 1987)?

The trends in life history characteristics are not discussed in either the extinction risk assessment nor the stock structure reports. As shown in ASFMC (2012), there are broad scale patterns of reduced mean size in spawning runs, reduced size at age, high Z, and reduced proportions of repeat spawners. These temporal changes in life history characteristics can have important consequences on population viability, but this is not considered in the extinction risk assessment. Lifetime reproductive potential is negatively impacted by the direction of change in these life history characteristics. The downward trends in mean size and size at age are mostly apparent in data sets south of Maine with corresponding run counts generally trending upward in Maine and downward elsewhere.

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.**

New information on genetics of alewife and blueback herring was reviewed by the Working Group on stock structure. These are the first reported broad-scale studies of genetic structure in anadromous river herring populations. The results of the coast-wide survey and genetic analyses of Palkovacs et al. (as referenced in the working group report) of 15 microsatellite markers was presented to the working group. The information is preliminary in nature and ongoing analyses have modified the interpretation of stock structure during the course of the development of the report. Initial analyses suggested six stock groupings (including one for Canada) for alewife and subsequent information provided after the June 2012 working group meeting resulted in a reduction to five. The working group identified further work and validation of the genetic typing initiative which could further refine the number of potential stock groupings.

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.**

The Stock Structure Working Group report provides a good summary of evidence in support of various stock grouping hypotheses. For alewife, there is sufficient information based on genetics, and supported by population abundance trends, for four groups along the eastern seaboard of the US. For blueback herring, genetics analyses were also interpreted to provide evidence of four stock groups of similar geographic grouping as alewife (Figures 1 and 2 of Working Group report). I agree with the statement in the report (p. 6) that river drainage is the appropriate level of management for both of the species, because the most important threats to either species are likely in the individual river systems and related to fish passage and habitat fragmentation. However, this does not imply that each river system has a unique stock. In fact, homing rates for blueback herring as reported by an expert are very low, particularly among neighbouring river systems, suggesting that the most appropriate stock grouping for both species is likely in the range (4 to 5) proposed by the Working Group.

### 4. Based on the scientific information presented in the extinction risk analysis 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 analysis report summarizes methods and data sets examined by the working group to define the steps to be undertaken to assess the risk of extinction for river herring, for either a coastal complex or for several units that could characterize distinct population segments. No final analyses were conducted nor are detailed analyses and diagnostics for any case studies provided. The report focuses on a set of extinction risk analysis models that characterize annual changes in indicators of population size from past observations to project abundances into the future.

The following issues are considered:

1) The models, modelling structure, and assumptions
2) Indices versus absolute estimates of abundance
3) Pre-treatment of data

<u>Models and modelling structure</u>

Extinction risk analyses have as the objective to estimate the trajectories of the population into the future based on an expectation of future states inferred from the past.

<u>Annual change models</u>

All the models explored by the assessment group can be characterized as annual change models. These models assume that the abundance time series are the result of transition probabilities (M, fecundity, life history, habitat availability) over the period of measurement but which are themselves not measured. As a result the average annual abundances in the future for any time step are modelled as exclusively dependent on time steps with annual stochastic variation that is independent and identically distributed.

Based on this structure, all the models described are deficient, as they assume that the future population trajectories are best described by the average trend of the past. In populations that have persisted over a long time period (as for example the inference one draws from the alewife indices of the offshore strata as shown in Figure 9, top panel), the average trend of the series should be zero, showing neither an increase nor a decrease over time. The estimate of the trend is strongly dependent upon the observation window used to characterize the trend (see example in Figure 7 for run count estimates of alewife in Mattapoisett River). The annual realisations are determined by the trend and by stochastic variability. It is this variability that defines how frequently and in combination with the average trend how quickly population abundance may exceed specified thresholds (time to extinction for example) within a given risk tolerance. At low relative variance, the annual variations are smaller, and the individual population trajectories are less variable. With a strong trend, the temporal changes are more rapid.

An important assumption of these models (Dennis et al. 1991; MARSS are described by Holmes et al. 2012) is that the stochastic process is time independent, i.e. that there is no autocorrelation in the residuals. The issue of independence of the residuals in these models should by default be questioned. Dennis et al. (1991) and other general texts on regression analyses (Hilborn and Walters 1992 for example) refer to diagnostics that should be done to check this assumption. For example, the Mattapoisett River data shown in Figure 7 (were approximated from the figure) were modelled as follows:

$Nt \sim Lognormal \mu t,\ \varepsilon$
$\mu t = \mu t{-}1 + \delta$
$\varepsilon \sim Normal 0, \sigma 2$

has a declining trend ($\delta$ = -0.089) over the time series and a very positive autocorrelation in the residuals ($\phi$ = 0.822 median). When autocorrelation is present, it may be the dominant factor that defines abundance, especially in cases when there is in fact no general trend over time. The pattern of abundances in the Mattapoisett River alewife data are more consistent with an autocorrelated process, or even strong density dependent regulation than a purely temporal process with independent annual stochasticity. The model above (log-linear time trend) and similar annual change models are not adequate for such a time series.

The MARSS modelling approach proposed in the report appears to be best of the annual change approaches. As described by Holmes et al. (2012a), the model structure is very flexible, being able to accommodate multiple indices, time series of unequal length and missing observations in indices. The Dennis model structure is a special case of the MARSS model when the abundance data are mapped on the log scale and density independence is assumed (as above). The advantages of the MARSS structure, as described in Holmes et al. (2012a,b) are that it can accommodate both process error and observation error, can incorporate multiple indices, and additionally as with the Dennis model or any other time series analysis model, can be modelled in a Bayesian framework. Indeed, applying these models with multiple indices but allowing for random effects for the rate of change parameter among indices should be considered. This exchangeability assumption would be a more appropriate structure than simply using the mean rate of change over the indices. Only preliminary analyses for a few data sets are presented in the report and the results as stated are very preliminary.

Alternate models to annual change models

Extinction risk modelling as described by Dennis et al. (1991) and Holmes (2001) do not provide any insights into the causes of population variation. A simple model that considers replacement rates (expressed as the ratio of Nt+a / Nt, with a the average age of recruitment) would help understand the role of variations in transition rates (recruits per spawner conditioned by mortality at intervening stages) compared to variations in spawner abundance. River herring are most susceptible to anthropogenic mortality as they are obligate freshwater spawners and use the ocean for rearing and maturation. Loss of access to spawning areas is likely the largest contributor to river herring declines throughout the species range. Within these areas, recruitment rates may also have changed, resulting from variations in spawning success in the accessible areas, density dependent regulation, density independent variations in mortality rates of young life stages, increased predation resulting from passage at barriers (upstream and downstream), etc. Efforts to go beyond simple annual rates of change modelling would provide additional information on factors and when in the life cycle they would be intervening, information useful in feasibility analyses and recovery planning.

Recruitment rates, expressed as spawners to spawners, should be calculated from some of the run count data series. Age information is seemingly available from a number of rivers (ASFMC 2012). In the absence of annual age structure data, average values from previous years could be used. The usual caveats regarding representativeness of the samples from the rivers would need to be considered. Although such data are not available over the entire range of river herring or for both species, it would provide information on the rate of recruitment for selected rivers, how variable these are among rivers and how they have changed over time. In cases when annual age data are not available, values from sampled years would be used, assuming therefore that age structure of first time recruits and proportion new recruits from recent years apply to the past. These are strong assumptions but they are collectively fewer and more biologically realistic than the assumptions made with the annual change models. These estimates of recruitment rates are then used to project abundance in the future based on the recent run counts (spawners). The recruitment rates applied in the forecasts can be drawn : 1) randomly from the values observed historically, 2) projected based on autocorrelation function of recruitment rates and the most recent value, 3) using an expanding window, with recruitment rates drawn from a distribution defined by a longer historical data set as the forecasts go further into the future.

> "An 'expanding window' resampling strategy …. As each year of projection is added an additional year of data is added to the pool from which values can be randomly resampled with replacement starting with the most recent and moving backwards in time. This means that the first few years of the projection samples from the most recent data. It also means that we assume that the stock conditions will have an increasing probability of being like the past conditions as the selection window expands into the past." (p. 45, DFO 2011).

The importance of exploring these types of simple life history models cannot be understated. For a species for which recruitment success can be highly variable annually, the potential for annual declines and increases is very large. Persistence and recovery depends upon a population's capacity to replace itself.

<u>Indices versus absolute estimates of abundance</u>

With the exception of situations where total counts without error are obtained, all the data are indices of abundance. Useful indices are those for which the relationship to the absolute measure of abundance are quantifiable and generally proportional. This relationship should as well be temporally stable. Indices which are most likely to meet these criteria are those developed from monitoring programs based on a statistical sampling design such as multi-species marine surveys conducted by NMFS. Potential sources of bias of these surveys are described in the report and can be accounted for. Presumably effects due to vessel or gear changes have been addressed. Whether the indices from the ocean surveys are representative of abundance of river herring species needs to be considered by experts. Factors such as the time of year of the survey, the sizes (i.e. life stages) of river herring sampled in the survey, and the spatial coverage of the survey may compromise the useful of these indices as species status indicators (ASFMC Stock Assessment Report No. 12-02, Section C, sub-section 2.2.5).

Consistent proportionality may be more difficult to confirm for some of the run counts in rivers, especially those at fishways whose passage efficiencies may be susceptible to variations in discharge (for example Monument River count for 2005; ASFMC 2012, Section C, page 25). Since river herring are not perfect natal river homing species, temporal variations in river counts may also reflect variations in distribution of spawners among spawning rivers within a complex. Be that as it may, total counts in rivers are the more direct measure of abundance of adult spawners, the key component in population viability analyses.

Pre-treatment of data

The working group report proposes to use 4-year running sum adjusted series for the run counts and Young of year (YOY) surveys as inputs for the MARSS model stock complex analyses. The reason for this proposal is that these abundance indices only counted a segment of the total population (p. 36, ERA Working Group Report). I don't understand this argument. If this is based on Holmes (2001), the transformation should be the slope transformation, not the running sum. Using a running sum also produces a highly serially-correlated series and one of the assumptions of the extinction risk models is the independence and identical distribution of the errors, which would subsequently be violated. The treatment of observation errors is best conducted using a model that includes observation error, as proposed by the MARSS model described by the working group.

5. **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.**

The working group report on stock structure provides information and interpretation in support of four sub-complexes of alewife and blueback herring in the eastern US (and a separate complex for river herring from Canada). Based on the information available, this seems reasonable.

The Extinction Risk Assessment group proposes a way forward in assessing risk of extinction for river herring by species group for either a coastwide grouping or for subgroups. The majority of the information to be used comes from fishery independent monitoring although for many there are likely important observation errors which weaken the relationship between the indices and the abundance. The indices most susceptible to this are the river counts and the YOY seine survey indices. Examination of serial patterns suggest very strong year effects in many of these (see counts for Exeter River Figure 2.19 in ASFMC 12-02, section C, page 124).

### 6. 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.

The Working Group on Stock Structure focused its work on compiling summaries from experts on various life history aspects of river herring and discussed new and recent analyses of genetic characteristics of alewife and blueback herring. Only one study is available that describes the genetics of both species along the entire Atlantic seaboard of the US. A second study examined genetic structure of populations of alewife and blueback in Maine and Canada. The working group provided a synthesis of evidence for and against stock structure options for both species ranging from one stock complex to individual river stocks. The review is complete.

The Working Group on Extinction Risk Analysis focused its efforts on models of annual change which have been developed and discussed for species lacking age specific information. For many species of concern, age structure information may be unavailable but this should not be the case for the river herring stocks. More relevant modelling exercises should be considered, not only to infer on population viability but to provide guidance on recovery potential and guide management interventions in the future. A full life-history cycle model as developed by Legault (2005) for Atlantic salmon may not be feasible at this time for river herring but it is only by considering such life history dynamics that the threats to river herring viability can be identified. The working group indicates that the development of an age-structured projection model is not tenable at this time but simpler life history models should be explored. Alternate points of view on this conclusion are provided.

**7. In general, is the best scientific and commercial data available for the stock structure and extinction risk analysis of river herring presented in the reports? If not, please indicate or provide sources of information on which to rely.**

There is a large amount of information presented in the Benchmark Assessment (ASFMC 2012), contributed by numerous agencies, and groups. The working group reports are a synthesis of discussions which occurred and for which future work is being planned. The compilation of the coast-wide information in a consistent format is time consuming, although considering the investments already made by states and governments is a worthwhile endeavour. It is unfortunate that in several cases, the species (alewife, blueback herring) are not distinguished in the monitoring programs. Some of the monitoring methods are visual counts or electronic counters with daily calibration (Monument River for example, calibration referring to translation of electronic signals to counts or to species composition is not specified, p. 24 Section C of ASFMC 2012-02) but no sampling and analysis details are provided.

The stock structure group has considered the single and recent preliminary study on genetics of river herring species on a coast wide basis. The consideration of available information is complete.

The Extinction Risk Assessment working group identifies the data sets to be retained for analysis but no modelling results and diagnostics are presented. As a starting point, the use of MARSS is proposed. For the coastwide assessment, the marine survey data sets would be used. I concur with this, although consideration should be given to the size/age groups sampled in the seasonal surveys and priority given to surveys that sample more homogeneous size / age group. For example, the Maine/New Hampshire inshore surveys sample different size/age components of alewife and blueback herring in the spring and in the fall; fall surveys have a broader size range and presumably include proportionally more mature and post-spawned adults than do the spring surveys (Stock Structure Working Group Report 2012, Figures 17-18). More details of these survey data and the consequences to model fitting and interpretation would be expected in the final report on stock trajectories. The same consideration should be given to the multiple stock complex analyses. Only indices of similar life history types should be treated simultaneously using MARSS. For example, the numerous YOY indices should be treated as a group and not combined with indices of run counts.

**Conclusions and Recommendations in accordance with the ToRs.**

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.

There is extensive information on life history characteristics of river herring available in ASFMC (2012) of interest in supporting the identification of stock structure and for examining population trends. Very little of this extensive information is brought forward and used in the Stock Structure Report to assist in the analysis of potential stock units, nor are the trends in life history characteristics discussed and considered in the extinction risk assessment. These should be considered in more detail when the analyses are conducted.

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.

There is a paucity of information on anadromous alewife and blueback herring genetics. The first broad-scale study of river herring genetics was reviewed by the Working Group on stock structure. Although the information is preliminary in nature, it appears sufficient to support four stock groupings along the US seaboard for each of alewife and blueback herring.

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.

Although the genetic information is preliminary in nature, it appears sufficient to support four stock groupings along the US seaboard for each of alewife and blueback herring.

4. Based on the scientific information presented in the extinction risk analysis 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 analysis report summarizes annual change methods and data sets available to assess the risk of extinction for river herring, for either a coastal complex or for several units that could characterize distinct population segments. No final analyses were conducted nor are detailed analyses and diagnostics for any case studies provided. All the models explored by the assessment group can be characterized as annual change models which are deficient, as they assume that the future population trajectories are best described by the average trend of the past. An important assumption of these models is that the stochastic process is time independent and this assumption should by default be questioned. Of the annual change models examined by the working group, the MARSS modelling approach provides the greatest flexibility. Only preliminary analyses for a few data sets are presented in the report. These models do not provide any insights into the causes of population variation. Efforts to go beyond simple annual rates of change modelling should be made that would take advantage of the extensive age and population characteristics information available from a number of rivers (ASFMC 2012). This would provide information on the rate of recruitment for selected rivers, how variable these are among rivers and how they have changed over time. These estimates of recruitment rates are then used to project abundance in the future based on the recent run counts (spawners). For a species for which recruitment success can be highly variable annually, the potential for annual declines and increases is very large. Persistence and recovery depends upon a population's capacity to replace itself.

5. 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.

The working group report on stock structure provides information and interpretation in support of four sub-complexes of alewife and blueback herring in the eastern US (and a separate complex for river herring from Canada). Based on the information available, this seems reasonable. The Extinction Risk Assessment group proposes a way forward in assessing risk of extinction for river herring by species group for either coastwide analyses grouping or for subgroups.

6. 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.

The working group on stock structure provided a synthesis of evidence for and against stock structure options for both species ranging from one stock complex to individual river stocks. The review is complete.

The Working Group on Extinction Risk Analysis focused its efforts on models of annual rates of change. Alternate modelling approaches should be considered as these may provide guidance on recovery potential and guide management interventions in the future. The working group indicates that the development of age-structured projection models is not tenable at this time. Alternate points of view on this conclusion are provided.

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

The working group reports are a synthesis of discussions and planning of future work. A compilation of coast-wide information for river herring is provided in ASFMC (2012). The stock structure group has considered the single and recent preliminary study on genetics of river herring species on a coast wide basis and the consideration of available information is complete. The Extinction Risk Assessment working group identified the data sets to be retained for analysis and proposed a modelling approach for analyses. Further work on alternate life history modelling should be considered.

**REFERENCES**

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Holmes, E. E., Ward, E. J., and Wills, K. 2012b. Marss: Multivariate autoregressive state-space models for analyzing time-series data. The R Journal 4:11–19.

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Loesch, J.G. 1987. Overview of life history aspects of anadromous alewife and blueback herring in freshwater habitats, p. 89-103. In Dadswell et al. (eds.) Common Strategies of Anadromous and Catadromous Fishes. American Fisheries Society Symposium 1. Bethesda, Maryland.

## APPENDIX 1: BIBLIOGRAPHY OF MATERIALS PROVIDED FOR REVIEW

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

Appendix A. Expert Opinions from the River Herring Stock Structure Workshop. June 20-22, 2012.

Appendix B. Updated Palkovacs *et al*. alewife stock complexes.

NMFS. 2012. River Herring Extinction Risk Analysis Working Group Report. Report to the National Marine Fisheries Service, Northeast Regional Office. August 13, 2012. 40 pp.

Supplementary Materials to the Extinction Risk Analysis Working Group Report for CIE Peer Review

## Appendix 2: Statement of Work

**External Independent Peer Review by the Center for Independent Experts**

**River Herring (Alewife and Blueback Herring)**

**Stock Structure and Extinction Risk Analysis**

**Scope of Work and CIE Process:** The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

**Project Description:** NOAA's National Marine Fisheries Service (NMFS) was petitioned to list alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), collectively referred to as river herring, under the Endangered Species Act (ESA) on August 5, 2011. NMFS reviewed the petition and published a positive 90-day finding determining that the information in the petition, coupled with information otherwise available to the agency, indicated that the petitioned action may be warranted. As a result of the positive finding, the agency is required to review the status of the species to determine if listing under the ESA is warranted. River herring are commercially important US-Canada transboundary species that have an expansive coast-wide range; therefore, determinations from this process have the potential to be highly controversial.

Approximately three years ago, the Atlantic States Marine Fisheries Commission (ASMFC) technical committee began working on a river herring stock assessment. The ASMFC is scheduled to complete the assessment in May 2012. NMFS is collaborating with ASMFC on this effort and intends to use the information in the stock assessment as a primary source of information in making the 12-month listing determination. Because the stock assessment does not contain all elements needed to make a listing determination under the ESA, NMFS has identified the missing required elements and intends to hold specific workshops focused on addressing these information gaps. Two of the workshops organized for this purpose will address River Herring Stock Structure and Extinction Risk Analysis, and reports from each workshop will be compiled this summer.

The extinction risk and stock structure meetings will bring together appropriate scientists to discuss the available information and perform the necessary analyses. The invited participants for these meetings will not come to a consensus; rather, they will provide their individual expert opinions related to stock structure and various methods to determine extinction risk of these two species. NMFS will take this information as compiled in the reports and determine which extinction risk method and stock structure analysis will best inform the listing determination. These reports will not contain any listing advice or reach any ESA listing conclusions – such synthesis and analysis is solely within the agency's purview. NMFS will use these reports along with the ASMFC river herring stock assessment to develop an ESA listing determination and is required to publish its finding in the *Federal Register* on or before August 5, 2012 (within 12 months of receiving the petition).

Given the significant public interest in river herring, it will be critical for NMFS to obtain a transparent and independent review of the associated meeting reports. The information and analysis in these reports will likely contain 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 stock structure and extinction risk of the species, and that all scientific findings be both reasonable and supported by valid information contained in the documents. Therefore, we seek a CIE review of the scientific information in the workshop reports on river herring based on the Terms of Reference (ToRs) to be developed. The CIE reviewers will help to ensure an independent, scientific review of information for a management process that is very public and is likely to be highly controversial no matter what NMFS' listing decision is. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**.

**Requirements for CIE Reviewers:** Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. CIE reviewers shall have combined 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; and/or 2) expertise in extinction risk analysis and population modeling; and/or 3) expertise in stock structure and genetics analysis. It is desirable that the extinction risk analysis expertise be familiar with applications in fisheries, particularly anadromous species. Each CIE reviewer's duties shall not exceed a maximum of 10 days to complete all work tasks of the peer review described herein.

**Location of Peer Review:** Each CIE reviewer shall conduct an independent peer review as a desk review, therefore no travel is required.

**Statement of Tasks:** Each CIE reviewers shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) to the COTR, who forwards this information to the NMFS Project Contact no later than the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, and other pertinent information. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

Desk Review: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. 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.

**Specific Tasks for CIE Reviewers:** The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Conduct an independent peer review in accordance with the ToRs (**Annex 2**).
3) No later than 4 September 2012, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator, via email to Dr. David Sampson david.sampson@oregonstate.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

**Schedule of Milestones and Deliverables:** CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

| | |
|---|---|
| 9 August 2012 | CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact. |
| 13 August 2012 | NMFS Project Contact sends the stock assessment report and background documents to the CIE reviewers. Background documents may be sent to the CIE reviewers one week earlier. |

| | |
|---|---|
| 20 August – 2 September 2012 | Each reviewer conducts an independent peer review as a desk review. |
| 4 September 2012 | CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator. |
| 18 September 2012 | CIE submits the CIE independent peer review reports to the COTR. |
| 25 September 2012 | The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director. |

**Modifications to the Statement of Work:** This 'Time and Materials' task order may require an update or modification due to possible changes to the terms of reference or schedule of milestones resulting from the fishery management decision process of the NOAA Leadership, Fishery Management Council, and Council's SSC advisory committee. A request to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent changes. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on changes. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

**Acceptance of Deliverables:** Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

**Support Personnel:**

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**Key Personnel:**

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## Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether 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:

   Appendix 1: Bibliography of materials provided for review

   Appendix 2: A copy of the CIE Statement of Work

**Annex 2: Terms of Reference for the Peer Review**

**River Herring (Alewife and Blueback Herring)**

**Stock Structure and Extinction Risk Analysis**

Provide a scientific peer review of Stock Structure and Extinction Risk Analysis reports on river herring (alewife and blueback herring) in accordance to the following 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.
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 analysis 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, 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.
6. 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.
7. In general, is the best scientific and commercial data available for the stock structure and extinction risk analysis of river herring presented in the reports? If not, please indicate or provide sources of information on which to rely.