

**ATLANTIC STATES MARINE FISHERIES COMMISSION**

**REVIEW OF THE INTERSTATE FISHERY MANAGEMENT PLAN**

**FOR ATLANTIC HERRING**  
*(Clupea herengus)*

**2012 FISHING YEAR**



Prepared by the Plan Review Team

Approved by the Atlantic Herring  
Management Board  
October 2013

## I. Status of Fishery Management Plan

Atlantic herring (*Clupea harengus*), also known as sea herring, is an oceanic schooling fish that is important to the ecosystem as a forage species and to industry as bait for lobster, blue crab, and tuna. This resource also serves as a food fish, typically canned, pickled, or smoked. The U.S. Atlantic herring fishery is currently managed as a single stock through complementary plans by the Atlantic States Marine Fisheries Commission (ASMFC) and New England Fishery Management Council (NEFMC). However, there is evidence to suggest there are at least two separate biological stocks. Generally, the resource has been divided into an inshore Gulf of Maine (GOM) and an offshore Georges Bank (GB) component. Individual spawning aggregations have been identified, but quantitative data on their relative size is lacking. Intermixing among these aggregations outside of the spawning season has led to difficulties in accurately assessing the status of individual stocks. Currently, ASMFC's Atlantic Herring FMP has been revised with two amendments and subsequent addenda since the original plan was approved in 1993.

<u>Date of FMP Approval</u>	November 1993
<u>Amendments</u>	Amendment 1 (February 1999) Amendment 2 (March 2006)
<u>Addenda</u>	Addendum I to Amendment 1 (July 2000) Technical Addendum #1A to Amendment I (October 2001) Addendum II to Amendment I (February 2002) Technical Addendum 1 to Amendment 2 (August 2006) Addendum I to Amendment 2 (March 2009) Addendum II (December 2010) Addendum V (October 2012) Addendum VI (August 2013)
<u>Management Unit</u>	US waters of the northwest Atlantic Ocean from the shoreline to the seaward boundary of the Exclusive Economic Zone (East Coast of Maine), and from US/Canadian border to the southern end of the species range (Cape Hatteras, NC).
<u>States With Declared Interest</u>	Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, and New Jersey
<u>Active Boards/Committees</u>	Atlantic Herring Section, Advisory Panel, Technical Committee, Stock Assessment Subcommittee, Plan Development and Plan Review Team

***Amendment 1*** (February 1999)

ASMFC's Amendment 1 to the Atlantic Herring Fishery Management Plan (FMP) was developed to complement the NEFMC's federal management plan; it was designed to minimize regulatory differences in fisheries conducted in state and federal waters. Amendment I established management goals and objectives for the U.S. Atlantic herring resource that can only be reached through the successful implementation of both the interstate and federal management plans. The management scheme relies on a total allowable catch (TAC) with effort control measures to avoid overfishing. TACs are developed for specific management areas to reflect the current state of knowledge concerning migratory behavior and mixing rates of the sub-components of Atlantic herring.

Amendment 1 defines overfishing and biological reference points based on an estimate of maximum sustainable yield (MSY) for the entire stock complex. In order to maintain consistency between Amendment 1 and NEFMC's FMP, ASMFC's Atlantic Herring Section adopted the same overfishing definition and biological reference points as in the federal plan, which were created under guidelines stipulated in the revised Magnuson-Stevens Fishery Conservation and Management Act (MSA) prior to the 2006 re-authorization. Both FMPs provide a process for setting annual specifications and contain institutional frameworks for developing and implementing future management action involving the ASMFC, the New England and Mid-Atlantic Councils, and (possibly) Canada. The plans also include state and federal spawning closures/restrictions and recommendations to prevent damage to herring spawning habitat and egg beds. State effort controls include specific "days out" of the week to slow the fishery's catch rates and extend the fishing season in Management Area 1A.

***Addendum I to Amendment 1*** (July 2000)

The Section approved Addendum I to re-address the protection of spawning areas and change the due date for annual state compliance reports to February 1. Because NOAA Fisheries disapproved the spawning closures for the federal waters of Management Area 1A (inshore Gulf of Maine), ASMFC developed Addendum I to redefine the state waters spawning areas outlined in Amendment 1. Addendum I also includes measures designed to reduce the exploitation and disruption of herring spawning aggregations by imposing a landing restriction in state ports for herring caught in the spawning areas, except that some states allow a 20% tolerance for spawn herring (Maine and Massachusetts).

***Technical Addendum #1A*** (October 2001) was approved to change the delineation of the Eastern Maine spawning boundary because the spawning aggregations were not adequately protected in 2000.

***Addendum II to Amendment 1*** (February 2002)

Addendum II was developed in conjunction with NEFMC's Framework Adjustment 1 to allocate the Management Area 1A's TAC on a seasonal basis. This addendum also specifies the procedures for allocating the annual Internal Waters Processing (IWP) quota.

***Amendment 2*** (March 2006)

The essential management components of ASMFC's Amendment 2 are consistent with the federal Amendment 1 (final rule published in March 2007). These provisions include identical

management area boundaries, joint TAC specifications setting process between NEFMC and ASMFC, and closure of an area when 95% of TAC is harvested and reduction of the possession limit to a 5% bycatch allowance. Despite coordinated development between Amendment 2 and the federal Amendment 1, there remained some inconsistencies. The east of Cutler exemption in *Section 4.3.2.4* of Amendment 2 was not adopted in the federal plan, as it was found to be “inconsistent with National Standard 1 and 3 of the Magnuson-Stevens Act.” Conversely, Amendment 1 contains a midwater trawl prohibition in Area 1A from June 1 – September 30, which is not included in the Amendment 2. It is unlikely that there are mid-water trawl vessels lacking federal permits.

***Technical Addendum I to Amendment 2*** (August 2006)

Upon implementation of Amendment 2, there was inconsistent interpretation of the Zero Tolerance provision. Therefore, a technical addendum was developed to clarify that prohibits any vessel from fishing for, taking, landing, or possessing “spawn” herring within a restricted spawning area except for incidental bycatch and transiting provisions.

***Addendum I to Amendment 2*** (February 2009)

Addendum I was intended to address effort in Area 1A. It includes a number of tools for the Section to use in order to maintain a steady supply of herring throughout the fishing season. Under Addendum I, states adjacent to Area 1A must set quotas, but can use bi-monthly, trimester, or seasonal quotas and can distribute quota from January – May to later on in the fishing season when the demand and price is greater—as best meets the need of the fishery. This addendum also includes measures to close the fishery when 95% of the quota allocation is harvested and the ability to roll quota into later periods in the event of an under harvest. States are also required to implement weekly reporting in order to manage quotas in a timely manner.

***Addendum II*** (December 2010)

In March 2011, NOAA Fisheries approved Amendment 4 to the federal FMP, bringing it under compliance with the MSA’s annual catch limit requirements. Addendum II was developed to mirror the federal Amendment 4. It revises the specifications process and definitions to be consistent with the federal management scheme, in which specifications can be set for up to three years based on best available science. Addendum II also establishes a threshold of 95% of an area’s TAC for fishery closure and overage paybacks as accountability measures.

***Addendum V*** (October 2012)

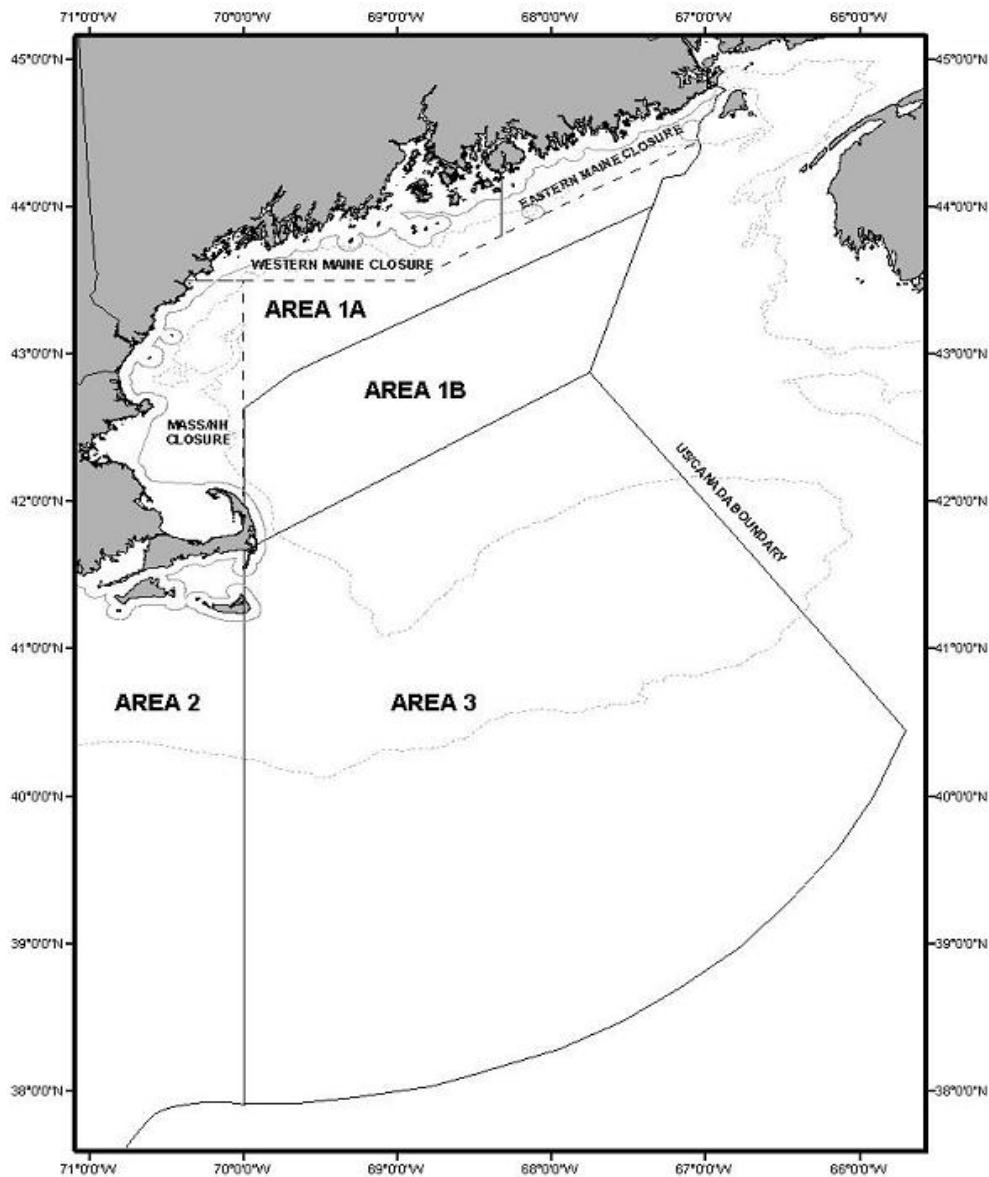
Intended to provide clarify and eliminate inconsistent spawning regulations among various interstate Atlantic herring FMP documents, Addendum V replaces all spawning regulations in previous management documents. It establishes provisions for determining spawning events and the implementation of area closures, and increases the sampling size from two sample of 50 fish to two samples of 100 fish or more. Addendum V includes new boundaries for the four management areas and identifies the locations of spawning areas subject to closures (Figure 1).

***Addendum VI*** (August 2013)

Developed to complement the NEFMC’s Framework Adjustment 2 (final rule published in October 2013), Addendum VI established new provisions and consistent management measures for the four Atlantic herring management areas. States were allowed to seasonally split sub-

ACLs for each management area to benefit the fishery. Up to 10% of unused sub-ACL can be carried over to the following fishing year after data is available, provided that the stockwide ACL has not been caught. Addendum VI also set new triggers: a directed fishery will close when 92% of an area's sub-ACL is projected to be reached, and the stockwide fishery will close when 95% of the total ACL is projected to be reached. There is a 2,000 lb trip limit to allow for incidental bycatch of sea herring for the remainder of the fishing year. In addition, Addendum VI allows for these the directed fishery closure triggers to be set through the specification process.

**Figure 1.** Map of Atlantic herring management areas with boundaries current to Addendum V (October 2012). Note that the three spawning areas are within Area 1A, the inshore region of Gulf of Maine.



## II. Status of the Atlantic Sea Herring Stock

The 2012 federal benchmark stock assessment (SAW/SARC 54), which considers data through 2011, determined that **Atlantic herring in Georges Bank and Gulf of Maine is not overfished and not experiencing overfishing; in fact, it is rebuilt.**

### Stock Definition

The U.S. Atlantic herring coastal stock complex includes two distinct spawning stocks that occupy discrete areas in the Gulf of Maine and on Georges Bank/Nantucket Shoals in the summer and fall. Fish belonging to these two components, and to smaller spawning populations within each component, migrate to continental shelf waters south of Cape Cod after spawning, then move northward in the spring to summer feeding grounds north and east of the Cape before eventually returning to their natal spawning grounds. Tagging studies suggest that fish from the New Brunswick, Canada weir fishery may be part of the GOM/GB complex, based on evidence of mixing.

Maximum sustainable yield (MSY) reference points were estimated to be  $F_{MSY} = 0.27$ ,  $SSB_{MSY} = 157,000$  mt ( $\frac{1}{2} SSB_{MSY} = 78,500$ ), and  $MSY = 53,000$  mt. Based on a comparison of the MSY reference points with the estimates of Fand SSB for 2011, overfishing is not occurring and the stock is not overfished.

### Spawning Stock and Total Biomass

Based on the ASAP model used in the 2012 stock assessment, the Atlantic herring spawning stock biomass (SSB) was estimated to be 517,930 mt (1.1 billion lbs) in 2011. Over the time series from 1965 - 2011, SSB ranged from a low of 53,349 mt (117.6 million lbs) in 1978 to a high of 839,710 mt (1.9 billion lbs) in 1997 (Figure 2). SSB generally declined during 1997-2010, but increased in 2011 to an estimated 1,322,446 mt (2.9 billion lbs). Total biomass was ranged from a minimum of 180,527 mt (406.7 million lbs) in 1982 to a maximum of 1,936,769 mt (4.3 billion lbs) in 2009. Total biomass and SSB showed similar trends over time, but with 1-2 year lag because the total biomass includes immature recruits, while SSB characterizes mature fish only. There was a strong cohort in 2009 that accounts for the greater biomass in recent years.

### Recruitment

With the exception of 2009, Age-1 recruitment since 2006 has been below the 1996-2011 average of 15.8 billion fish. The 2009 age-1 recruitment, however, was the largest in the time series at 59.4 billion fish. This large 2009 age-1 cohort consistently appeared in all sources of data that contain age composition.

### Fishing Mortality

Atlantic herring's fishing mortality (F) peaked in 1971 at a rate of 0.79. Since then, the F rate remained high and began declining in the 1980s, following the trend of decreasing stock biomass, until it dropped to a historic low of 0.13 in 1994 (Figure 3). Since then, F has remained below the  $F_{MSY}$  threshold of 0.27, with a slight increasing trend until overfishing occurred in 2009 ( $F_{2009} = 0.32$ ). The F in 2010 and 2011 was relatively low because of the presence of a strong cohort that increased the stock biomass (Figure 2).

### III. Status of the Fishery

The Atlantic herring resource occurs in waters off Canada and the United States, and fisheries exist in both countries. Based on the total catch, including discards, by the U.S. fixed gear and mobile gear and Canada’s New Brunswick weir fisheries, a majority of the fish (time series average of 87%) are caught by the U.S. commercial fleet (Figure 4). The Atlantic herring fishery is predominantly commercial; recreational catch accounts for less than 1% in the U.S.

#### Combined Canada and U.S. Catch

Total catch for Canada and US combined, including discards, averaged 114,625 mt (252.7 million lbs) per year from 1996 - 2011. The trend in combined catch has generally declined throughout the time series. In 2011, total catch was 84,815 mt (187.0 million lbs).

**Canadian landings.** Canadian landing have been dominated by the New Brunswick weir fishery. Since 1996, the New Brunswick weir fishery caught an average of 14,739 mt (32.5 million lbs), while the 5-year average from 2007-2011 was 11,218 mt (24.7 million lbs).

**U.S. landings.** Over the time series from 1965 to 2012, annual landings by the United States Atlantic herring fleet generally increased and averaged about 56,9 mt (125.4 million lbs). Landings reached the lowest level in 1983, with 23,254 mt (51.3 million lbs) and peaked in 2006 with 119,343 mt (263.1 million lbs) (Figure 5). Average landings were 78,394 mt (172.8 million lbs) since the FMP was implemented in 1993, and 86,342 mt (190.4 million lbs) a year in the past decade. In 2012, landings totaled 85,883 mt (189.3 million lbs), with the majority taken by trawl and purse seine gears.

#### State Fisheries in the U.S. in 2012

In 2012, Maine and Massachusetts accounted for 94.1% of the commercial Atlantic herring landings (source: state compliance reports). Maine landed 66.8% with 87,783 mt (193.53 million lbs) and Massachusetts landed 27.3% with 35,897 mt (79.14 million lbs) (Table 1). Rhode Island landed 4.8%. New Hampshire, New Jersey, New York, and Connecticut each landed less than 1% (Figure 5).

**Table 1.** State Landings of Atlantic herring in 2012.

State	Commercial (mt)	Commercial (lbs)	% of Total
ME	87,783	193,528,157	66.8%
MA	35,897	79,140,109	27.3%
RI	6,277	13,838,730	4.8%
NH	1,084	2,390,747	0.8%
NJ	349	768,837	0.3%
NY	39	85,001	0.0%
CT	9	19,896	0.0%
<b>Total</b>	<b>131,438</b>	<b>289,771,391</b>	

#### **IV. Status of Assessment Advice**

There were no research recommendations from the previous assessment, and so 15 new recommendations were developed during the 2012 assessment. The new recommendations are listed below. They are also included in the prioritized research recommendations in Section XI of this report.

##### New Research Recommendations from the 54<sup>th</sup> Northeast Region Stock Assessment for Atlantic Herring (2012)

- a. More extensive stock composition sampling including all stocks (i.e. Scotian Shelf).
- b. Develop (simple) methods to partition stocks in mixed stock fisheries.
- c. More extensive monitoring of spawning components.
- d. Analyze diet composition of archived mammal stomachs. Improve size selectivity of mammal prey. Also sea birds.
- e. Consider alternative sampling methods such as HabCam.
- f. Research depth preferences of herring.
- g. Simulation study to evaluate ways in which various time series can be evaluated and folded into model.
- h. Evaluate use of Length-based models (Stock Synthesis and Chen model)
- i. Develop indices at age from shrimp survey samples
- j. Evaluate prey field to determine what other prey species are available to the predators that could explain some of the annual trends in consumption.
- k. Develop statistical comparison of consumption estimates and biomass from model M.
- l. Consider information on consumption from other sources (i.e. striped bass in other areas) and predators inshore of the survey.
- m. Investigate why small herring are not found in the stomachs of predators in the NEFSC food habits database.
- n. Develop an industry-based LPUE or some other abundance index (Industry Based Survey).
- o. Develop objective criteria for inclusion of novel data streams (consumption, acoustic, larval, etc) and how can this be applied



## V. Status of Research and Monitoring

Under Amendment 1, states are not required to conduct fishery independent surveys for Atlantic herring. However, state survey programs designed to catch other species may encounter herring regularly, so some states do collect biological information on sea herring. A summary of these surveys results follow.

Spawning Monitoring: Addendum V to Amendment 2 (2012) required states to collect 100 samples for spawning analysis, an increase from 50 samples, of sea herring during the spawning season in order to detect spawning events for the closure of spawning areas. This requirement only pertains to states bordering spawning areas: Maine, New Hampshire, and Massachusetts. New Hampshire does not analyze sea herring spawning, but its samples are included in Maine's program.

**Maine and New Hampshire:** ME and NH jointly operate an inshore bottom trawl survey in the fall that is designed for catching groundfish, but regularly encounters sea herring. From 2003 to 2010, the number of herring per tow has been generally increasing, with variance between years. The abundance peaked in 2009 (consistent with 2009 strong cohort) at nearly 1,600 fish per tow. In 2012, the ME/NH fall survey encountered about 1,200 fish/tow. Weight per tow (measured as kilograms) also had an upward trend for the time series from 2000-2010, but at a much lower rate of increase. In 2012, the weight per tow was about 28 kg/tow. A majority of the fish were between 7 and 14 cm in length. Due to limit staff resources, the data has not been analyzed for 2011 or 2012. In 2012, Maine processed 87 samples from Area 1A and collected biological data in addition to spawning condition.

**Maine** Department of Marine Resources also conducts commercial portside catch sampling as part of an ACCSP grant to examine bycatch. In 2012, approximately 170 fish samples were taken over the calendar year, and have been processed for length, weight, sex, and maturity.

**New Hampshire** also conducts the juvenile finfish survey in Great Bay, in addition to the joint survey with ME. In 2012, two sea herring were observed in September, although the final survey report has not been completed at the time of this FMP review.

**Massachusetts** Division of Marine Fisheries (MA DMF) also conducts portside sampling of MA's fishery (including mid-water trawl fleet) and four Small-Mesh Bottom Trawl (SMBT) herring vessels out of Rhode Island through the River Herring Bycatch Avoidance in Small-Mesh Fisheries Study, which is funded through the National Fish and Wildlife Foundation. Sampling program began in October 2010.

**Massachusetts** DMF conducts gonad somatic index (GSI) sampling of commercial landings from Area 1A during the spawning season. In 2012, MA DMF conducted 5 port samples beginning in August 28. The trigger of 25% spawn herring was reached by September 14, resulting in a closure from September 21 - October 18, and again from October 31 - November 12. MA DMF also conducted 5 GSI samplings of Area 3 landings.

**Rhode Island** Division of Fish & Wildlife (RI DFW) conducts a Seasonal Trawl Survey that yield abundance indices for sea herring. In 2012, fishery-independent monitoring suggested an increase in relative biomass and abundance in RI waters from 12.0 fish/tow in 2011 to 134.3 fish/tow in 2012. Sea herring are rarely encountered by the fall survey, but are observed in the spring.

**Connecticut** Department of Energy and Environmental Protection (CT DEEP) monitors sea herring through the Long Island Sound Trawl Survey (LISTS), which is conducted each spring and fall since 1984. In 2012, the spring abundance index was 0.73 fish/tow, which is 37% below the 10-year average. Few herring are caught in the fall survey, and the rare specimens are generally under 15 cm in length.

**New York's** Western Long Island Juvenile Striped Bass Survey and Peconic Estuary Small Mesh Trawl Survey encounter juvenile sea herring with great variance year to year, but does not routinely summarize the data. However, the information can be prepared at the request of management.

## **VI. Management Measures and Issues**

*Section 5.1.1.1* of Amendment 2 to the Interstate Fishery Management Plan for Atlantic Sea Herring lists the following state regulatory requirements:

1. Each jurisdiction must enact spawning area restrictions that are at least as restrictive or more than those in (Section 4.3);
2. Each jurisdiction shall prohibit the landing of herring from a management area or sub-area when the TAC has been attained in that area or sub-area (Section 4.3);
3. Each jurisdiction shall prohibit directed fishing for herring in state waters when the TAC has been attained in that area or sub-area (Section 4.3);
4. Each jurisdiction shall prohibit the landing of herring to an Internal Waters Processing (IWP) operation that were harvested from an area or sub-area closed to directed herring fishing (Section 4.3);
5. Each jurisdiction shall require that (daily) herring landings from fixed gear fisheries be reported on a weekly basis in order to monitor progress toward attaining the TAC (Section 4.3); and
6. Each jurisdiction shall annually provide a report on any mealing activity of herring occurring in their state, specifically, the amount in weight of herring processed into meal or like product, biological sampling results and location of catch by NMFS statistical area or Management Area.

## VII. State Compliance

Each jurisdiction is required to submit a compliance report for the previous fishing season by February 1 of each year. The standard components and plan-specific requirements for the Atlantic Herring FMP are listed in Table 2.

- I. Introduction: Summary of the year that highlights significant changes in monitoring, harvest, or regulations.
- II. Request for *de minimis* status, where applicable.
- III. Previous calendar year's fishery and management program.
- IV. Planned management programs for the current calendar year.
- V. Plan-specific requirements (see Section VI of this report)
- VI. Law Enforcement Reporting Requirements

**Table 2.** Completion of state compliance reports for the 2012 fishing year.

Section	ME	NH	MA	RI	CT	NY	NJ
I	✓	✓	✓	✓	✓	✓	✓
II	NA	NA	NA	NA	NA	DM	NA
III	✓	✓	✓	✓	✓	DM	✓
IV	✓	✓	✓	✓	✓	DM	✓
V	✓	✓	✓	✓	✓	DM	✓
VI	NA	NA	NA	NA	NA	NA	✓

✓ refers to whether the report addressed the compliance requirements listed in Section VI.  
**DM** = requests *de minimis* status.  
**NA** (does not apply) refers to restrictions that would not apply to a state.

### Request for *De minimis* Status

Amendment 1 to the FMP establishes the definition and criteria for *de minimis* status. A state with approved *de minimis* status has been determined to not have significant contributions to a coastwide conservation program required by an FMP or amendment. States may apply for *de minimis* status if, for the last two years, their combined commercial landings by weight constitute less than 1% of coastwide commercial landings for the same two-year period. *De minimis* states are still required to implement management measures to address regulatory requirements 2, 3, and 4 under the FMP's Section 5.1.1.1. (see Section VI of this report).

New York has requested and met the requirements for *de minimis* status. Its landings have averaged 0.04% of the coastwide landings since 1991. New York landed 30,692 lbs in 2011 and 85,001 lbs in 2012.

## VIII. PRT Recommendations

The Plan Review Team recommends the following for the Atlantic Herring Section's consideration:

1. All states who submitted reports meet or exceed the regulatory measures in the FMP.
2. The state of New York meets the criteria for *de minimis* status.

## **IX. Law Enforcement Report**

The Law Enforcement Committee reviewed Addendum V (Comprehensive Spawning Regulations) on July 22, 2012 and provided the following comments.

*Members of the Law Enforcement Committee (LEC) of the Atlantic States Marine Fisheries Commission reviewed the management options contained in Atlantic Herring Addendum V for consideration of any law enforcement concerns or issues. The review was based on 3 components of the addendum:*

- 1) Refining the sampling protocol for spawning area closures.*
- 2) Considering a mechanism to shift the boundary between areas based on sampling data.*
- 3) Consolidating all regulations into one primary management document.*

*No concerns or issues were raised by LEC members regarding these management measures. Current management allows for changes in spawning area seasons depending on the availability of sampling data, and no additional problems are foreseen with a mechanism to change boundaries provided that timely notification of such changes is integral to the process. The LEC is supportive of efforts to consolidate and standardize regulations into one primary management document.*

*The LEC appreciates the opportunity to review this addendum and provide input.*

## **X. Future Compliance Issues**

None.

## **XI. Research and Monitoring Recommendations**

### Fishery-Dependent Priorities

#### *High*

- Develop (simple) methods to partition stocks in mixed stock fisheries.
- Investigate bycatch and discards in the directed herring fishery through both at sea and portside sampling.
- Continue commercial catch sampling of Atlantic herring fisheries according to ACCSP protocols

### Fishery-Independent Priorities

#### *High*

- Conduct more extensive stock composition sampling including all stocks (i.e., Scotian Shelf).
- Expand monitoring of spawning components.

#### *Low*

- 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.
- Consider alternative sampling methods such as HabCam.

### Modeling / Quantitative Priorities

#### *High*

- Evaluate use of length based models (Stock Synthesis and Chen model).
- Develop statistical comparison of consumption estimates and biomass from model M.

#### *Moderate*

- Develop indices at age from shrimp survey samples.
- Conduct simulation studies to evaluate ways in which various time series can be evaluated and folded into the assessment model.
- Develop new approaches to estimating recruitment (i.e., juvenile abundance) from fishery-independent data.
- Examine the possible effects of density dependence (e.g., reduced growth rates at high population size) on parameter estimates used in assessments.

#### *Low*

- Develop an industry based LPUE or some other abundance index (Industry Based Survey).
- Conduct a retrospective analysis of herring larval and assessment data to determine the role larval data plays in anticipating stock collapse and as a tuning index in the age structured assessment.
- Investigate the M rate assumed for all ages, the use of CPUE tuning indices, and the use of NEFSC fall bottom trawl survey tuning indices in the analytical assessment of herring.
- Develop objective criteria for inclusion of novel data streams (consumption, acoustic, larval, etc.) and how this can be applied.

### Life History, Biological, and Habitat Priorities

#### *High*

- Consider information on consumption from other sources (i.e. striped bass in other areas) and predators inshore of the current surveys.

#### *Moderate*

- Continue 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.
- Analyze diet composition of archived mammal and sea bird stomachs. Improve knowledge on prey size selectivity of mammals and sea birds.
- Evaluate prey field to determine what other prey species are available to predators that could explain some of the annual trends in herring consumption.
- Investigate why small herring are not found in the stomachs of predators in the NEFSC food habits database.

#### *Low*

- Research depth preferences of herring.

### Management, Law Enforcement, and Socioeconomic Priorities

#### *High*

- Evaluate the current herring spawning closure design in terms of areas covered, closure periods, catch-at-age within (before fishing prohibition in 2007) and outside of spawning areas to determine minimal spawning regulations (Maine DMR).
- Continue to organize annual US-Canadian workshops to coordinate stock assessment activities and optimize cooperation in management approaches between the two countries.

#### *Moderate*

- Develop a strategy for assessing individual spawning components to better manage heavily exploited portion(s) of the stock complex, particularly the Gulf of Maine inshore spawning component.
- Develop socioeconomic analyses appropriate to the determination of optimum yield.

#### *Low*

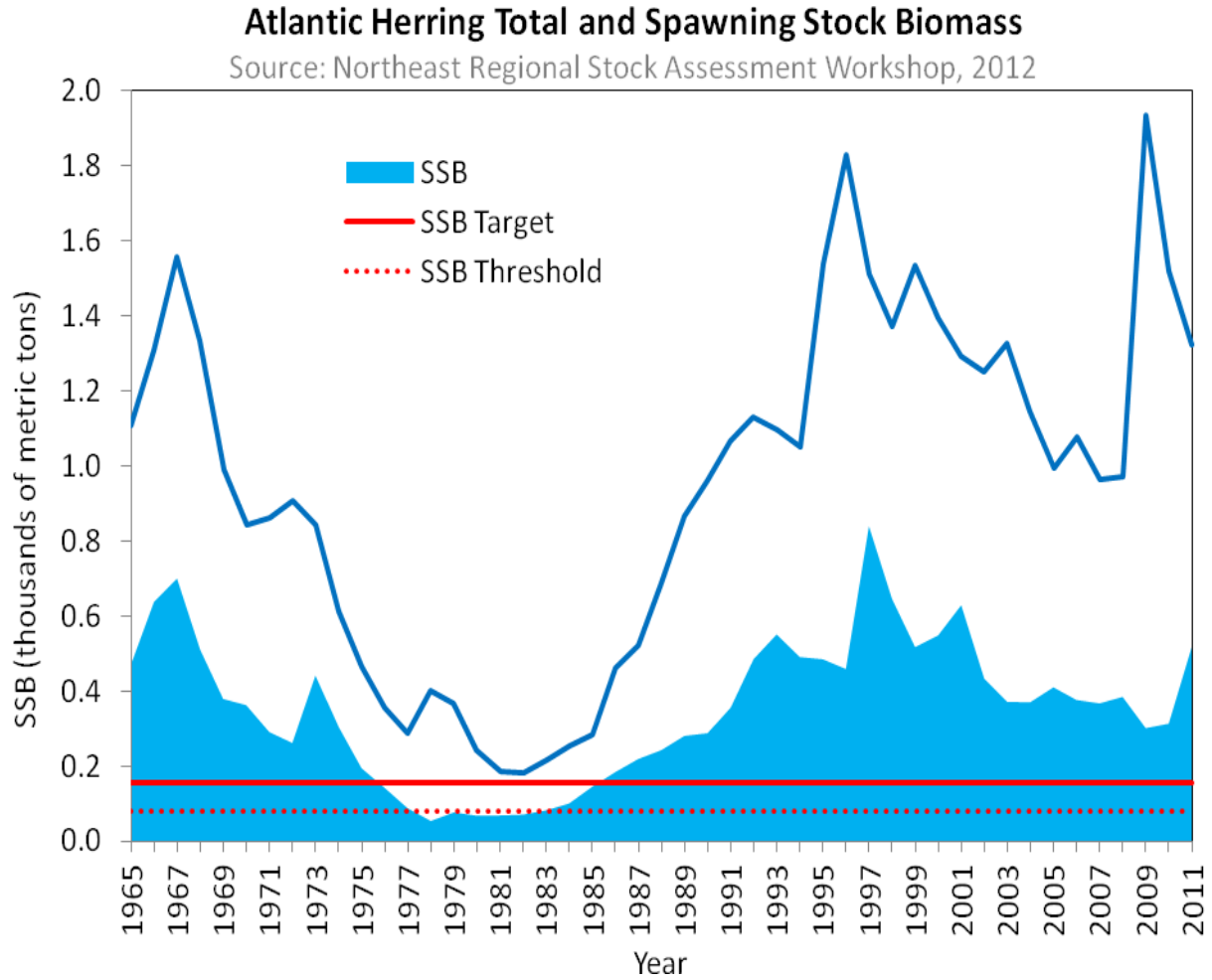
- Develop economic analyses necessary to evaluate the costs and benefits associated with different segments of the industry.

### Atlantic Sea Herring Research Priorities Identified as Being Met

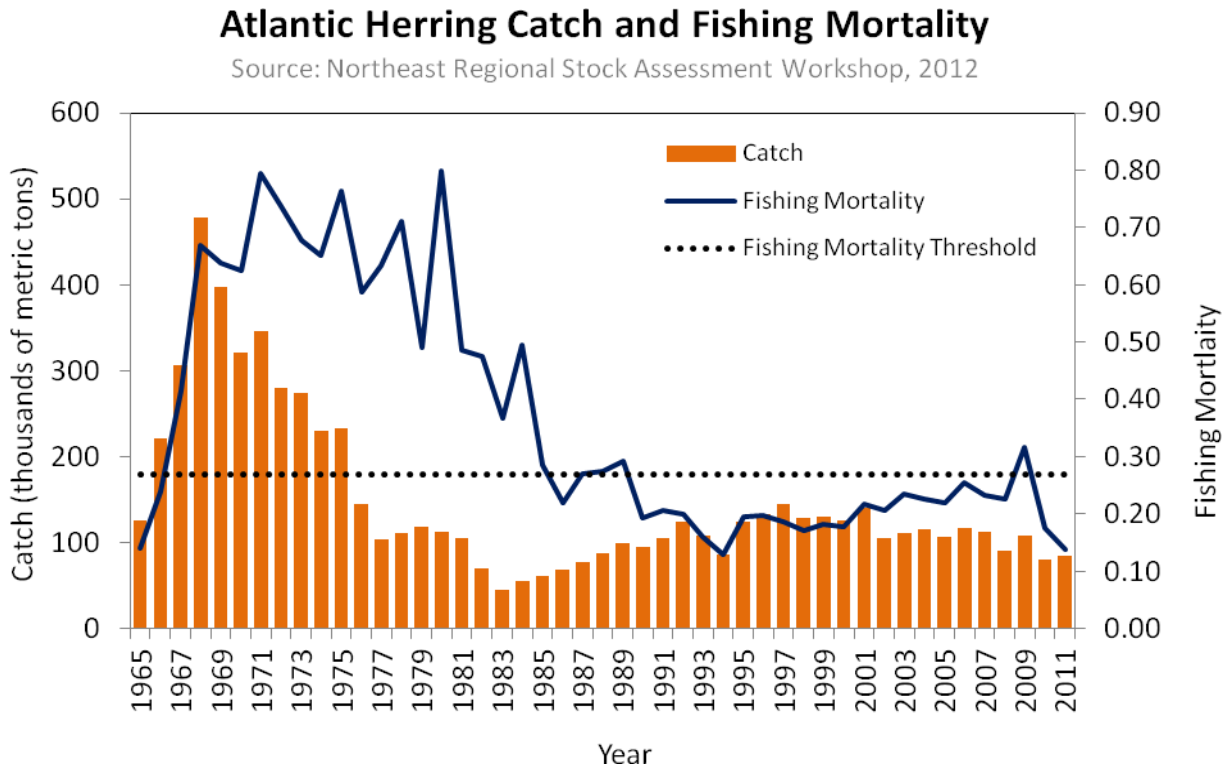
- Evaluate the merit of acoustic surveys and other techniques to achieve sub stock complex monitoring. Gulf of Maine Research Institute.

## Figures of the Atlantic Herring FMP Review for the 2012 Fishing Year

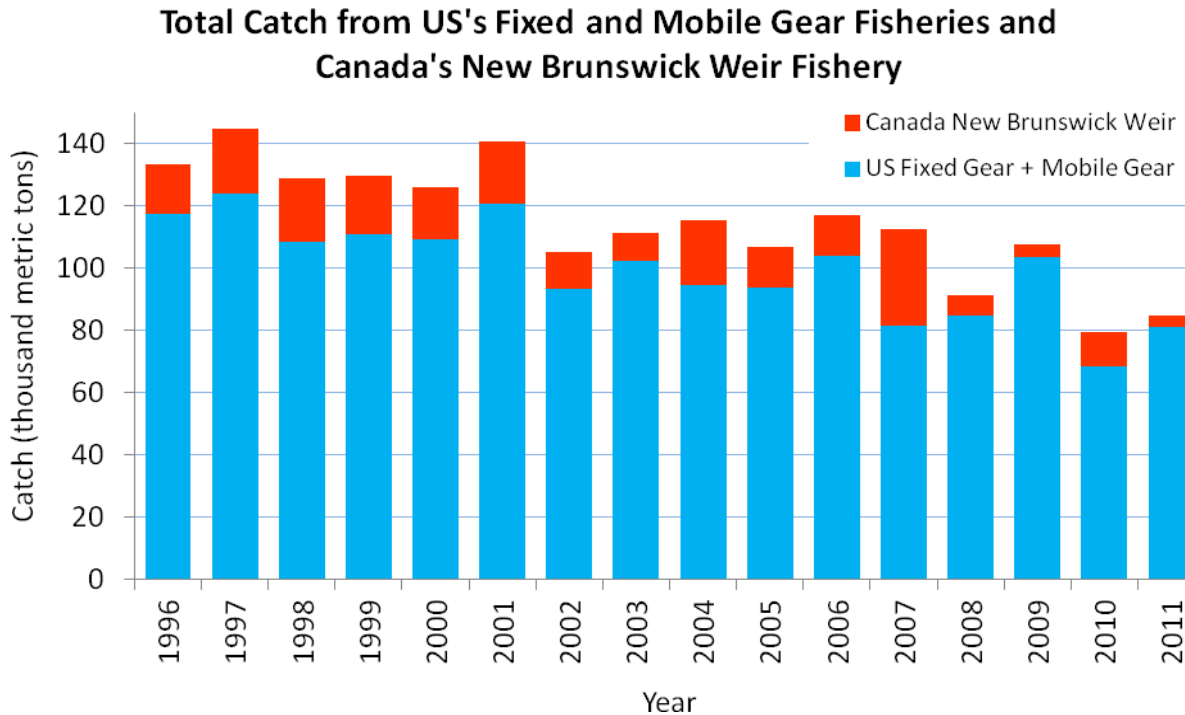
**Figure 2.** Total and spawning stock biomass and thresholds of Atlantic herring from 1965 to 2011. Total biomass is based on January 1 estimates.



**Figure 3.** Atlantic herring catch and fishing mortality from 1965 to 2011.

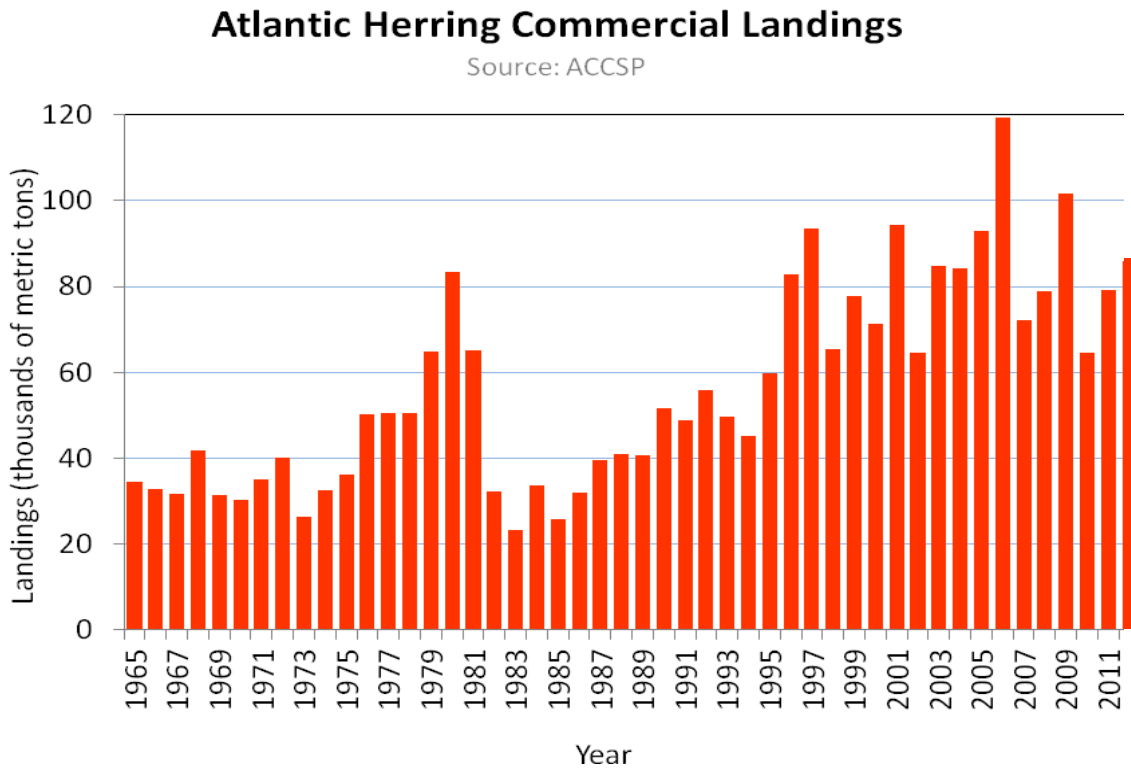


**Figure 4.** Total catch from US and Canadian fleets, including discards. Source: SAW54 report.





**Figure 5.** Commercial Atlantic herring landings by the U.S. fleet from 1965-2012.



**Figure 6.** 2012 herring landings by state. Source: State compliance reports

