Compilation of Recently Identified River Herring Research Needs

(To be distributed to the River Herring Technical Expert Working Group and/or Subgroups, and updated as needed)

Draft
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I. ASMFC River Herring Reports

ASMFC River Herring Stock Assessment Report, Table 3, which includes a summary of the Peer Review Panel's evaluation, comments, and added research recommendations (these last are preceded by an asterisk).

Research recommendation	Time period	Priority	Review Panel Comments
Assessment			
*Undertake an analysis of the consequences of interaction between the offshore bycatch fishery and those in the rivers	Short term	High	This would allow informed decisions on future mitigation measures.
Improve methods to develop biological benchmarks used in assessment modeling (fecundity-at-age, mean weight-at-age for both sexes, partial recruitment vector/maturity schedules) for river herring stocks.	Short term	Moderate	Panel agrees that there is a need but other recommendations will have a greater impact.
Explore use of peer-reviewed stock assessment models for use in additional river systems in the future as more data become available.	Long term	Moderate	In addition, further develop existing models to understand coast-wide differences in dynamics, etc.

Implementation			
Development of better fish culture techniques and supplemental stocking strategies for river herring.	Long term	Low	Success rate in other stocking programs (e.g. atlantic salmon, shad, etc) has been low
Encourage studies to quantify and improve fish passage efficiency and support the implementation of standard practices.	Long term	High	Dams and other impediments will continue to impact river herring; improving passage efficiency is critical to sustaining/restoring runs

Research recommendation	Time period	Priority	Review Panel Comments
Population dynamics			
Investigate contribution of landlocked versus anadromous produced fish.	Long Term	Low	Peripheral to management of coastal population
Continue genetic analyses to determine population stock structure along the coast and enable determination of river origin of incidental catch in non-targeted ocean fisheries.	Short term	High	Research underway in combination with otolith chemistry
Determine and quantify which stocks are impacted by mixed stock fisheries (including bycatch fisheries). Methods to be considered could include otolith microchemistry, oxytetracycline otolith marking, genetic analysis, and/or tagging.	Long Term	High	Combined with above.
Develop models to predict the potential impacts of climate change on river herring distribution and stock persistence.	Short term	Low	Premature given state of data and model developments; need to link to population dynamics

Validate [better estimate] the different values of M for river herring stocks and improve methods for calculating M.	Long term	High	Important to understand sources of high M (e.g. predation, habitat, etc)
Continue to assess current aging techniques for river herring, using known-age fish, scales, otoliths and spawning marks.	Short term	High	Review panel fully supports this recommendation
Conduct biannual aging workshops to maintain consistency and accuracy in aging fish sampled in state programs.	Long term	High	Important for aging program quality assurance
Summarize existing information on predation by striped bass and other species and quantify consumption through modeling (e.g., MSVPA), diet, and bioenergetics studies.	Long term	Moderate	Important but sort out M issue (above) first
Investigate the relation between juvenile river herring production and subsequent year class strength, with emphasis on the validity of juvenile abundance indices, rates and sources of immature mortality, migratory behavior of juveniles, and life history requirements.	Long term	High	Has potential to indicate relative role of production (catch plus growth) and environment in recruitment strength, however, not easily achievable
Evaluate the performance of hatchery fish in river herring restoration.	Long term	Low	Due to low current hatchery production

Research recommendation	Time period	Priority	Review Panel Comments
Monitoring			
Improve reporting of harvest by water body and gear.	Short term	High	The Panel agrees this should be a priority at all levels.
Investigate additional sources of historical catch data of the U.S. small pelagic fisheries to better represent or construct earlier harvest of river herring.	Short term	Moderate	Would assist current model formulation but would not facilitate interpretation of current status
Develop and implement monitoring protocols and analyses to determine river herring population responses and targets for rivers undergoing restoration (dam removals, fishways, supplemental stocking, etc.).	Short term	High	Also should be assessing success of moratoria
Develop comprehensive angler use and harvest survey techniques for use by Atlantic states with open or future fisheries to assess recreational harvest of river herring.	Long term	Low	It is a higher priority to address issues in larger fisheries
Expand observer and port sampling coverage to quantify additional sources of mortality for alosine species, including bait fisheries, as well as rates of incidental catch in other fisheries.	Long term	High	However, first undertake statistical study of observer allocation and coverage (see Hanke et al., 2011 for example)
Evaluate and ultimately validate large-scale hydroacoustic methods to quantify river herring escapement (spawning run numbers) in major river systems.	Long term	Moderate	Considered an adjunct to current monitoring systems and would have to be implemented in tandem with these
* Explore the sources of and provide better estimates of incidental catch in order to reduce uncertainty in incidental catch estimates.	Short term	High	Explore existing data but also observer coverage analysis as indicated above

*Develop bottom and mid-water trawl CPUE indices of offshore biomass.	Short term	Moderate	This is exploratory, data are available and may or may not provide useful indices
*Consider the use of GLM to provide better trend estimates and to better characterize uncertainty in trends.	Short term	Moderate	GLM provides a general statistical structure to the description of uncertainty in stock indices

Reference for additional information: Atlantic States Marine Fisheries Commission. 2012. River Herring Benchmark Stock Assessment. Volumes I and II. Stock Assessment Report No. 12-02.

Additional recommendations from *Research Priorities and Recommendations to Support Interjurisdictional Fisheries Management, Special Report No. 89 of the Atlantic States Marine Fisheries Commission (2013).*

- Develop an integrated coastal remote telemetry system or network that would allow tagged fish to be tracked throughout their coastal migration and into the estuarine and riverine environments.
- Conduct biannual ageing workshops to maintain consistency and accuracy of ageing fish sampled in state programs.
- Ascertain how abundance and distribution of potential prey affect growth and mortality of early life stages of alosines.
- Determine factors that regulate and potentially limit downstream migration, seawater tolerance, and early ocean survival of juvenile alosines.

II. Stock Structure Working Group Report
Excerpt on "Data Gaps"

Data Gaps:

For both alewives and blueback herring, the expert panel identified numerous data deficiencies that would otherwise aid in identifying stock structure. Data deficiencies include:

- Limited information on historic run size, distribution, and trends through time;
- Inconsistencies and uncertainties in the proper identification of alewives and blueback herring in river herring datasets;
- Genetic structure of mixed stocks at sea;
- Information on movements and migrations at sea;

- Longer and finer scale genetic data for returning spawners;
- Otolith microchemistry range wide and at a finer scale;
- Straying rate data;
- Information on hybridization and conditions that contribute to hybridization (e.g. climate change, dams);
- Information on whether the abundance of Atlantic herring differentially affect bluebacks and/or alewives;
- Understanding if fishways inadvertently select for certain phenotypes or certain species;
- Understanding the hatchery effects of stocking on genetic diversity.

Reference for additional information: Stock Structure Working Group Report. Report to the National Marine Fisheries Service, Northeast Regional Office. August 13, 2012, 60pp.

III. River Herring Extinction Risk Analysis Working Group Report

The Extinction Risk Analysis Working Group believed that the research needs detailed in the stock assessment adequately captured the research needs, and in general thought that there needs to be better sampling of all areas.

Reference for additional information: 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.

IV. River Herring Climate Change Workshop Report

Excerpt on "Data and Analysis Needs"

Data and Analysis Needs:

- Historical level of the population
- Life history (ocean, habitat, etc.) for all stages and habitat areas (e.g., lake, river, estuary and ocean) using consistent coastwide protocols
    - For example, in the ocean… Where are they? What are they doing? Are there mixed school age classes? What depth are they at? What are their predators? When do they get eaten? How many get eaten?
- Habitat use
    - Spawning, foraging, overwintering, early life stage, presence/absence studies
    - Downstream habitat studies to see how salt marshes are utilized
- Assess fish just above the tide zone and below a structure

- Quantitative larval assessment for habitats (e.g., for spawning areas in North Carolina other than the Albemarle Sound)
- Ocean distribution
- Fishing impact in the ocean environment
- Migratory patterns coast wide for all stocks
- Overcome barriers to pull datasets together and coordination across states to fill-in data gaps
- Increased river monitoring, not just at the first dam
- Linking river runs to water temperatures and flow
- Environmental tolerances and thresholds (e.g., temperature) for all life stages
    - Laboratory studies that document biological responses to water chemistry and habitat thresholds
    - Investigate whether these limits change latitudinally
- River herring sensitivity to climate change variables and projecting these into the future
- Water chemistry and habitat criteria for river herring
- Water quality (including temperature, pH, salinity, contaminants, etc.) and match it up to spawning habitat and early life stage development
- Well-coordinated fishery independent survey network in juvenile habitats
    - Supporting tagging, genetic samples, microchemistry with otoliths, baselines, hydroacoustics, cameras to monitor movements in the estuaries, monitor ocean catch, prey/predation, etc.
- Stock recruitment
- Quantify juvenile emigration
- Data disparity for blueback herring versus alewives
- Improve long term indices on population status
- Use GIS to develop high resolution elevation models to project inundation due to sea level rise
- Behavior and physiological studies
- Reproduction
- Environmental cues that lead to spawning and migration
    - For example, use telemetry; combine acoustic work with PIT tag arrays, temperature probes on Northeast lobster traps, ocean gliders
- Amount of available river herring spawning habitat
- Historical relationships with environmental variables
- Juvenile indices
- Continuous climatologies for marine estuaries and freshwater, as well as migratory habitats
- Improved monitoring of restocking in the rivers

- River flow and temperature
- Appropriate habitat baselines are important for comparisons
- Homing rates to determine how quickly fish may be able to adapt to change
- Estimates of spawning habitat by watershed (with and without dams)
- Ocean acidification impacts
- Flood magnitudes and frequencies in watersheds impacted by human development
- Flood types and timing looking at recruitment (as egg sets and densities are not always available)
- More information on river herring at the extremes of the range to see the most acute climate change effect (e.g., on blueback herring in the St. Johns River, alewife in North Carolina)
- Additional genetic information (although it was acknowledged that work is ongoing)
- Better methods to count river herring (e.g., Hewitt, 2003) and/or for other areas standardizing technologies where good counts can be obtained
    - For example, hydroacoustic (e.g., North Carolina and Maine via Joe Hightower, USGS), pound net surveys working with fishermen (e.g., North Carolina, Maryland)
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Reference for additional information: River Herring Climate Change Workshop Report. Report to the National Marine Fisheries Service, Northeast Regional Office. December 27, 2012, 60pp.

V. New England and Mid-Atlantic Fishery Management Councils

Both the New England Fishery Management Council (NEFMC) and Mid-Atlantic Fishery Management Council (MAFMC) have briefly mentioned a few data and research needs that are currently lacking. There is a need for better river herring discard records, better data concerning the measured effect of the mackerel and longfin squid fisheries on river herring, and more observer coverage and data (NEFMC 2013a, MAFMC 2013). The effects of the fishing effort shifts on targeted and non-targeted river herring are still unknown. To better understand the impacts of river herring catch in the Atlantic herring fishery, longer time series of the following data sets are desired: year-class strength and population size, oceanographic conditions, and the distribution of Atlantic herring fishing effort (NEFMC 2013a). Tagging studies, age data for blueback herring cause in the Northeast Fisheries Science Center (NEFSC) fall surveys, and comprehensive assessments in various river systems are also lacking (MAMFC 2013).

The NEFMC (2013a) stressed that two high priority research needs are testing the effectiveness of Study Fleet net sensor technology and video monitoring in the Atlantic herring fishery. This cost-effective net sensor technology was created by the NEFSC and would

potentially be tied to the winch and pump systems to better monitor bycatch slippage and improve bycatch reports. The video monitoring would be tested in a pilot study (NEFMC 2013a).

The NEFMC (2013a) has listed and prioritized additional research needs which are located below.

High Priority

- Continue to utilize the inshore and offshore hydroacoustic and trawl surveys to provide an independent means of estimating stock sizes. Collaborative work between NMFS, DFO, state agencies, and the herring industry on acoustic surveys for herring should continue to be encouraged.
- Develop tagging and morphometric studies to explore uncertainties in stock structure and the impacts of harvest mortality on different components of the stock. Although tagging studies may be problematic for assessing survivorship for a species like herring, they may be helpful in identifying the stock components and the proportion of these components taken in the fishery on a seasonal basis.
- Continue commercial catch sampling of Atlantic herring fishery according to ACCSP/ME DMR protocols.
- Organize annual US-Canada workshops to coordinate stock assessment activities and optimize cooperation in management approaches between the two countries.
- Develop a strategy for assessing individual spawning components to better heavily exploited portion(s) of the stock complex.
- Examine the root causes of the discrepancy between Forward Projection and ADAPT assessments.
- Investigate bycatch and discards in the directed herring fishery.
- Synthesize predator/prey information and conduct investigations to address information gaps.

Medium Priority

- Develop a stock assessment for the Gulf of Maine component of the stock complex.
- Conduct an otolith methods workshop to address aging differences between DFO, NMFS and ME DMR readers after age 5.
- Investigate possible density-dependence reduced growth rates affecting both the entire complex and inshore subcomponent.

Low Priority

- Develop socio-economic analyses appropriate to the determination of optimum yield.
- Consider potential discards if fishing mortality increases in the future.
- Develop economic analyses necessary to evaluate the costs and benefits associated with different segments of the industry.

The NEFMC (2013b) also identified river herring bycatch avoidance and portside sampling as the top priorities for cooperative research to be funded through the 2014-2015 herring RSA program.

The MAFMC also identified the following priorities in various documents, announcements and/or meetings:

- Five year (2013-2017) research priorities (http://www.mafmc.org/research-priorities/):
  - Evaluate spatial catch patterns in the small pelagic fisheries to identify "hot spots" of co-occurrence; and
  - Explore management complementarities among small pelagic fisheries (e.g., mackerel, Atlantic herring and river herring).

- Research Set-Aside Program 2014 research and information priorities list (multi-year specification) (excerpts related to river herring)
  - Spanning Multiple Species
    - Conduct fishery independent surveys for all Mid-Atlantic species, especially in the near shore zone (as provided by the Northeast Area Monitoring and Assessment Program-NEAMAP). (Top research priority as identified by the SSC).
  - Interactions Between Loligo Squid, Butterfish, Atlantic Mackerel & River Herring
    - Test gear modifications (in addition to mesh size), videography and/or alternative gear types (e.g., jigging) in the Loligo squid fishery to reduce bycatch of butterfish and other species.
    - Investigate mesh size and/or gear technologies (grates or separators) to reduce retention of small mackerel and river herring in the mackerel fishery.

- Mackerel Squid and Butterfish Monitoring Committee and other associated teams (e.g., Fishery Management Action Team) have noted that portside sampling could be an important sampling process for the Atlantic mackerel fishery and this type of sampling should be furthered.

References for additional information:
Mid-Atlantic Fishery Management Council (MAFMC). 2013. Amendment 14 to the Atlantic Mackerel, Squid, and Butterfish (MSB) Fishery Management Plan (FMP): Final Environmental Impact Statement. August 2013.

New England Fishery Management Council (NEFMC). 2013a. Amendment 5 to the Fishery Management Plan (FMP) for Atlantic Herring Including a Final Environmental Impact Assessment (FEIS). Volume I. March 2013.

NEFMC, 2013b. Framework Adjustment 2 to the Atlantic Herring Fishery Management Plan (FMP)and Proposed Atlantic Herring Fishery Specifications for the 2013-2015 Fishing Years (January 1, 2013 – December 31, 2015). July 2, 2013.

VI. River Herring Endangered Species Act Listing Determination

In the National Marine Fisheries Service's (NMFS) August 12, 2013 river herring listing determination (78 FR 48944), NMFS noted that there were existing data gaps for river herring in many areas. At that time, NMFS determined particular research needs for river herring based on needs identified in the ASFMC stock assessment, Council documents and through the status review process (see references above). The research needs identified in the listing determination are included below:

- Gather additional information on life history for all stages and habitat areas using consistent and comprehensive coast-wide protocols (i.e., within and between the United States and Canada). This includes information on movements such as straying rates and migrations at sea. Improve methods to develop biological benchmarks used in assessment modeling.
- Continue genetic analyses to further assess genetic diversity, determine population stock structure along the coast (U.S. and Canada) and determination of river origin of incidental catch in non-targeted ocean fisheries. Also, obtain information on hybridization and understand the effects of stocking on genetic diversity.
- Further assess human impacts on river herring (e.g., quantifying bycatch through expanded observer and port sampling coverage to quantify fishing impact in the ocean environment and improve reporting of commercial and recreational harvest by waterbody and gear, ocean acidification)
- Continue developing models to predict the potential impacts of climate change on river herring. This includes, as needed to support these efforts, environmental tolerances and thresholds (e.g., temperature) for all life stages in various habitats.

- Develop and implement monitoring protocols and analyses to determine river herring population responses and targets for rivers undergoing restoration (e.g., dam removals, fishways, supplemental stocking). Also, estimate spawning habitat by watershed (with and without dams).
- Assess the frequency and occurrence of hybridization between alewife and blueback herring and possible conditions that contribute to its occurrence (e.g., occurs naturally or in response to climate change, dams, or other anthropogenic factors).
- Continue investigating predator prey relationships.