

**2017 REVIEW OF THE  
ATLANTIC STATES MARINE FISHERIES COMMISSION  
FISHERY MANAGEMENT PLAN FOR**

**ATLANTIC HERRING  
(*Clupea harengus*)**

**2015 - 2016 FISHING YEARS**



**Atlantic Herring Plan Review Team**

Renee Zobel, New Hampshire Fish and Game  
Melissa Smith, Maine Department of Marine Resources  
Ashton Harp, Atlantic States Marine Fisheries Commission

**Approved May 2017**

## Table of Contents

I. Status of Fishery Management Plan .....	2
II. Status of the Stock .....	4
III. Fishery Performance in 2015 and 2016 .....	4
IV. Status of Assessment Advice .....	7
V. Status of Research and Monitoring .....	8
VI. Management Measures and Issues .....	9
VII. PRT Recommendations .....	10
VIII. Law Enforcement Report .....	11
IX. Future Compliance Issues .....	11
X. Research and Monitoring Recommendations .....	11

## I. Status of Fishery Management Plan

<u>Date of FMP Approval</u>	November 1993
<u>Amendments</u>	Amendment 1 (February 1999) Amendment 2 (March 2006) Amendment 3 (February 2016)
<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 to Amendment 2 (December 2010) Addendum V to Amendment 2 (October 2012) Addendum VI to Amendment 2 (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 the US/Canadian border to the southern end of the species range (Cape Hatteras, North Carolina).
<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 Team, and Plan Review Team

Atlantic herring (*Clupea harengus*), also known as sea herring, are an oceanic fish that occur in large schools and undergo seasonal inshore-offshore migrations. Herring are important to the Northwest Atlantic ecosystem as a forage species and to industry as bait for lobster, blue crab, and tuna. To a lesser degree 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 the New England Fishery Management Council (NEFMC).

The stockwide annual catch limit (ACL) is divided amongst four distinct management areas: inshore Gulf of Maine (Area 1A), offshore Gulf of Maine (Area 1B), Southern New England/Mid-Atlantic (Area 2), and Georges Bank (Area 3). The Area 1A fishery is managed by ASMFC's Atlantic Herring Section (Section), which includes representatives from Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York and New Jersey.

The 1993 ASMFC Atlantic Herring Fishery Management Plan (FMP) was implemented to address the growth of the herring resource and interest in Internal Waters Processing (IWP) operations.

Amendment 1 to the FMP was developed to complement the goals and objectives of the NEFMC federal management plan. It established total allowable catch limits (TACs) for specific management areas. The Days Out program was established for state waters.

Addendum I (2000) redefined spawning areas in state waters. It also reduced the exploitation of herring spawning aggregations by imposing a limited landing restriction on herring caught in spawning areas (20% tolerance for spawn herring in Maine and Massachusetts). Technical Addendum #1A (October 2001) was approved to change the delineation of the Eastern Maine spawning area.

Addendum II (2002) was developed in conjunction with NEFMC's Framework Adjustment 1 to allocate the Management Area 1A TAC on a seasonal basis. This addendum also specifies procedures to allocate the annual Internal Waters Processing (IWP) quota.

Amendment 2 (2006) to the FMP was developed to complement management measures in Amendment 1 to the federal FMP. Identical management area boundaries were adopted, in addition to a joint TAC specification setting process between NEFMC and ASMFC, and management area closure when 95% of the TAC is harvested. Technical Addendum I to Amendment 2 (2006) was developed to address inconsistent interpretation of the zero tolerance spawning provision.

Addendum I (2009) identifies tools to address effort in Area 1A in order to maintain a steady supply of herring throughout the fishing season. States adjacent to Area 1A can set bi-monthly, trimester or seasonal quotas and roll the quota into later periods if there is under-harvest. It also requires states to implement weekly reporting for timely quota management.

Addendum II (2010) was developed to complement Amendment 4 to the federal FMP. It revises the specifications process (sets measures for three-years) and terminology (e.g., TAC is now called ACL) to be consistent with federal management.

Addendum V (2012) compiles the previously approved spawning regulations into one document and revises the spawning sample provisions.

Addendum VI (2013) was developed to complement the NEFMC's Framework Adjustment 2 to the federal FMP. It established new provisions and consistent measures for the four management areas. States may seasonally split sub-ACLs for each management area, and up to 10% of unused sub-ACL may be carried over to the following fishing year (after data is available). Addendum VI also set new closure 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.

Amendment 3 (2016) to the FMP consolidates prior amendments, addenda, and recent management decisions into a single document; it is now the comprehensive document for Atlantic herring management in state waters. The amendment refines the spawning closure

system using a modified GSI-based spawning monitoring system. Additionally, the fixed gear set-aside is now available to fixed gear fishermen through December 31.

The Section initiated Draft Addendum I to Amendment 3 in October 2016 to address herring shortages for the bait market. The Draft Addendum includes management options to ensure the seasonal quota is distributed throughout Trimester 2 (June through September), are applied consistently by the states adjacent to Area 1A, and address excessive capacity. It will be considered for final approval in 2017.

## **II. Status of the Stock**

A benchmark stock assessment was published in 2012. An update was released in 2015 to incorporate data through 2014. Both assessments indicate the stock is not overfished and not experiencing overfishing.

In the 2015 update, the maximum sustainable yield (MSY) based reference points were updated; the overfishing threshold is  $F_{MSY} = 0.24$  and the overfished threshold is  $\frac{1}{2}SSB_{MSY} = 342$  million lbs. (155,573 mt). The 2015 update estimated fishing mortality to be 0.16 in 2014 and spawning stock biomass to be 1.3 billion lbs (623,000 mt). The 2012 age-1 recruitment was estimated to be the second largest in the time series and equaled 42.4 billion fish.

For the 2016-2018 fishing season, the Council and Commission set the ACL at 231 million pounds (104,800 mt), a mere 2.6% decrease from the 2013-2015 fishing limits. For all three years, the ACL is further subdivided by Atlantic herring management areas as follows: Area 1A = 66.79 million pounds, Area 1B = 9.9 million pounds, Area 2 = 64.1 million pounds, and Area 3 = 90.16 million pounds. The Area 1A sub-ACL is distributed seasonally with 72.8% available from June 1-September 30 and 27.2% available from October 1-December 31. Underages from June through September may be rolled into the October through December period. Directed fisheries within a management area will close when 92% of the sub-ACL has been harvested, and the stock-wide fishery will close when 95% of the ACL is projected to be reached.

## **III. Fishery Performance in 2015 and 2016**

There is an Atlantic herring fishery in the United States and Canada. The U.S. Atlantic herring fishery is controlled by annual catch limits (ACL) set by NOAA Fisheries. The stockwide ACL is distributed among the four management areas. Specifications are set every three years and adjusted annually to account for overages or underages from the previous fishing season. Once 92% of the sub-ACL for an area is reached, the respective fishery will be closed. The stockwide fishery will close when 95% of the total ACL is projected to be reached (Addendum VI). Following a closure, there is a 2,000 lb trip limit to allow for incidental bycatch of Atlantic herring for the remainder of the fishing year. In addition to quota-based closures, the “days out” and spawning closure programs provide additional measures to control fishing effort.

The domestic Atlantic herring fishery is predominantly commercial; recreational catch accounts for less than 1% of landings. Over the time series from 1965 to 2016, annual landings by the

United States Atlantic herring fleet generally increased and averaged about 58,335 mt. Landings reached the lowest level in 1983, with 23,254 mt and peaked in 2006 with 121,807 mt. Average landings are 78,838 mt since the FMP was implemented in 1993. Landings totaled 78,972 mt in 2015 and 62,348 mt in 2016, with the majority taken by trawl and purse seine gears.

### State Fisheries

Based on preliminary data provided in state compliance reports, Maine and Massachusetts accounted for 89.7% of the commercial Atlantic herring landings in 2015, and 91.1% in 2016 (Table 1).

**Table 1.** Commercial landings by state and percent of total harvest. Source: State compliance reports

State	2015		2016*	
	Commercial Landings	Percent of Total	Commercial Landings	Percent of Total
ME	85,030,089	48.8%	78,358,902	57%
NH	3,998,860	2.3%	89,730	0.07%
MA	71,135,004	40.8%	46,877,215	34.1%
RI	10,390,744	5.9%	9,278,837	6.75%
CT	21,914	0.01%	51,458	0.04%
NY	128,596	0.07%	72,538	0.05%
NJ	3,526,334	2.02%	2,798,128	2.03%
Total	174,231,541		137,526,808	

\*2016 data is preliminary

In 2015 and early in the 2016 fishing season, the Area 1A seasonal quota was harvested at an above-average rate and there were concerns about the availability of Atlantic herring bait throughout the summer and early fall months (June-September). For more information on historical Area 1A effort controls and the 2015/2016 fishing season, refer to the fishery performance white paper.

[http://www.asafc.org/uploads/file/58124582AtlHerringArea1AFisheryPerformance\\_2015\\_2016.pdf](http://www.asafc.org/uploads/file/58124582AtlHerringArea1AFisheryPerformance_2015_2016.pdf)

### 2015 Fishing Season

Summary: In Area 1A the rate of landings accelerated in August such that the seasonal quota was exceeded on August 28; triggering a zero landing day scenario for all of September.

The increase in Area 1A landings occurred as Area 3 landings became stagnant, likely due to Georges Bank haddock catch cap concerns. Based on preliminary haddock data, 63% of the Georges Bank haddock catch cap had been used by the midwater trawl fleet at the end of July,

which likely deterred vessels from continuing to fish in Area 3. This lack of Area 3 landings in August disrupted the flow of herring supply to markets and put more pressure on Area 1A.

On August 26, the Commission scheduled an emergency days out call to discuss the increase in Area 1A landings. Some harvesters agreed to stop fishing until the next landings report was released. Ultimately, the sudden increase in effort in August could not be diminished by decreasing the number of landing days, rather the Area 1A fishery moved to zero landing days on August 28. As a result, Atlantic herring vessels could not fish in Area 1A during the month of September, when demand for herring is strong. Area 1A re-opened for Trimester 3 on October 5, 2015 with three landing days and closed on November 9, 2015.

### **2016 Fishing Season**

Summary: Above-average landings at the start of the season and thereafter led to emergency restrictions for vessels landing in Maine (on behalf of Maine DMR), which were more restrictive than those of the Commission.

The 2016 Area 1A Atlantic herring fishing season opened in June to almost double the projected landings. For example, three weeks into June the fishery was projected to have harvested 1,300 mt; however, 2,837 mt had been harvested. During June – August, the primary source of Atlantic herring landings was from Area 1A. Similar to 2015 but earlier in the season, Area 3 landings became stagnant and Area 1A landings increased. Area 3 herring fishermen reported finding some Atlantic herring schools, but in deep waters and intermixed with haddock schools. Utilization of more than half of the Georges Bank haddock catch cap so early in the 2015 fishing season prompted a small number of midwater trawl vessels to shift effort to Area 1A in 2016 to operate as purse seiners.

The New Hampshire landings dropped significantly in 2016 due to the restrictive landing regulations for Maine vessels. In prior years a Maine purse seine vessel landed in New Hampshire. In 2016, New Hampshire herring harvesters were primarily small mesh bottom trawl vessels.

The Area 1A fishery moved to zero landing days on September 18. Area 1A re-opened for Trimester 3 on October 2, 2016 with four landing days and closed on October 18, 2016.

### **Spawning Area Closures**

The Atlantic Herring Area 1A (inshore Gulf of Maine) fishery regulations include seasonal spawning closures for portions of state and federal waters in Eastern Maine, Western Maine and Massachusetts/New Hampshire. In 2016, the Commission's Atlantic Herring Section approved a one-year pilot of a new forecasting method that relies upon at least three samples, each containing at least 25 female herring in gonadal stages III-V, to trigger a spawning closure.

Vessels were not fishing in the Eastern Maine spawning area during Trimester 2, as a result there were no samples to determine spawning condition. The Eastern Maine spawning area was closed from August 28, 2016 to September 24, 2016.

Sampling in the Western Maine spawning area began on August 7, 2016; five samples totaling 216 female herring were collected to evaluate spawning condition. Based on the analysis of the samples, the Western Maine spawning area was closed from September 18, 2016 to October 15, 2016.

Sampling in the Massachusetts/New Hampshire spawning area began on August 8, 2016; nine samples totaling 654 female herring were collected to evaluate spawning condition. Based on the analysis of the samples, the Massachusetts/New Hampshire (MA/NH) spawning area was closed from October 2, 2016 to October 29, 2016.

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

The following research recommendations were included in the 2012 benchmark stock assessment (also in Section XI). The 2015 stock assessment update did not provide additional research recommendations.

##### 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 3, 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 Atlantic herring. A summary of these surveys results follow.

### **Spawning Area Closure Monitoring Program**

Upon approval of Amendment 3, the Atlantic Herring Section granted a one-year pilot of a new method, known as the GSI30-Based Forecast System, to be tested in the 2016 fishing season. The closure date for a spawning area will be projected based on a minimum of three fishery dependent or independent samples, each containing at least 25 female herring in ICNAF gonadal stages III-V. See Section III for 2016 results.

**Maine and New Hampshire:** The states jointly operate an inshore bottom trawl survey in the spring and fall that is designed to catch groundfish, but regularly encounters Atlantic herring. From 2003 to 2016, the number of herring per tow was generally increasing, with variance between years.

In 2015, preliminary data indicate 53 Atlantic herring (lengths ranging between 9 and 24 cm) were captured during the spring inshore trawl survey, while 8,332 Atlantic herring (lengths ranging between 13 and 27 cm) were captured during the fall survey. In 2016, preliminary data indicate 96 Atlantic herring (lengths ranging between 11 and 27 cm) were captured during the spring inshore trawl survey, while 661 Atlantic herring (lengths ranging between 19 and 27 cm) were captured during the fall survey.

**Maine** Department of Marine Resources also conducts commercial portside catch sampling as part of an ACCSP grant to examine bycatch. In 2015 and 2016, 144 and 88 samples were taken each year, respectively. The fish were processed for length, weight, age, sex, spawning condition, gut fullness, etc.

**New Hampshire** Fish and Game Department also conducts the juvenile finfish seine survey in the Great Bay, its tributaries, and other coastal harbors. In 2015, 124 Atlantic herring were observed during the months of June, July, and August. In 2016, 8 herring were observed during June and July.

In 2015, **Massachusetts** Division of Marine Fisheries and UMass-Dartmouth School for Marine Science and Technology (SMAST) applied for the 2016-2018 Atlantic herring Research Set-Aside (RSA), and were awarded the majority of RSA quota. Portside sampling and the River Herring Bycatch Avoidance program were conducted with both the midwater trawl (MWT) fishery (primarily operating out of Massachusetts ports) and the small-mesh bottom trawl (SMBT)

fishery operating out of Rhode Island ports. These programs have been ongoing since 2010 and 2011, respectively.

The primary goals of the River Herring Bycatch Avoidance programs are to characterize the landings of vessels and advise the fleets of river herring bycatch, in an effort to minimize bycatch independent of management actions. Similar to the 2015 fishing year, participating fishermen were not able to pursue RSA quota until November of 2016, therefore funds were not generated until late in the year. Eventually 873 of 2,136 metric tons of RSA quota were harvested (41%); however industry partners compensated for additional uncaught quota, helping the RSA generate over \$68,000 towards the sampling and bycatch avoidance program. Some of the funds generated in late 2016 will allow for sampling in 2017, when the awarded RSA quota will likely be harvested late in the calendar year.

**Rhode Island** Division of Fish & Wildlife conducts a Seasonal Trawl Survey to develop abundance indices for Atlantic herring. Fishery-independent monitoring for 2015-2016 suggested a recent increase in relative biomass and abundance of Atlantic herring in Rhode Island waters in the spring component of the RIDFW seasonal trawl survey (2016, 3.82 kg/tow, 189.88 fish/tow; 2015, 0.92 kg/tow, 27.90 fish/tow). Atlantic herring are rarely observed in the fall component of the survey, but are not uncommon in the spring.

**Connecticut** Department of Energy and Environmental Protection monitors Atlantic herring through the Long Island Sound Trawl Survey (LISTS), which is conducted each spring and fall since 1984. The spring abundance index was 0.69 fish/tow for both 2015 and 2016, which is 51% below the previous 10 year average. Few herring are caught in the fall survey, and most Atlantic herring taken in LISTS spring survey are greater than 20 cm fork length. It is believed that juvenile Atlantic herring are a significant component of the LIS forage base despite low survey indices of adults.

**New York** has *de minimis* status and does not conduct directed monitoring of Atlantic herring. Western Long Island Juvenile Striped Bass Survey and Peconic Estuary Small Mesh Trawl Survey encounter juvenile Atlantic herring with great variance from year to year, but does not routinely summarize the data. However, the information can be prepared at the request of management.

### **New Jersey**

New Jersey Division of Fish and Wildlife monitors Atlantic herring through the New Jersey Ocean Trawl Survey, which collects samples during five surveys conducted throughout the year between Sandy Hook, NJ and Cape Henlopen, Delaware. In 2016, 869 pounds, or 3,556 individual Atlantic herring were caught.

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

Amendment 3 to the Interstate Fishery Management Plan for Atlantic Herring lists the following state regulatory requirements:

1. Each jurisdiction shall prohibit the landing of herring when the management area sub-ACL has been attained.
2. Vessels are prohibited from landing more than 2,000 lbs. of Atlantic herring from Area 1A when the fishery is closed, during a 'day out' or during spawning closures.
3. Jurisdictions will close the directed fishery when 92% of a management area's sub-ACL is projected to be harvested.
4. Each jurisdiction must enact spawning area restrictions that are at least as restrictive as those in Section 4.2.6.
5. States adjacent to Area 1A will implement days out restrictions as identified in Section 4.2.4.1.
6. States are required to implement weekly reporting by all non-federally permitted fishermen on Atlantic herring (including mobile and fixed gear).
7. Any herring vessel transiting a management area that is under a herring spawning closure or a 'day out' must have all of its fishing gear stowed.
8. The harvest of herring for the primary purpose of reduction to meal or meal-like product is prohibited.
9. Internal Water Processing operations will be prohibited from processing herring caught in all state waters.

## **VII. PRT Recommendations**

### **State Compliance**

All states are required to submit annual compliance reports by February 1.

All states with a declared interest in the management of Atlantic herring have submitted compliance reports and have regulations in place that meet or exceed the requirements of the Interstate Fisheries Management Plan for Atlantic herring as described in Amendment 3.

There is a PRT request for the following information to be included in next year's compliance reports:

- **All states:** Provide a web link to the regulations

### **Request for *De Minimis* Status**

A state may be eligible for *de minimis* status if its combined average of the last three years of commercial landings (by weight) constitute less than one percent of the coastwide commercial landings for the same three-year period.

New York has requested and met the requirements for *de minimis* status in 2017. Landings have averaged 0.06% of the coastwide landings since 2014. New York landed 116,982 lbs in 2014; 128,596 lbs in 2015; and 72,538 lbs in 2016.

## VIII. Law Enforcement Report

There were no law enforcement concerns in 2015-2016.

## IX. Future Compliance Issues

None.

## X. 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 a fishery-independent estimation of 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.

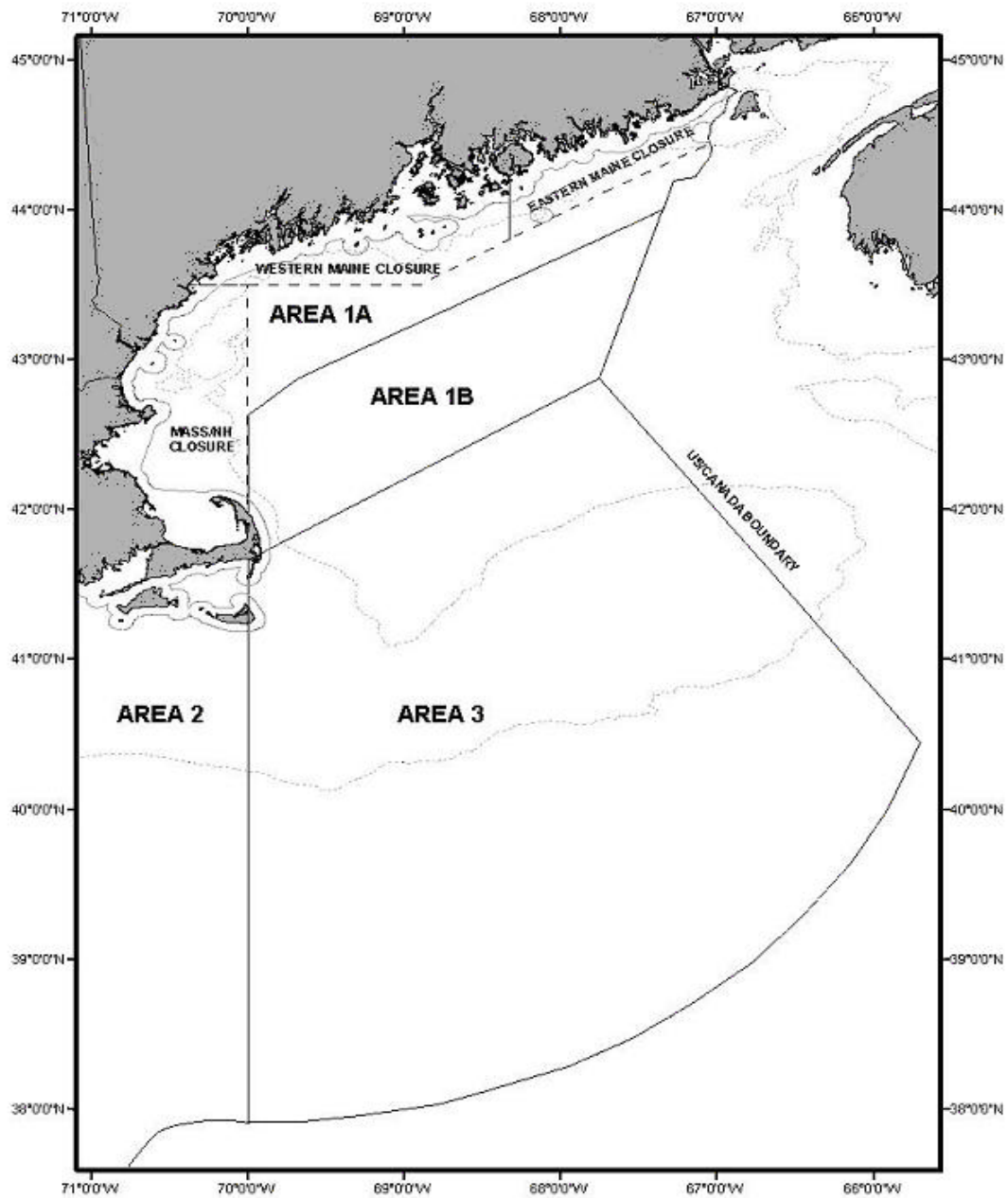
*Low*

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

Atlantic 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).

## XI. Figures



**Figure 1. Map of Atlantic herring management areas with boundaries and the three spawning areas are within Area 1A, the inshore region of Gulf of Maine.**

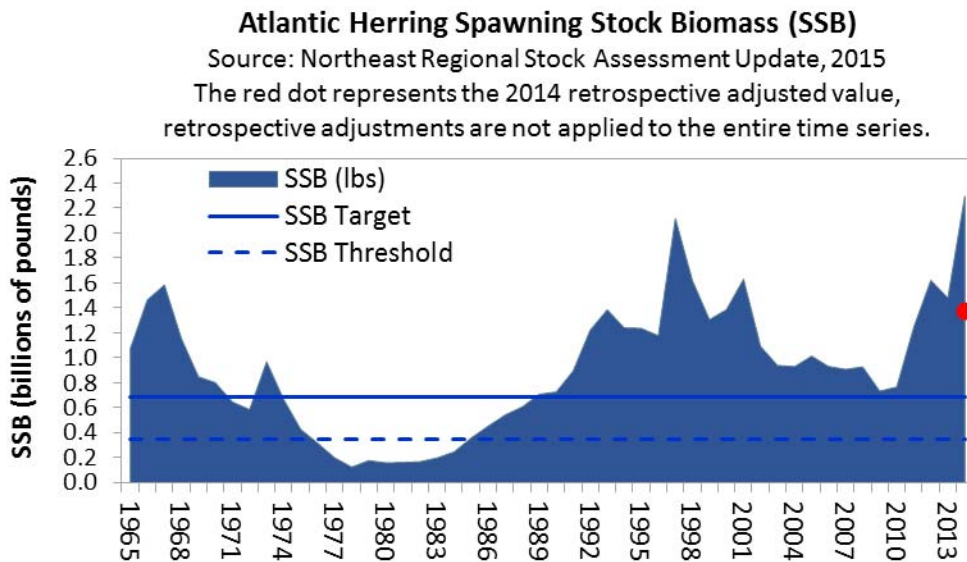


Figure 2. Spawning stock biomass from 1965 to 2014.

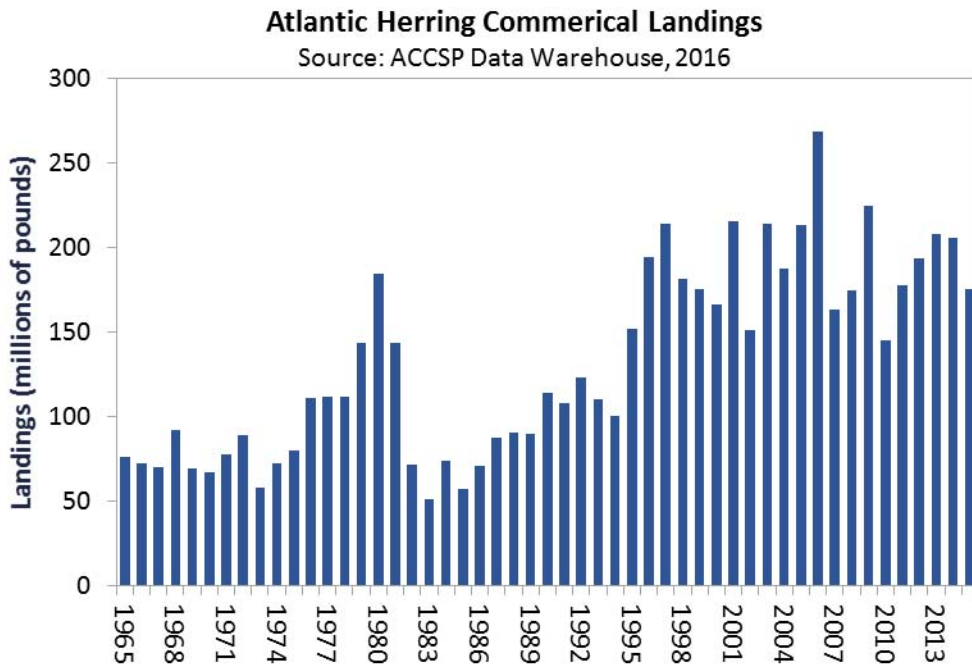


Figure 3. Commercial Atlantic herring landings by the U.S. fleet from 1965-2015