

Fishermen's Insights into River Herring Population Trends, Fisheries, and Restoration, from Maine to South Carolina



**Julia Beaty
Dan Kircheis**

**National Marine Fisheries Service
Protected Resources Division**

Orono, Maine

Dan.kircheis@noaa.gov

207-866-7320

About the National Marine Fisheries Service

The National Marine Fisheries Service (NMFS) is an agency within the National Oceanic and Atmospheric Administration (NOAA), under the United States Department of Commerce. NMFS is tasked the stewardship of living marine resources off the United States coasts. NMFS works to ensure productive and sustainable fisheries, safe sources of seafood, recovery and conservation of protected species, and healthy marine ecosystems. NMFS works to prevent overfishing, rebuild fish stocks, and provide economic benefits and opportunities for commercial, recreational, and subsistence fishing. NMFS derives authority from the Magnuson-Stevens Fishery Conservation and Management Act, the Endangered Species Act, the Marine Mammal Protection Act, and other statutes.

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INTRODUCTION

River herring

Alewives (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) are two closely related fish species in the herring family (figure 1). They are anadromous fish, which means they spend most of their lives at sea but spawn in fresh water. The two species are collectively referred to as river herring. Many people refer to them simply as “herring”. In Rhode Island, some call them buckeyes. In Maryland, Delaware, and Virginia, alewives are sometimes called branch herring and bluebacks are sometimes called glut herring or May herring. Some Virginians refer to alewives as cold water herring. Both species can be easily mistaken for American shad, hickory shad, or Atlantic herring.



River herring leap in a stream in Franklin, Maine.
Photo by Julia Beaty.

Alewives and blueback herring are both widely distributed throughout the east coast of the United States. Alewives can be found from Labrador and Newfoundland to North Carolina. Bluebacks can be found from Nova Scotia to the St. John’s River in Florida (Munroe 2002, ASMFC 2012).

River herring play important roles in coastal and marine ecosystems. They deliver marine-derived nutrients to freshwater and terrestrial ecosystems during their spawning migrations and they are a seasonally important prey species for many predators from the land, air, and sea (Durbin et al. 1979, Munroe 2002, MacAvoy et al. 2009). Both species have supported commercial, recreational, and sustenance fisheries throughout their range. They have been

“Obviously it’s an extremely important food source to have out there for other commercially viable fisheries. It starts with that. It starts with the primary food source.”

Recreational fisherman from New Hampshire

harvested for a variety of uses, including food, bait, and fertilizer (Munroe 2002). In recent years, river herring fisheries have been prohibited in many east coast states in response to declining river herring abundances (table 1). These closures ended centuries-long traditions of catching river herring in the spring for food, profit, and sport. As of 2015, only Maine, New Hampshire, New York, and South Carolina allowed limited fisheries for

river herring.

Abundances of both alewives and bluebacks have declined throughout their range due to a combination of impaired access to spawning habitat, overfishing, pollution, predation, climate change, and other impacts. The magnitude of these abundance declines has varied on a river-by-river basis, which poses challenges for population-wide assessments of river herring. Additionally, the factors that regulate their abundance at sea, where they spend the majority of their lives, are poorly understood. Much remains unknown about coast-wide population trends and threats to recovery (ASMFC 2012, USOFR 2013).

Table 1: A summary of the status of river herring fisheries from Maine to South Carolina as of early 2015.

State	Status of river herring fisheries
Maine	Commercial, recreational, and personal use fishing allowed on a town-by-town basis
New Hampshire	Commercial, recreational, and personal use fisheries allowed with river-specific regulations
Massachusetts	Total moratorium since 2005, with the exception of tribal fishing
Rhode Island	Total moratorium since 2006
Connecticut	Total moratorium since 2002
New York	Commercial, recreational, and personal use fishing allowed only in Hudson River and its tributaries
New Jersey	Total moratorium since 2012
Delaware	Total moratorium since 2012
Maryland	Total moratorium since 2012
Virginia	Total moratorium since 2012
North Carolina	Moratorium since 2007, small “discretionary harvest” allowed until 2014
South Carolina	Commercial, recreational, and personal use fisheries allowed

Figure 1: A blueback herring (top) and an alewife (bottom). Photo by Chris Bartlett.

Blueback herring *Alosa aestivalis*

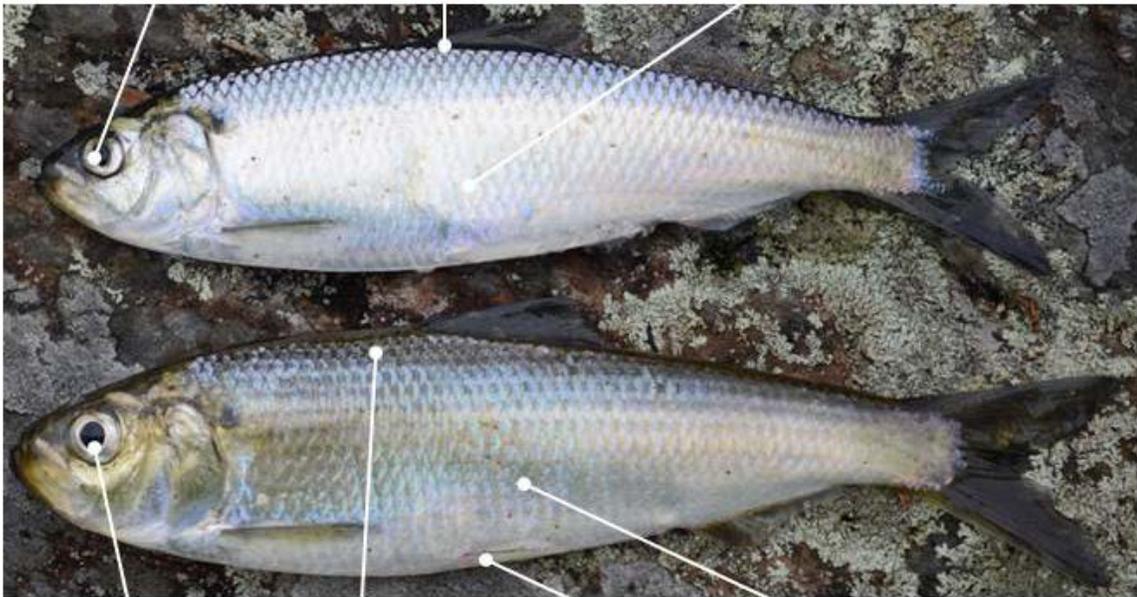
Also known as glut herring or May herring

Eye diameter smaller than snout length

Dark blue coloration on back, fades quickly after death

Lining of inner body cavity dark black or brown (not shown)

Often smaller than alewives



Eye diameter greater than snout length

Usually green coloration on back, fades quickly after death

"Fuller" body shape than blueback

Lining of inner body cavity pale in color (not shown)

Often larger than blueback herring

Alewife *Alosa pseudoharengus*

Also known as branch herring or cold water herring

Motivation for this survey effort

Scientists, fisheries managers, and environmental advocates have become increasingly aware of the ecological importance of river herring in recent years. Several studies have highlighted the importance of river herring as prey for many predators, including charismatic species such as the endangered Atlantic salmon (Saunders et al. 2006) and the iconic Atlantic cod (Ames and Lichter 2013). Special management considerations for forage species are now recognized as an important part of ecosystem-based fisheries management (Pikitch et al. 2012).

Environmental organizations have pushed the National Marine Fisheries Service (NMFS) to protect river herring by listing them as endangered or threatened under the Endangered Species Act (NRDC 2011). In 2013 NMFS stated that neither alewives nor blueback herring warranted listing as endangered or threatened based on the information available at the time; however, the agency also acknowledged that further research and expanded monitoring efforts are needed to address current data gaps and scientific uncertainty (USOFR 2013). NMFS considers both alewives and blueback herring to be “Species of Concern” (NMFS 2009).

Much research is being carried out to better understand the various factors that may affect the recovery of these species throughout the east coast (NMFS 2014, DSRRN 2014). In light of this heightened concern for and research focus on river herring, we carried out a survey to assess an important but often overlooked aspect of fisheries science: fishermen’s¹ knowledge.

Many studies have documented the value of fishermen’s observations and local knowledge to fisheries science (Huntington 2000, Hind 2015). To be successful at their trade, fishermen must understand the behavior of the fish they catch. Those who fish over many years build up a vast store of knowledge based on trial and error and careful observation. These individuals are well positioned to notice changes in local fish populations through time. More than a few studies have documented examples of fishermen observing changes in fish stocks before those changes could be detected in data collected by biologists (e.g. Johannes et al. 2000, Holm 2003, Gilchrist et al. 2005). Fishermen’s knowledge can be very valuable to fisheries scientists and managers seeking to better understand why declines in fish abundances take place and how to best restore fish abundances to historic levels. In order to better understand the changes in river herring abundances and impediments to recovery at a local level, we knew it would be necessary to reach out to those who have the most intimate knowledge of the fish in their local areas: the commercial, recreational, and sustenance fishermen.

¹ Throughout this report, “fishermen” is meant to describe all individuals who catch river herring, regardless of gender.

The goals of this survey were to:

- Document fishermen's observations of river herring in their local areas, including their observations of changes in run timing, the size and abundance of river herring, and other aspects of the runs;
- Identify local threats to river herring,
- Document fishermen's opinions on the best ways to restore their local river herring runs, and
- Identify future research needs.

METHODS

Defining potential survey respondents

We aimed to capture a diversity of perspectives and opinions on river herring, the threats they face, and how to restore their populations. Potential respondents for this survey included all individuals in the coastal states from Maine to South Carolina who harvested river herring commercially, recreationally, or for personal use at any point in time between 1994 and 2014.² We chose to survey individuals from Maine and South Carolina because these states represent the northern and southern boundaries of the current range of river herring in the United



States (ASMFC 2012). We assumed that the timeframe of 1994-2014 would be long enough for survey respondents to have noticed changes in river herring runs and also recent enough that their responses would be minimally impacted by normal memory loss.

Potential survey respondents included individuals who caught river herring for profit, recreation, food, bait, sustenance, and other uses. We sought to survey both tribal members and non-tribal fishermen.

² We allowed some exceptions to this timeframe. A few individuals who had not caught a river herring in more than 20 years expressed interest in participating in this survey. In these cases the interviewer briefly summarized the questions and asked the interested individuals if they thought their memories were reliable enough to answer most of the questions. If they said yes, the interviewer proceeded with the survey.

Identifying potential survey respondents

The call list that we used for this survey contained 1637 potential survey respondents (table 2). We obtained most of these names and associated phone numbers (representing 1434 individuals, 88% of the total) through a data request to the Atlantic Coastal Cooperative Statistics Program (ACCSP). The ACCSP sent us the names and phone numbers of any individuals who reported landing at least one river herring between 1994 and 2014. This included individuals who held a fishing license specifically for river herring as well as those who fished under a general fishing license and those who reported catching at least one river herring while targeting other species. The ACCSP's databases are built from data provided by state agencies. Because each state in the survey area had different requirements for reporting catches of river herring and different policies regarding the release of names and phone numbers, the ACCSP provided more names and phone numbers from some states than from others. For example, the ACCSP provided the names and phone numbers of hundreds of individuals from New York, North Carolina, and Virginia, but only one individual from Massachusetts (table 3). These numbers are not reflective of the relative amounts of fishing effort for river herring in each state, but rather are reflective of different catch reporting requirements and data sharing policies.

We contacted every relevant state natural resource management agency in the survey area to discuss possibilities for identifying additional potential survey respondents to supplement the list provided by the ACCSP. Six state agencies collectively provided 117 additional names and numbers from their own databases.³ One town natural resource department (Town of Barnstable, Massachusetts) provided 14 additional names and numbers.

Between the ACCSP, state agencies, and town natural resource departments, we obtained a total of 1557 names and associated phone numbers. This information was all compiled from fishing license lists. Our conversations with state natural resource managers led us to believe that this list had significant gaps in coverage from some states (table 3), and so we made many efforts to supplement this list through other methods.

Employees of tribal natural resource departments provided recommendations for tribal members to include on the call list. We contacted 7 federally recognized tribes and 18 state recognized tribes to request assistance identifying potential survey participants (see Appendix B for a list of the Tribes we contacted). These efforts resulted in the addition of five individuals to the call list. The lists provided by the ACCSP and state agencies may have included tribal

³ The following state agencies provided names and phone numbers to supplement the data provided by the ACCSP: Delaware Department of Natural Resources and Environmental Control, Maine Department of Marine Resources, Maryland Department of Marine resources, New York Department of Environmental Conservation, North Carolina Department of Marine Fisheries, and Virginia Marine Resources Commission.

members who fished for river herring under non-tribal fishing licenses. We do not know how many, if any, of these individuals were on the final call list.

We made many efforts to spread announcements about the survey through outlets likely to be visible to potential survey respondents. These methods increased awareness about the survey among individuals on the call list and also reached potential respondents who were not yet on the call list. Announcements included short summaries of the questions we would ask, who we wished to survey, and how to contact us to participate or to learn more. Announcements were spread through a NOAA webpage, emails to several individuals and organizations, fliers, presentations at meetings, blog posts, local newspapers, fishing magazines, and one-on-one conversations (Appendix B). These efforts began about two months in advance of the survey and continued until we finished collecting survey responses. Many of the venues through which we spread announcements were suggested by survey participants. Several newspapers and online blogs shared announcements about the survey without our knowledge, thus we are unsure of the total number of outlets through which announcements were spread. As a result of these efforts to raise awareness about the survey, 34 additional potential survey respondents contacted us and were added to the call list.

In the process of completing the survey, several survey respondents recommended friends, family members, and acquaintances. Their recommendations resulted in the addition of 20 names and associated phone numbers to the call list.

Table 2: The number and sources of potential survey respondents on the final call list.

Source of names and phone numbers	Number of individuals contributed to call list
Atlantic Coastal Cooperative Statistics Program (ACCSP)	1434
State natural resource management agencies	117
Announcements in emails, newspapers, magazines, fliers, blog posts, etc.	34
Recommendations of other survey respondents	20
Town natural resource management agencies	14
Recommendations through one-on-one conversations about the survey	13
Tribal natural resource management agencies	5
Total potential survey respondents on final call list	1637

Table 3: The number of individuals on the final call list, grouped by state and by source from which we obtained the names and phone numbers. The “representativeness of call list” column summarizes our assumptions about how well the final call list represented the actual population of commercial, recreational, and personal use river herring fishermen from each state. These assumptions are based on our conversations with state natural resource managers.

State	Names and phone numbers from license lists	Names and phone numbers from other sources	Total number of potential respondents	Representativeness of call list
Maine	72	3	75	Commercial: high Recreational: low Personal use: low
New Hampshire	0	10	10	Low for all use types
Massachusetts	15	20	35	Low for all use types
Connecticut	2	7	9	Low for all use types
Rhode Island	1	8	9	Low for all use types
New York	275	6	281	High for all use types
New Jersey	3	9	12	Low for all use types
Pennsylvania	2	1	3	Low for all use types
Delaware	46	1	47	Low for all use types
Maryland	73	4	77	Commercial: moderate Recreational: low Personal use: low
Washington D.C.	0	1	1	Low for all use types
Virginia	296	3	299	Commercial: high Recreational: low Personal use: low
North Carolina	754	7	761	Commercial: high Recreational: low Personal use: low
South Carolina	18	0	18	Low for all use types
Total	1557	80	1637	

The survey script

The interviewer (Julia Beaty) used a standardized script when speaking with potential survey respondents. The script included a description of the intent of the survey, questions to verify that potential respondents had caught river herring in the past, and a statement to inform them that we could make no promises of confidentiality or anonymity of their survey responses. The interviewer proceeded with the question list if the potential respondent agreed to all of these conditions.

The survey questions were chosen to address topics related to NMFS' efforts to assess, monitor, and restore river herring runs throughout the east coast. The questions asked about the respondents' fishing practices, about their observations of certain aspects of local river herring runs, and about their thoughts on how to restore river herring populations (see Appendix A for the full question list). Most survey questions were open-ended to encourage participants to answer the questions as they saw fit. This allowed us to capture much more detail than if we had asked multiple choice questions. Respondents were encouraged to ask questions of the interviewer and to discuss topics not addressed by survey questions.

We ran a trial run of the survey script with six river herring fishermen. We asked for feedback on how to improve both the introductory explanations about the survey and the wording of the survey questions. The first four individuals to pre-test the survey script were fishermen from Maine who were already familiar with the interviewer and with the intent of the survey. At the beginning of the call the interviewer stated that she was doing a trial run and encouraged them to interrupt her when they had comments. We modified the survey script based on their suggestions. We then tested the survey with a fifth individual who contacted us after seeing an online announcement about the survey and with a sixth individual whose name and phone number were provided the ACCSP and who had no prior knowledge of the survey. The interviewer did not inform these two individuals that they were being called as part of a trial run. She asked both to provide suggestions at the end of the call. Both stated that the script was clear and easy to understand and recommended no changes.

Contacting potential respondents and collecting survey responses

We attempted to contact all individuals on the final call list from all states in the survey area except for North Carolina. The final call list contained 759 potential survey respondents from North Carolina, representing almost half of the total call list. We attempted to contact a randomly selected subset of 300 potential respondents from North Carolina. We decided to select 300 individuals because this was approximately the number of individuals on the call list from Virginia, the state with the second highest representation on the final call list.

We made at least one attempt to contact potential survey respondents. We made two attempts to contact individuals from states which contributed fewer than 50 individuals to the final call list (table 3).

The interviewer called potential survey respondents between 4:00 pm and 8:00 pm on weekday evenings from September 2014 through January 2015. She left messages when possible. When individuals expressed interest in doing the survey at a later date, the interviewer called back at the suggested date and time. She encouraged all respondents to do the survey over the phone but sent paper and electronic versions of the survey to individuals who requested them. Paper surveys were sent with a postage-paid return envelope.



River herring destined for use as lobster bait in Maine. Photo by Julia Beaty.

The interviewer asked each survey respondent for permission to record their conversation. If the respondent did not give permission to record, the interviewer documented his or her responses by taking notes and informed the respondent that she was doing so. A few respondents began to talk about river herring before the interviewer could ask for permission to record the conversation. In some cases she did not wish to interrupt these respondents to ask for permission to record and so she only used notes to document their responses.

The interviewer typed responses into an electronic form as each respondent spoke. We used this form to create a spreadsheet with all survey responses. We used the recordings to clarify the meaning of the notes in the spreadsheet when necessary. We also used the recordings to transcribe some quotes verbatim. We only transcribed quotes we thought illustrated key points or were otherwise noteworthy. We did not transcribe the full conversations. We stored the recordings until this report was finalized, after which point we deleted the recordings. This step was taken to protect respondents' information from possible future misuse. The recordings contained information such as respondents' names and home addresses. Rather than edit out this personal information, we decided to delete the recordings.

Analyzing survey responses

Survey responses were analyzed using Microsoft Excel and R (R Foundation for Statistical Computing 2013). Responses were examined in groupings based on the state where respondents fished, their primary use of river herring, the time period during which they fished, and other factors.

RESULTS

Response rate

We called a total of 1179 individuals, 188 of whom successfully completed the survey (table 4). The majority of survey respondents (133 individuals, 71% of the total) were identified from fishing license lists. About 30% of respondents (57 individuals) either contacted us after seeing an announcement about the survey or they were recommended to us.

The states which provided names and phone numbers for potential respondents (either directly or through the ACCSP) generally had higher numbers of responses, but lower response rates, than the states from which we obtained the majority of names and phone numbers by other means (tables 3 and 5).

Table 4: A summary of the outcomes of our attempts to contact potential survey respondents. We attempted to contact many individuals more than once. In those cases, the data below summarize the outcome of the final attempt at contact.

Outcome of call	Number of instances	Percentage of all call attempts
Wrong number or number out of service	222	19%
Deceased	12	1%
No answer or individual not home; if left message, individual did not call back and complete survey	605	51%
Individual did not meet survey criteria	102	9%
Individual interested but busy at time; did not successfully complete survey	23	2%
Individual met survey criteria but refused to participate	22	2%
Individual requested a paper or electronic version of survey but did not send back completed survey	5	0.4 %
Individual successfully completed survey	188	16%
Total	1179	

Table 5: Survey response rate by state.

State	Number of individuals called	Completed surveys	Response rate
Maine	75	19	25%
New Hampshire	10	8	80%
Massachusetts	34	16	47%
Connecticut	9	5	56%
Rhode Island	9	8	89%
New York	280	57	20%
New Jersey	12	7	58%
Pennsylvania	3	1	33%
Delaware	47	7	15%
Maryland	77	17	22%
Washington D.C.	1	1	100%
Virginia	299	21	7%
North Carolina	303	18	6%
South Carolina	18	3	17%
Total	1177	188	16%

Respondents' fishing practices

We asked all survey respondents to state whether they identified primarily as commercial, recreational, or personal use harvesters of river herring. For the purposes of this survey, we defined “commercial fishermen” as men and women who either directly or indirectly made a profit from the river herring they caught. This included respondents who sold river herring to bait shops, restaurants, and to individuals, as well as respondents who used them as bait when fishing commercially for other species, and those who used them as bait while operating a charter fishing business. We defined “recreational fishermen” as those who fished for river herring for pleasure and those who fished for river herring for bait to catch other fish for pleasure. We defined “personal use fishermen” as those who caught river herring primarily for personal consumption. We distinguished between “personal use” and “recreational” fishermen because we assumed that individuals who fished for river herring only for consumption would tend to harvest different amounts of river herring over different time periods than recreational fishermen. This proved to be an accurate assumption, at least in some cases. For instance, some respondents who identified as recreational fishermen said they would not fish for river herring until the first striped bass showed up in the spring, which was usually after the first river herring arrived, and they would only catch enough to use as live bait for striped bass. A few respondents who fished for personal use said they only caught enough river herring to pickle for their own consumption and to give to friends and family members. These individuals caught river herring whenever it was convenient for them to do so.

It quickly became apparent that the phrase “personal use” caused some confusion and so when respondents stated that they considered themselves to be personal use harvesters, the interviewer asked how they used river herring. Those who said they used river herring primarily for bait for commercial or recreational fishing and were re-classified accordingly.

The interviewer asked respondents who listed more than one category (55 individuals, 30% of the total) to choose a primary use type. A slight majority of respondents identified primarily as commercial harvesters of river herring (99 individuals, 53% of the total). About 40% of respondents (74 individuals) said they were primarily recreational harvesters. About 8% of respondents (15 individuals) harvested river herring primarily for personal use (figure 2). The

“[I’ve been fishing for them] all my life. And my parents did. And my grandparents did. That’s what we lived off of. We couldn’t wait for the time to come, early spring.”

*Personal use fisherman from
Massachusetts*

The number of respondents in each of the three use categories varied by state. A high percentage of respondents from New Hampshire, New York, Connecticut, and Rhode Island fished primarily

for recreation. A high percentage of respondents from Maine, Delaware, Maryland, Virginia, and the Carolinas were primarily commercial fishermen (figure 3).

Our efforts to supplement the call list with individuals identified through methods other than fishing license lists yielded more recreational fishermen than commercial or personal use fishermen (figure 4).

Figure 2: The percentage of survey respondents who stated that they identified primarily as commercial, recreational, or personal use fishermen of river herring.

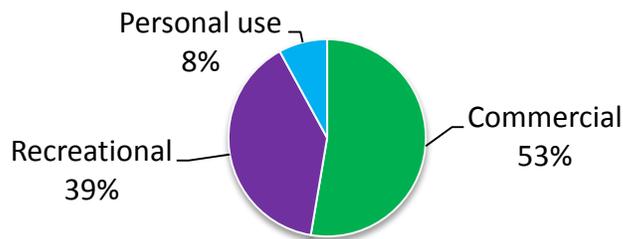


Figure 3: The number of respondents by state who identified as primarily commercial, recreational, or personal use fishermen of river herring.

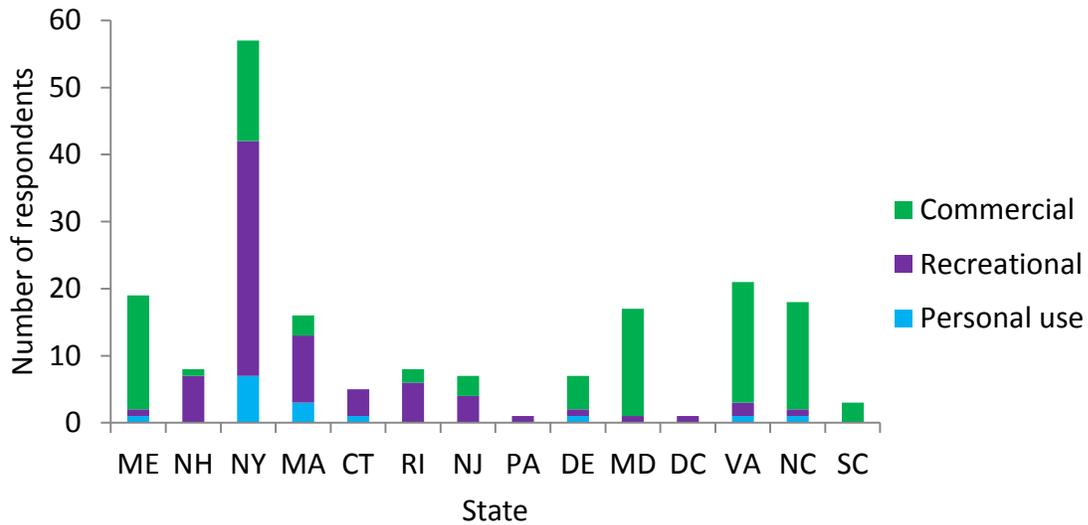
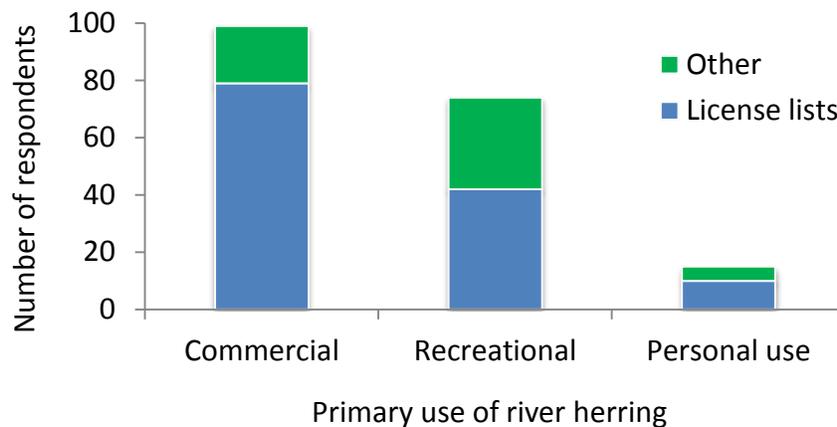


Figure 4: The number of respondents by use category who were identified through fishing license lists or through other sources.



20 survey respondents (11% of the total) said they did not target river herring but frequently caught them while fishing for other species.⁴ These respondents all identified primarily as commercial fishermen. Some considered river herring to be a valuable byproduct which they retained for consumption or sold for supplemental income. Others attempted to avoid river herring as much as possible but still caught some on a regular basis.

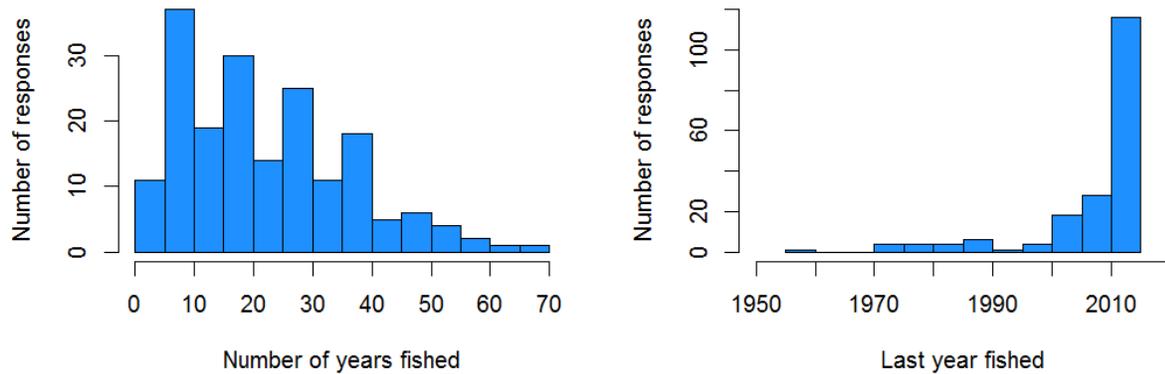
Survey respondents had fished for river herring for as few as three and as many as 70 years. Respondents caught river herring over an average of 24 years (figure 5). About half of the respondents (95 individuals) had not caught a river herring in at least three years, in most cases due to moratoria in their home states (figure 5, table 1).

Respondents who identified primarily as recreational fishermen tended to have fished for river herring for a shorter amount of time (20.3 years, on average) than those who were primarily commercial (26.1 years on average) or personal use (26.6 years on average) fishermen. The most recent year that respondents had fished for river herring was similar across the three use type categories (2007 on average for commercial fishermen, and 2009 on average for both recreational and personal use fishermen).

T-tests revealed no significant difference in the number of years that respondents who were identified from license lists had fished for herring compared to respondents identified through other methods ($p=0.5$); however, respondents who were identified from license lists tended to have fished for river herring more recently (the last year that this group fished for river herring was, on average, 2009) than those who were identified through other methods (who, on average, last fished for river herring in 2004; $p = 0.02$).

⁴ Incidental catch was not directly addressed by any of the survey questions (Appendix A) and so the total number of respondents who caught river herring primarily as incidental catch may be greater than 20.

Figure 5: Left: the number of years that respondents fished for river herring. Right: The most recent year in which respondents fished for river herring.



Survey respondents used many different types of fishing gear to catch river herring. Many respondents (76 individuals, 40% of the total) fished for river herring with more than one type of gear. The most common gear types were gill nets (used by 51% of respondents), hook and line (used by 31% of respondents), dip nets (used by 23% of respondents), cast nets (used by 10% of respondents), scap nets (used by 10% of respondents), and pound nets (used by 9% of respondents; figure 6).

Most respondents (172 individuals, 91% of the total) fished for river herring in rivers and streams. Several fished in coastal and marine environments (figure 7). Many fished in more than one type of habitat (44 individuals, 23% of the total). We did not ask survey respondents to describe their fishing locations in detail. In most cases we do not know anything about the size, salinity, and tidal regime of the water bodies where respondents fished for river herring.



A tidal weir used to harvest river herring in Orland, Maine.
Photo by Julia Beaty.

Figure 6: The gear types used by survey respondents to catch river herring. Many respondents (76 individuals, 40% of total) listed more than one type of gear.

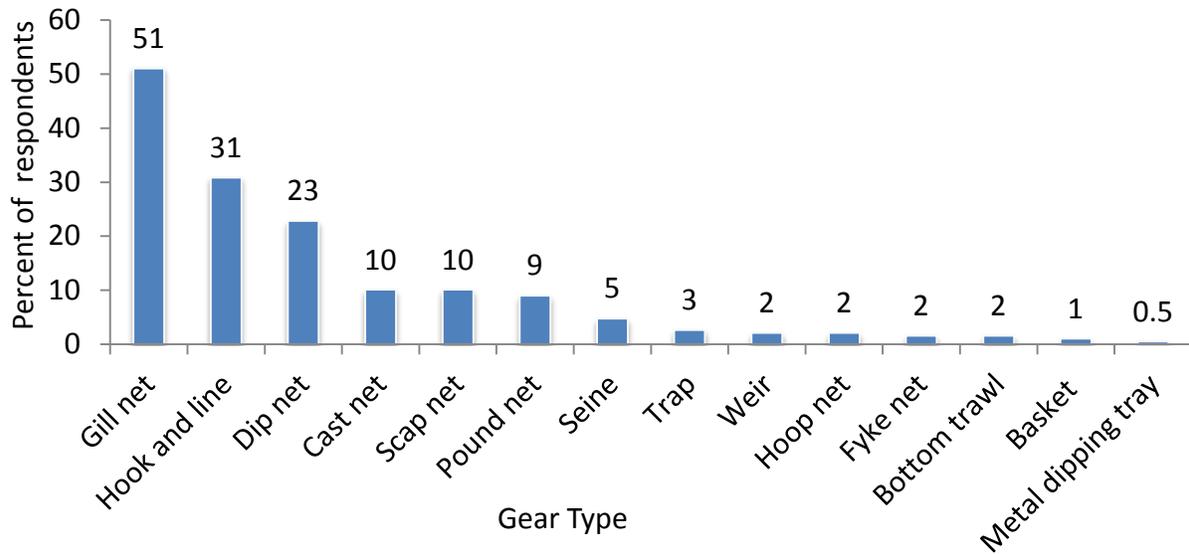
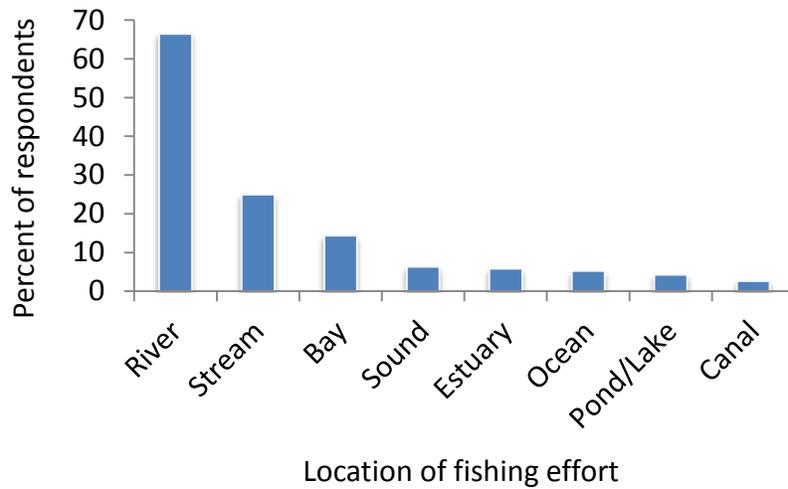


Figure 7: The locations of respondents' fishing efforts for river herring. Several respondents (44 individuals, 23% of total) listed more than one habitat type.



Do respondents distinguish between alewives and bluebacks?

We asked all survey respondents, with the exception of those who fished only in South Carolina, whether they distinguished between multiple different types of river herring. We did not ask respondents from South Carolina this question because alewives are not found in South Carolina (ASMFC 2012). Most survey respondents (120 individuals, 64% of the total) distinguished between alewives and blueback herring, at least some of the time. Most respondents distinguished between the two species based on their size, shape, the timing of their arrival, and the size of and position their eyes (figure 8). Some respondents were not familiar with the names alewife and blueback herring and called them by other local names (table 6). In instances where there was confusion about the names of the fish, the interviewer used the respondents' descriptions of distinguishing features to determine if they were referring to alewives, blueback herring, or another species.

"I can tell the difference by looking at them. For example, the first part of our run is always complete alewives. The last part of the run we start seeing blueback herring mix in...Their bodies are smaller and slenderer. The contour of their head into their belly is different."

Commercial fisherman from Maine

Figure 8: A simplified summary of the types of features used by respondents to distinguish between alewives and blueback herring. Most respondents listed more than one feature.

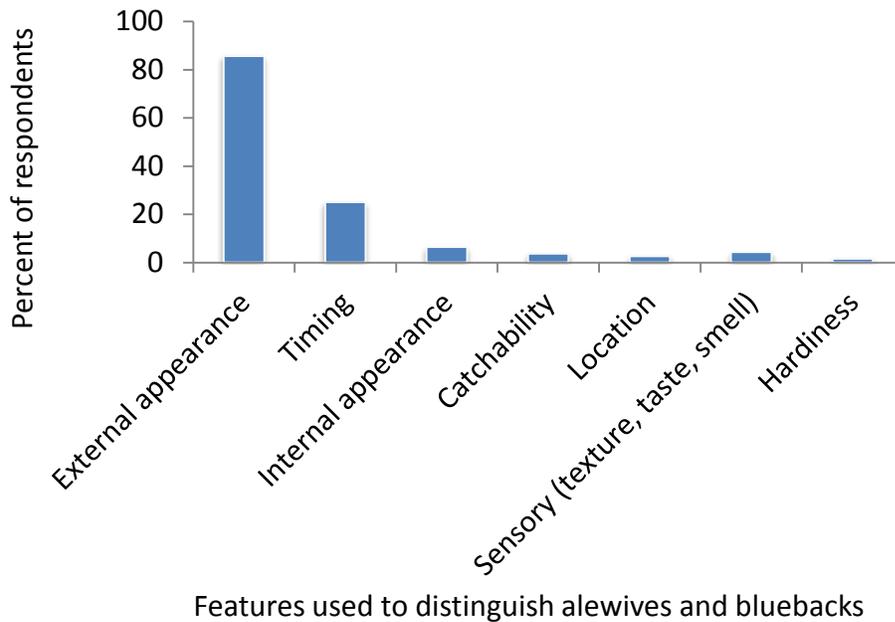


Table 6: A list of local names used by survey respondents for alewives and blueback herring.

Local name for alewife (<i>Alosa pseudoharengus</i>)	Local name for blueback herring (<i>Alosa aestivalis</i>)	States where local name is commonly used
Herring		All coastal states from Maine to South Carolina
Buckeyes		Rhode Island
Branch herring		Maryland, Delaware, Virginia
	Glut herring	Maryland, Delaware, Virginia
	May herring	Maryland, Delaware, Virginia
Cold water herring		Virginia

Table 7: The features used by respondents to distinguish between alewives and bluebacks.

Features used to differentiate alewives and bluebacks	Number of responses
Size	73
Timing	47
External color	31
Body shape	22
Eye	14
Peritoneum color	11
External appearance (not specific)	10
Catchability	7
Location	5
Shape of head	4
Texture	4
Taste	3
Spot	3
Nose	3
Hardiness	3
Mouth	1
Number of bones	1
Smell	1

“I can tell the difference between an alewife and a blueback but it doesn’t make any difference to me. When I catch them it’s a herring... If it was a herring, we put it in the bucket.”

*Commercial, recreational,
and personal use fisherman
from Virginia*

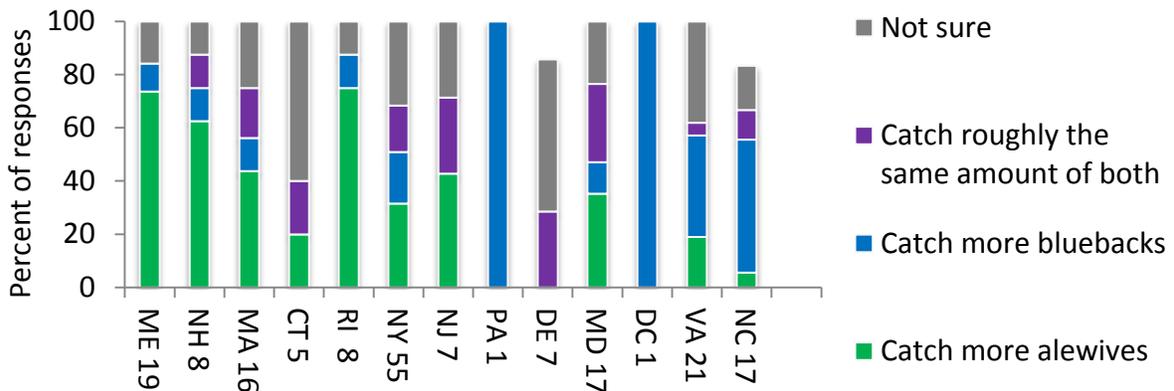
“The alewives don’t hit the herring rig as readily as the bluebacks. The bluebacks will really hit the flies. There’s another method that we use too. We’ll take what they call a stoolie or a stool pigeon, you’ll take a big fake herring, a rubber herring, and you throw it out and you bring it back and the herring will follow it like they’re trying to mate with it. They’ll follow it right into shore and you pull it over a net and you scoop up the herring. We do that mostly with the alewives because they won’t readily hit the herring rigs. The beginning of the year, that’s what most of the people do to catch the alewives. Once the bluebacks come in and they start hitting you don’t bother with the other because you can catch all you want with the herring rig.”

Recreational fisherman from New York

We asked respondents whether they usually caught more alewives or more blueback herring over the course of a year. About 39% of respondents (73 individuals) said they either did not catch more of one than the other or they were not sure. Some said the species they caught more of at any given time depended on where and when they fished and the gear they used. About 35% of respondents (65 individuals) said that over the course of a year they usually caught more alewives and 20% (38 individuals) thought they usually caught more bluebacks.

In general, respondents from northern states tended to catch more alewives and respondents from the southern states tended to catch more bluebacks (figure 9).

Figure 9: Survey respondents’ answers about whether they usually caught more alewives or more blueback herring over the course of a year. The results from some states do not sum to 100% because not all respondents were asked this question. Responses are grouped by state. The total number of survey responses from each state is shown below the X-axis.



The timing of river herring runs

Respondents' observations of the timing of river herring runs were influenced by a variety of factors including fishing regulations which dictated when and where they could fish and their participation in fisheries for other species. Many respondents were not able to observe the beginning and the end of their local river herring runs each year, but they always knew when the runs were the strongest.

Respondents from the states in the northern part of the survey area generally reported later runs than respondents from southern states. Respondents from Maine mostly said that their local river herring runs began between late April and mid May. In North Carolina, on the other hand, most respondents said that their local river herring runs began in March. Within each state, respondents' descriptions of the beginning and end of the runs varied within a few weeks.

When asked about the beginning and end of the river herring runs in their local areas, most respondents stated the months during which they typically caught river herring. Some respondents elaborated by describing other annual occurrences which they associated with river herring. For example, some respondents (12 individuals) associated the timing of river herring runs with a holiday such as St. Patrick's Day, Easter Sunday, Mother's Day, or Memorial Day. Others (10 individuals) mentioned that their local river herring run overlapped with the fishing season for other species such as trout, perch, striped bass, shad, and weakfish. Many respondents (10 individuals) said that river herring first showed up each year around the same time that flowering plants such as dogwood, apple, and cherry trees were in bloom. Others (4 individuals) associated the arrival of river herring with a full moon during a particular month.

Many respondents (73 individuals, 39% of the total) said the timing of the river herring runs in their local areas varied by as much as a few weeks every year based on environmental conditions. For example, 48 respondents (25% of the total) stated that the timing of the arrival of river herring each spring depended on temperature, with runs starting later in colder than average years and earlier in warmer than average years. Some respondents (11 individuals, 6% of the total) thought that the amount precipitation and freshwater runoff influenced the timing of the runs, with the runs starting later during times of heavy rain, high runoff, and low salinity.

"As soon as the striped bass fishing is done, that's when I'm done with them because I can't sell any more at that point."

Commercial fisherman from New York

"Around Easter time they were thick in there, by the millions."

Recreational fisherman from New Jersey

Most respondents (168 individuals, 90% of the total) stated that they had not witnessed any noticeable changes in the timing of river herring runs beyond the normal year-to-year variation. Only eight individuals (4% of the total) reported noticeable changes in timing (figure 10). Those eight respondents did not agree on the direction of the change in run timing. Three respondents said their runs ended earlier in recent years than they had in the past. Two respondents said the runs started later. One respondent said it started earlier. Two said the timing of their runs had become more variable.

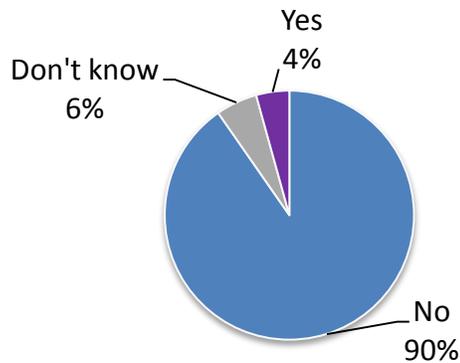
“You can pretty well count on them on the full moon in March.”

Commercial fisherman from South Carolina

“It’s all depending on the water temperature. They’re like clockwork. When that water hits 42 degrees, you see them.”

Recreational and personal use fisherman from New York

Figure 10: A simplified summary of respondents’ answers to the question, “Over the years that you’ve been fishing, have you ever noticed any changes in the timing of when river herring were around?”



Changes in the size of river herring

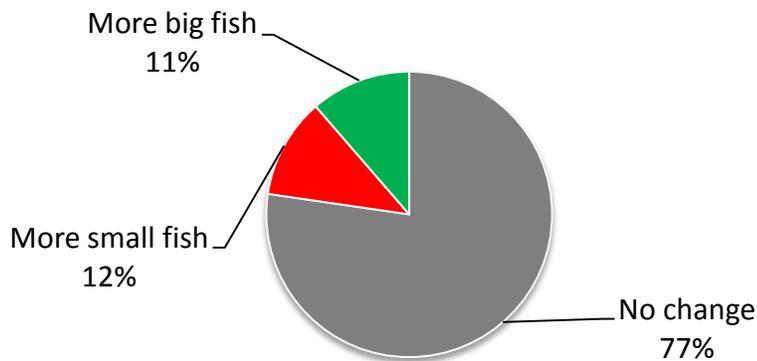
Most respondents (144 individuals, 77% of the total) said they had not noticed any changes in the size of river herring over time. Twenty-one respondents (11% of the total) reported seeing a greater amount of large river herring than in the past. Twenty-one respondents (11% of the total) reported seeing more small river herring (figure 11).

The majority of respondents in each state did not observe changes in the size of river herring over time; however, notable minorities of respondents from Maine (32% of respondents from Maine), New York (21%), and New Jersey (17%) reported increases in the number of large river herring. Notable minorities of respondents from Connecticut (20%), Rhode Island (38%), New Jersey (17%), Virginia (29%), North Carolina (17%), and South Carolina (33%) reported increases in the amount of small river herring over time (figure 12).

“They’re getting bigger. The alewives, they’re like small bass now. They’re huge... I haven’t noticed a big change in the bluebacks.”

Recreational and personal use fisherman from New York

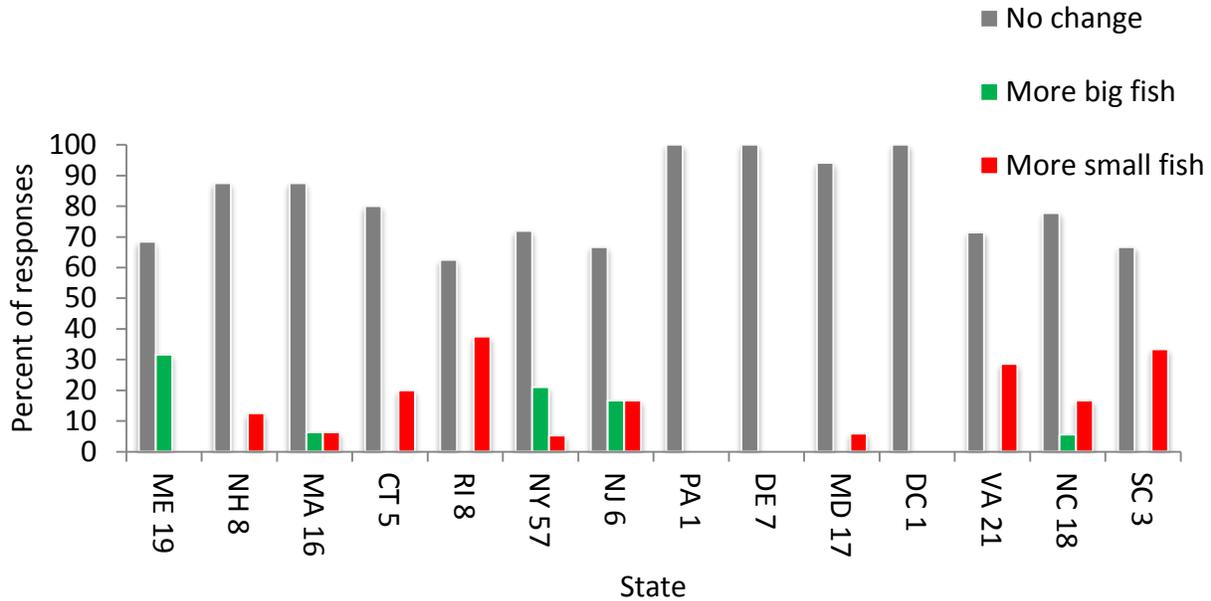
Figure 11: Percentage of all survey respondents who reported seeing more large river herring over time, more small river herring, or no change in the size of river herring.



“They were a lot bigger way back...The gill net we used to fish was a 3 inch and you could barely push those fish through that 3 inch mesh net. But now if you fished a 3 inch you won’t hardly catch any fish, they would just go right through it. You have to fish a 2.5 now. So they’re actually a half an inch smaller fish than they were back, I would say 10 years ago.”

Commercial fisherman from South Carolina

Figure 12: Respondents answers to the question, “Over the years that you’ve been fishing, have you noticed any changes in the size of the individual river herring?” Responses are summarized as the percentage of all responses from each state. The numbers of responses (to this question only) from each state are shown below the state abbreviations on the x-axis.



Changes in the local abundance of river herring

Most respondents (103 individuals, 55% of the total) saw a decrease in abundances of river herring during their lifetimes; however, almost a quarter of those who reported a decline overall (24 individuals, 13% of the total) said they saw an increase in abundance in recent years, though not to the relatively high levels they had seen in the past (figure 13).

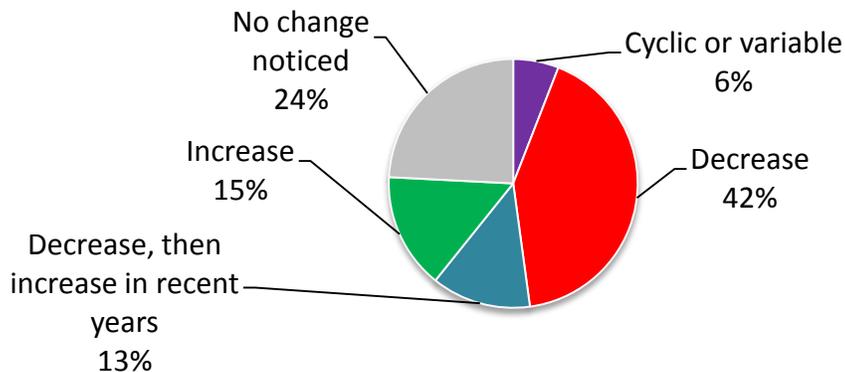
Respondents from most states, especially those from New Hampshire, New York, and Maryland, did not show high levels of agreement on the direction of abundance changes. Respondents from North Carolina and Virginia largely agreed that river herring abundances had declined. Many respondents from Maine reported an increase in abundances (figure 14).

Respondents who reported an increase in abundance tended to have fished for river herring more recently and for a shorter time period than those who reported a decrease in abundance (table 8). Most of the respondents who fished for river herring for at least 50 years reported a decrease in the abundance of river herring over time (11 of the 14 respondents who had fished for at least 50 years).

A chi-square test found significant differences ($p = 0.011$) in respondents’ answers about abundance changes based on their primary use category. Commercial fishermen were more

likely to report both increases and decreases in abundance compared to the other two use categories (figure 15). A chi-squared test found no significant differences ($p = 0.37$) in respondents answers about abundance changes based on whether they were identified through fishing license lists or other methods.

Figure 13: A simplified summary of respondents' answers to the question, "Over the years that you've fished for river herring, have you noticed any changes in their overall abundance?"



"I can tell you compared to the '50s and '60s, they're poor compared to that. But they seem to be on an even keel...I'd say they're holding their own. They're surviving."

Commercial, recreational, and personal use fisherman from Virginia

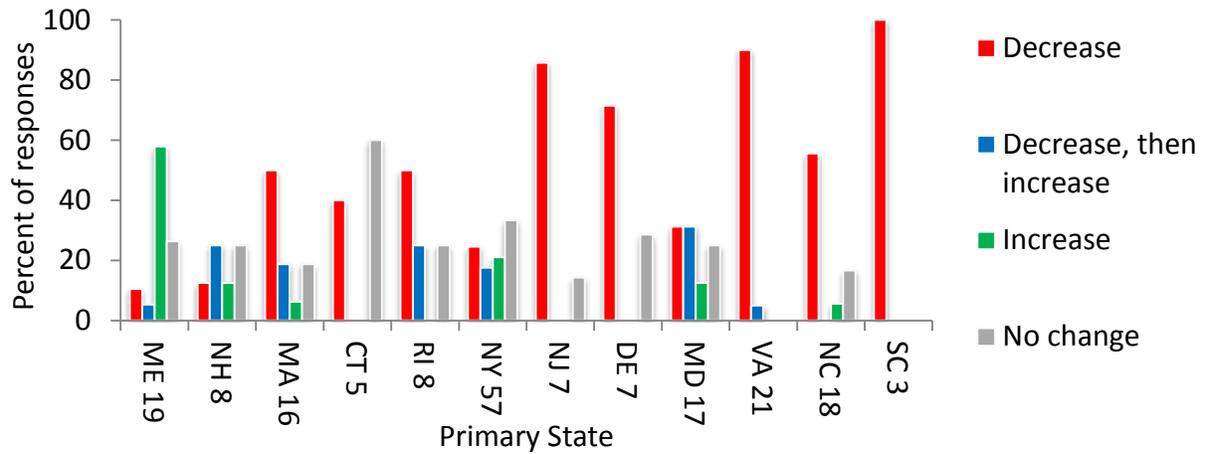
"When we'd set our gill net, like a 300 foot net, as soon as we set it we would go to the other end and start pulling it because they would sink it, there would be so many herring. This is going back 35 years... But then it just got down to the point where you might catch 5, 6, 10 fish in a drift leading up to when they closed it."

Commercial fisherman from Virginia

"The first couple of years it seemed like there was a lot less of them. But over the last five it seems like there's – I don't know how to put it - a crap load of them. The last three years there's been more bait fish than I don't know what... You could walk across them last year in the creek. It was unbelievable."

Recreational and personal use fisherman from New York

Figure 14: A simplified summary of respondents’ answers to the question, “Over the years that you’ve fished for river herring, have you noticed any changes in their overall abundance?” Answers are grouped by state. The number of respondents from each state is shown on the x-axis. Washington D.C. and Pennsylvania each had only one survey respondent and are not shown in the figure below.



“Every year has gotten better, there’s been more of them.”

Commercial fisherman from Maine

“It’s been trending down, for sure. Although this year was the best run I’ve seen in maybe forever. But they’ve been trending down, definitely.”

Recreational fisherman from New Hampshire

“We never had a problem catching bait, ever. In the Delaware [River] or any of those places. Ever. There would be days when they weren’t there, but there would be days when there was millions of them, you know?...There was never a year where we went, ‘Wow, we didn’t get any bait this year!’”

Recreational fisherman from New Jersey

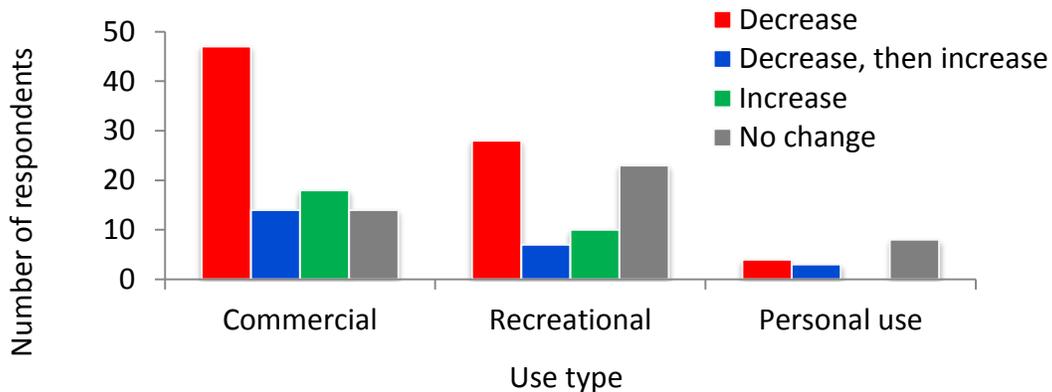
“There would always be one day where they were just all over the river and spawning on every sand bar, piled everywhere. At the end, I never saw that happen.”

Commercial fisherman from New Jersey

Table 8: The average last year that respondents fished for river herring and the average number of years they fished for river herring summarized according to how they described changes in river herring abundances. T-tests showed significant differences ($p < 0.05$) between those who reported a decrease in abundance and those who reported either an increase or a decrease with an increase in recent years. No other comparisons showed significant differences.

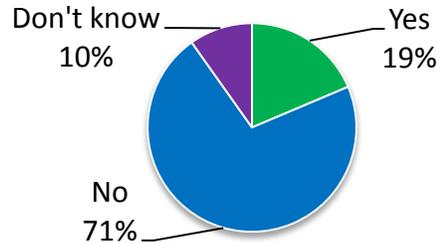
Change in abundance	Average last year fished	Average number of years fished
Increase	2013	18.7
Decrease	2005	28.3
Decrease, then increase in recent years	2012	25

Figure 15: Responses about changes in abundance shown by primary use type.



We asked respondents who distinguished between alewives and blueback herring at least some of the time if they had seen any changes in the relative abundances of the two species. Most (82, or 68% of the 120 respondents who distinguished between the two species) said they either had not seen a change in the ratio of alewives to bluebacks or they said they were unsure. Nineteen individuals noticed a change in the ratio of alewives to bluebacks (figure 16), but their descriptions of those changes varied widely. Eleven respondents gave answers that described a decrease in the ratio of alewives to bluebacks, some because of an increase in alewives, some because of a decrease in bluebacks. Eight individuals reported an increase in the ratio of alewives to bluebacks. We found no geographic trends in their responses.

Figure 16: Respondents' answers to the question, "Over the years that you've been fishing, have you noticed any changes in the abundance of alewives relative to bluebacks?" We posed this question only to respondents who distinguished between the two species.



Perceptions of the health of river herring stocks

We asked respondents, "Based on your observations while fishing, how would you describe the status of river herring populations in your area?" Most respondents answered this question by describing the status of their local runs at the time when they last fished for river herring (figure 3). Some respondents had not fished for river herring for several years but continued to observe river herring, either because they lived near a run or because they participated in research and monitoring programs. Some of these individuals chose to describe the status of river herring based on both their current observations and their memories of when they fished for river herring in the past. We allowed respondents to answer this question as they saw fit and did not ask for clarification about the timeframe to which they referred.

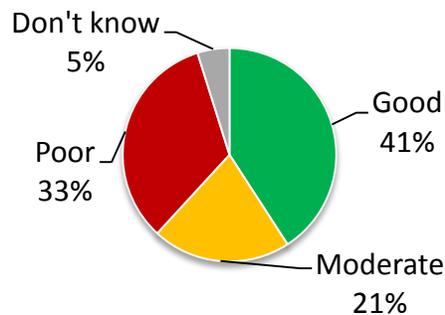
Some respondents were confused about the meaning of the word "status". In such cases the interviewer clarified the intent of the question by saying, "Do you think the river herring population in your area is doing well, poorly, or is the status moderate?" For summary purposes, we grouped all responses into categories of "good", "moderate", and "poor". This classification allowed for comparisons across states, across use types, and through time. Examples of answers classified into each of the three categories are listed in table 9.

A slight majority of respondents described the status of their local river herring runs in a way which we classified as "good" (76 individuals, 40% of the total). We classified about a third of the responses as "poor" (62 individuals, 33%) and 11% of responses as "moderate" (21 individuals; figure 17).

Table 9: Examples of responses to the question, “Based on your observations while fishing, how would you describe the status of the river herring populations in your area?”

Examples of answers classified as “good”	Examples of answers classified as “moderate”	Examples of answers classified as “poor”
Abundant.	Getting better.	Not good at all. We’ve had five years of increases, but modest. Lots of little runs have disappeared.
Exactly the same every year. Millions come up the river in April and May every year.	Moderate and improving, probably because of regulations. We need more observations.	Definitely not like it used to be. It has definitely gone down in my lifetime.
Good. Growing.	Seem stable.	Very, very spotty now.
Fairly plentiful. No shortage. Not endangered.	Pretty consistent.	Almost extinct.
Greatly increased.	Increasing.	Low.
Healthy.	Doing a lot better now than they were four or five years ago.	There's a lot less now.
If we're out fishing for other fish we still can see plenty of bait in the water.	Very high up until last ten years. They dropped down to 85%. The main part that you could notice was the herring stopped going up ditches and creeks. They spawned in the river.	Compared to previous years, it’s critical.
More every year over eight years. It’s doing great. It’s coming back.	Fair.	This year they were solid. But the status over the last 15 years, they're trending down. There are fewer.

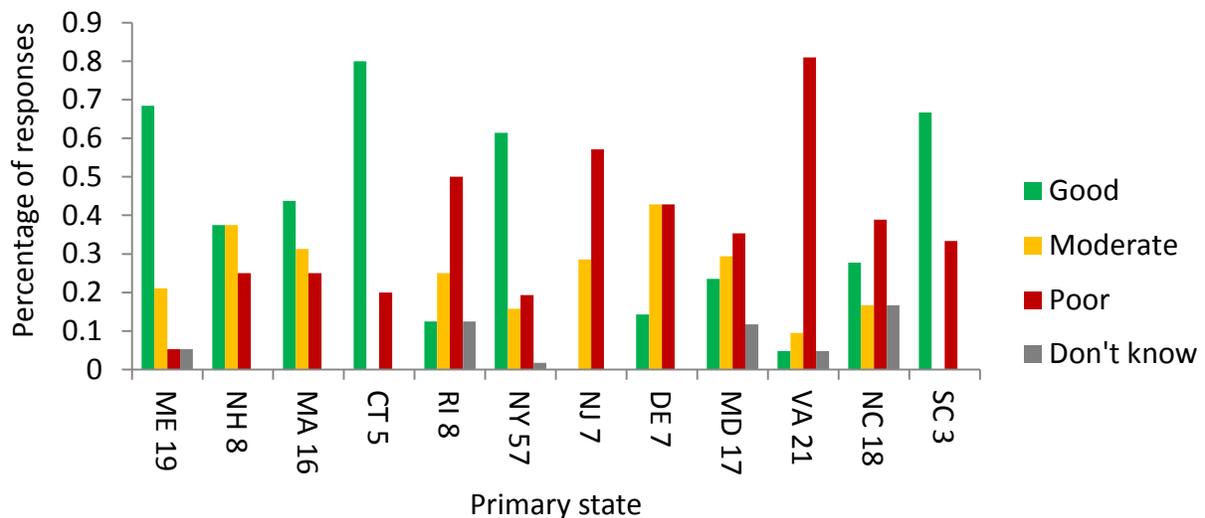
Figure 17: Summary of respondents’ descriptions of the status of river herring runs.



Responses varied by state. The categories of “good” and “moderate” were dominated by respondents from New England and New York. The category of “poor” was dominated by respondents from Mid-Atlantic states other than New York and southern states (figure 18).

A chi-square test showed no significant differences in the categorized answers about status across the three primary use types (i.e. commercial, recreational, or personal use; $p = 0.42$). A chi-square test also showed no differences in categorized answers about status between respondents who were identified through license lists and those who were identified through other methods ($p = 0.49$). Student’s t-tests did show differences in answers about status based on the number of years that respondents had fished for river herring. Those who responded in a way that was categorized as “good” tended to have fished for river herring for fewer years (19.5 years, on average) than those who answered in a way that was categorized as either “moderate” (25.8 years, on average; $p = 0.03$) or “poor” (28 years, on average; $p = 0.0007$). T-tests also showed significant differences in the most recent year that respondents fished for river herring and how they described the status of their runs. Those whose answers were categorized as “poor” tended not to have fished for river herring as recently (2003 was the average last year fished for this group) as those whose answers were categorized as “moderate” (last fished in 2010, on average; $p = 0.0003$) or “good” (last fished in 2010, on average; $p = 0.001$).

Figure 18: Percentage of survey respondents in each state who described the status of their local river herring runs as “good”, “moderate”, or “poor”. Pennsylvania and Washington D.C. are not shown in the figure below because they each had only one survey respondent.



Local threats to river herring and potential solutions

We asked respondents, “What do you think are the biggest threats to river herring, if any?” This question addressed opinions, not direct observations.

Respondents described a variety of threats to river herring (figure 19). Many respondents (72 individuals, 38% of the total) listed more than one threat.

Predation was the most frequently mentioned threat (mentioned by 64 individuals, 34% of the total). Striped bass, blue catfish, and cormorants were the most frequently mentioned predators (table 10). Predation was more frequently mentioned by survey respondents from Mid-Atlantic and southern states than by respondents from New England (figure 20). A high percentage of commercial fishermen said that predation was a threat, compared to other use categories (53% of commercial fishermen compared to 18% of recreational fishermen and 13% of personal use fishermen; figure 21).

Many survey respondents (53 individuals, 28% of the total) stated that river herring faced great threats at sea, due both to directed harvest and to incidental catch. Most of these respondents did not observe catches of river herring at sea but knew this to be a threat from reading fishing magazines and blogs, participating in fishing organizations, attending meetings, and other ways that they stayed informed about commercial and recreational fishing. A few survey respondents had observed evidence of catches of river herring at sea, either on the dock, in bait shops, or while at sea themselves.

“We used to have a boat come in, they were a mid-water trawler or something like that, for sea herring. They were unloading on a friend of mine’s dock and it was just full of river herring and sea herring and mackerel and whiting all mixed in. We can’t keep them but they can. It doesn’t make sense.”

*Recreational fisherman from
Massachusetts*

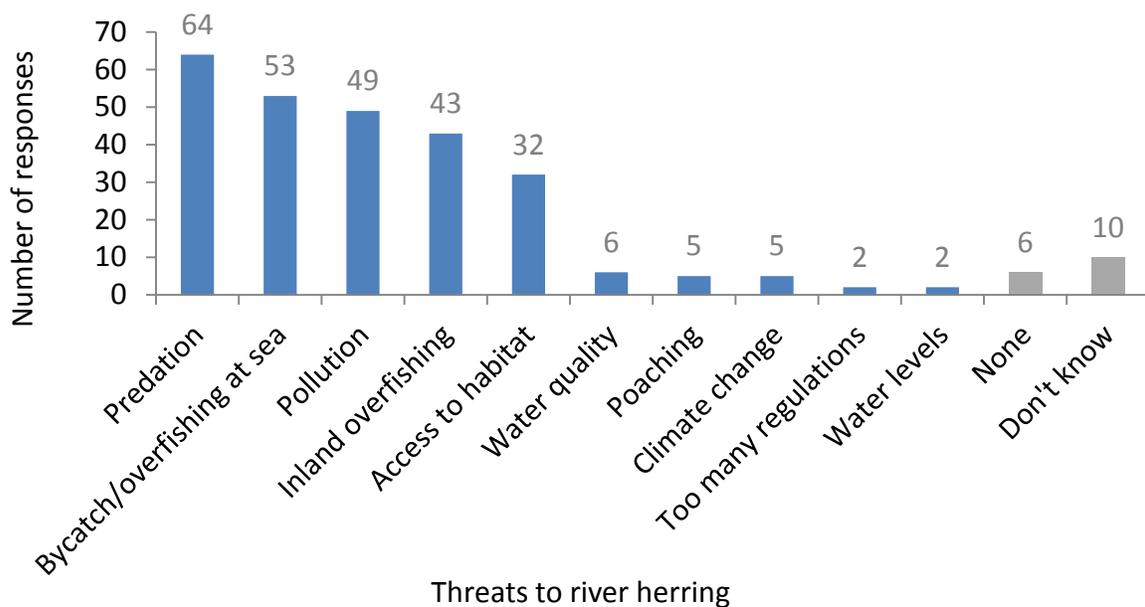
Many survey respondents (43 individuals, 23% of the total) thought that overfishing in freshwater and in the mouths of rivers was a major threat to river herring. When summarizing responses, we considered this to be a different threat than overfishing at sea because many respondents described the two as very different types of fisheries. When respondents simply said “overfishing”, the interviewer usually asked them to clarify what type of fishing they were referring to. Most of these individuals made a distinction between freshwater and marine fishing, but several also made distinctions between commercial and recreational fishing and fishing with different gear types. A relatively low percentage of respondents who identified primarily as commercial fishermen (10%) thought inland overfishing was a major threat

compared to those who identified as recreational fishermen (34%) or personal use fishermen (27%; figure 21).

Many survey respondents (49 individuals, 26% of the total) thought pollution of spawning habitats posed a major threat to river herring. Pollution was more frequently mentioned by respondents from Mid-Atlantic and southern states than by respondents from New England (figure 20). The most commonly mentioned forms of pollution were sewage and agricultural runoff.

Several respondents (32 individuals, 17% of the total) thought that access to spawning habitat posed a major threat to river herring. They described impediments created by dams, poorly maintained fish ladders, debris in streams, urban sprawl, and beach replenishment projects. Access to spawning habitat was more frequently mentioned by survey respondents from New England than by respondents from Mid-Atlantic and southern states (figure 20).

Figure 19: Responses to the question, “What do you think are the greatest threats to river herring populations, if any?” Responses were grouped into 12 broad categories for summary purposes. Only threats mentioned by at least two survey respondents are shown below.



“When I was a kid you could play around in a lot of the smaller creeks that come in the river. The herring would come up those creeks to spawn, but nowadays with siltation, primarily due to construction and development, a lot of those coves and creeks are closing up too much.”

Recreational fisherman from Washington D.C.

Table 10: Predators described as threats to river herring. Only predators mentioned by at least two survey respondents are shown below.

Predator	Number of responses
Striped bass	33
Blue catfish	14
Cormorants	11
Seals	7
Sharks (including spiny dogfish)	4
Gulls	3
Osprey	3
Eagles	2
Otters	2

“I clean quite a few catfish in the spring...When you cut that catfish open, they’re full of herring...That’s my biggest concern is they need to do something about these invasive species that are eating up the herring.”

Commercial fisherman from Virginia

“I know before they regulated it it was overfished. And I contributed to that. We could go there and fill our pickup truck full of alewives.”

Recreational fisherman from New Hampshire

Figure 20: The five most frequently mentioned threats to river herring, with responses grouped by state. Pennsylvania and Washington D.C. are not shown below because each had only one survey respondent. The number of respondents from each state is shown below the state labels on the x-axis.

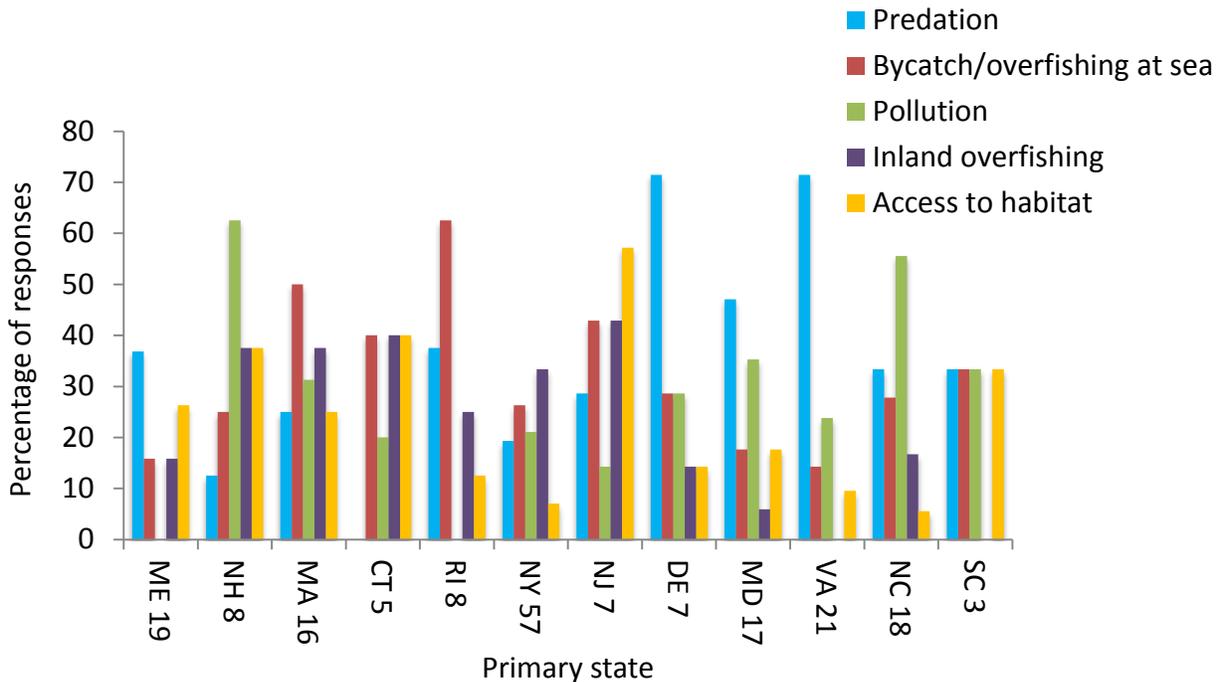
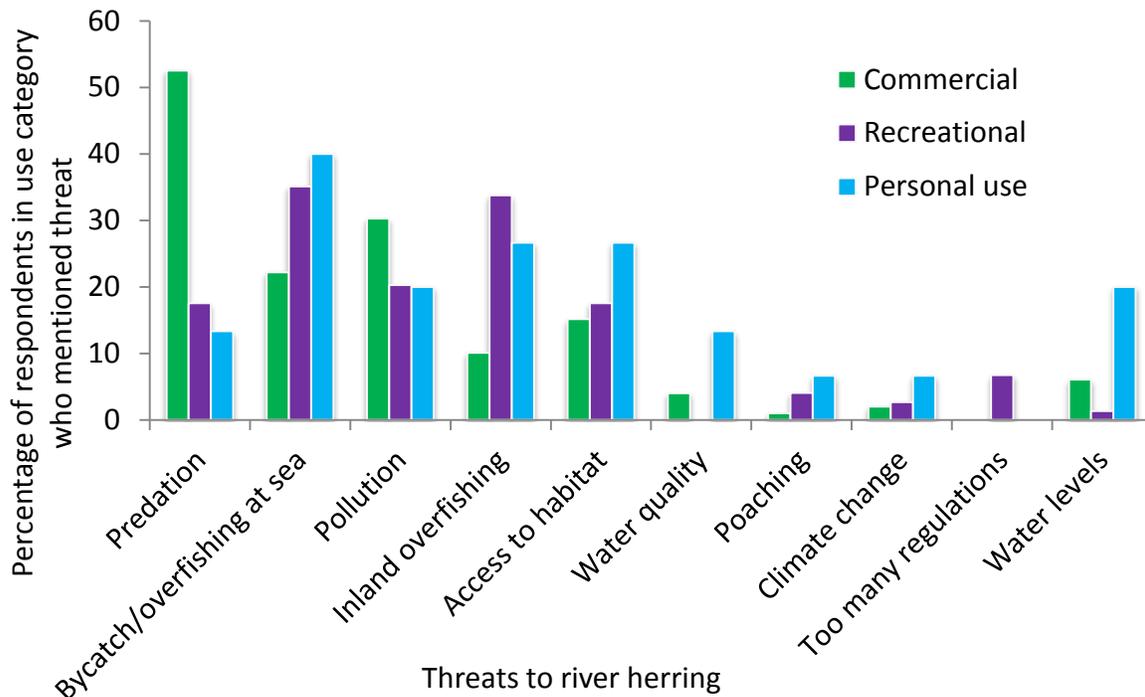


Figure 21: The proportion of individuals in each use category (commercial, recreational, or personal use) who mentioned each category of threats to river herring. Only threats mentioned by at least two individuals are shown below. Threats are shown in order of most to least frequently mentioned by all survey respondent.



“When I was young, which was a long time ago, in the Roanoke River there was just millions and millions of them. They had this huge seine that they pulled just constantly day in and day out. They would load up these tractor trailers with them to go to a cannery...Of course you’re taking out fish that are going up river to spawn. So that really hurt... It was a fish that a lot of locals looked forward to. They would eat herring roe. They would have a herring fry. There was a herring festival in the town. It was just way overfished. They were overfished recreationally.”

Commercial, recreational, and personal use fisherman from North Carolina

“Striped bass came back tremendously because of the efforts to replenish the stock. And that increased the number of fishermen, which increased the demand on the bait. A lot of illegal harvest. There was a black market, really, of live herring. Those guys really did some damage.”

Recreational fisherman from Massachusetts

We asked all survey respondents for their opinions on the best ways to address the threats they described. We grouped their responses into 23 broad categories for summary purposes (table 11). The most common response was, “I don’t know” (30 individuals, 16% of survey respondents). This answer usually reflected a belief that a given problem was unsolvable. For example, some respondents thought it would be impossible to reduce abundances of invasive blue catfish to a level where they would no longer pose a threat to river herring. Others doubted that meaningful regulations on pollution and habitat destruction would ever be enforced.

Table 11: Summary of respondents’ opinions on how to best address what they considered to be the greatest threats to river herring.

How to address threats	Number of responses
Better regulations for catch/bycatch at sea	22
Improve water quality	21
Ensure passage to spawning grounds	19
Harvest more striped bass and/or blue catfish	18
Allow a limited river herring fishery with catch limits	18
Better monitoring and research	15
Keep current regulations	10
Predator control (for species that aren't target of fisheries, e.g. cormorants, seals)	9
Better enforcement of current regulations	8
Prohibit a certain type of fishing (e.g. mid water trawling, gill netting, all commercial fishing, foreign fishing)	7
Establish closed areas to prevent over-harvest and habitat destruction	5
Stocking/hatcheries	5
Education	3
Allow small amounts of incidental catch of river herring	2
Prohibit all harvest of river herring	2
Allow commercial harvest of river herring on spawning grounds	1
Manage based on escapement goals	1
Do away with all regulations	1
Prohibit harvest of female river herring	1
Better regulate water levels	1
Implement more flexible fishing regulations	1
Nothing can or should be done	3
Don't know	30

The final question we asked all survey respondents was, “In your opinion, what is the most important thing we could do to help river herring populations grow and maintain themselves at a sustainable level?” Although we asked for “the most important thing”, several survey respondents (42 individuals, 22% of the total) described more than one action. About half of respondents (96 individuals, 51% of the total) gave a different answer to this question than to the question about how to address the greatest threats to river herring. For summary purposes, we grouped their answers into 22 categories; none of which stood out as being mentioned by a high number of respondents (table 12).

Fishing regulations were the most frequently mentioned action (mentioned by 30 individuals, 16% of the total). Respondents called for biologically appropriate catch limits, closed areas, gear restrictions, and other fishing regulations. Other frequently mentioned actions included improvements to water quality (mentioned by 25 individuals, 13% of the total), improved access to spawning habitat, (24 individuals, 13% of the total), stronger regulations on incidental catch at sea (20 individuals, 11% of the total), and greater harvest allowances for striped bass and blue catfish (16 individuals, 9% of the total).

“I think the best thing to do first is to try to nail down what it is that’s putting the pressure on them, because otherwise you’re pouring bad money after good trying to find the right solution. It was kind of easy in the ‘40s, ‘50s, and ‘60s to put the finger on pollution and say clean it up and it will get better because you did and it did. This time around I don’t know if there’s one easy answer. I hate to say it, but it’s doing the necessary research to find out what’s going on.”

Commercial fisherman from New Jersey

“I think it's too late. They've already built these subdivisions and they have these sewage treatment plants all the way up the river. They're putting too much into the river.”

Commercial fisherman from Maryland

“Definitely we have to restore the ladders to get the fish up into the rivers to spawn, there’s no doubt about that. And there’s a lot of streams that have good runs that have no ladders, so that’s an issue.”

Recreational fisherman from Massachusetts

Table 12: Summary of responses to the question, “In your opinion, what is the most important thing we can do to help river herring populations grow and maintain themselves at a sustainable level?” Responses were grouped into the categories show below for summary purposes.

Suggested action	Number of responses
Better fishing regulations (e.g. different catch limits, closed areas, gear restrictions, etc.)	30
Improve water quality	25
Ensure access to spawning habitat	24
Regulate/monitor incidental catch of river herring at sea	20
Harvest more striped bass and/or blue catfish	16
Collect better data/do more research	14
Prohibit a certain type of fishing (e.g. all commercial fishing, harvest at sea, gill netting)	13
Keep current regulations	13
Allow a limited river herring fishery with catch limits	7
Maintain or establish a total moratorium on harvest of river herring	6
Predator control (for species not the target of a fishery, e.g. seals, cormorants)	5
Improve enforcement of current regulations	4
Stock river herring	4
Protect habitat (e.g. with closed areas or regulations on new construction)	3
Education	3
Better collaboration between state and federal agencies	2
Better regulate water levels	2
Implement uniform river herring fishing regulations across states	1
De-regulate the river herring fishery; allow a free-enterprise system	1
Prohibit hydraulic fracturing	1
Nothing can or should be done	8
Don't know	17

DISCUSSION

Patterns in responses

Respondents fished for river herring over different periods of time, in many different habitats, and with many different gear types, all of which influenced their observations of river herring and undoubtedly led to variation in their answers to survey questions. If we define high agreement on a particular question as at least 75% agreement across all responses, moderate agreement as between 50% and 75% agreement, and low agreement as less than 50% agreement, then there is low overall agreement among survey respondents. Respondents showed high agreement in their responses to two survey questions; they largely agreed that neither the timing of river herring runs nor the size of individual river herring had changed over time.

Many respondents described year-to-year variability in the timing of river herring runs. Their responses imply that if the timing of river herring runs has changed over the past 50 years, it has not changed enough to stand out against a backdrop of natural year-to-year variability. Many respondents caught river herring with gill nets (51 individuals, 27% of the total), and this may have influenced their observations of the size of river herring. Gill nets catch different sizes of fish depending on the size of the mesh. Most respondents who used gill nets were likely not able to catch very large or very small river herring. If the size of river herring has changed over time, most respondents were either unable to notice it due to the gear they used, or the change was too small or too gradual for them to notice.

There was low agreement in the answers to questions about abundance changes, the status of river herring, the greatest threats to river herring, and what to do about those threats. Responses about the status of river herring did not show similar patterns to the answers about changes in abundance. Many respondents reported a decline in abundance but thought the status of river herring was moderate or good. This likely implies that many survey respondents did not think the observed abundance declines were great enough to threaten the river herring runs in their local areas (though some respondents certainly did express that sentiment).

Respondents who reported an increase in the abundance of river herring tended to have fished in more recent years and for fewer years than those who reported a decrease in abundance. Respondents who described the status of river herring as “good” tended to have fished more recently and for fewer years than those who described the status as “poor”. These results suggest that the timeframe of respondents’ observations may have influenced their answers. This may be an example of what is known as a “shifting baseline” phenomenon. Shifting baselines in the fisheries context refers to a situation in which fishermen consider the condition

of a fish stock at the time they first began to fish to be the “normal” or baseline condition. This is the baseline to which all future conditions are compared. The accepted standard for “normal” changes over time and masks declines in abundance and other changes (Pauly 1995, Sáenz-Arroyo et al. 2005). Someone who began fishing for river herring fifty years ago may have seen higher abundances than someone who began fishing for river herring twenty years ago. Both individuals have different perceptions of what is “normal” and that influences their opinions of the current state of the fish stocks in their local area.

State-by-state differences were also evident in responses about changes in abundance and the status of river herring. We did not statistically evaluate state-by-state differences due to the large differences in the number of respondents from each state; however, the graphical representations in the results section suggest that state-by-state differences do exist. Respondents from most New England states and from New York tended to describe their local river herring runs in a more positive light, in terms of both abundance and status, compared to respondents from other Mid-Atlantic states and from southern states. Responses also showed differences in the threats faced by river herring in different states. These differences are likely influenced, at least in part, by state-by-state differences in fishing regulations, land use patterns, population densities, and other factors which affect diadromous fish.

The states in which respondents fished appears to have a greater influence on their responses than their primary use type (i.e. commercial, recreational, or personal use). We did not examine the interaction effects between state and primary use type when examining responses, but this interaction is likely very important. For example, commercial fishermen were more likely to have noticed a change in the abundance of river herring over time – they were both more likely to have seen increases and to have seen decreases when compared to other use types. This pattern may be better explained by geographic differences in river herring runs than by use type.

The social and economic importance of river herring

Many respondents described changes that had taken place in their local communities as river herring fisheries had become increasingly restricted or entirely eliminated. Many respondents said they enjoyed eating herring roe, pickled herring, or salted herring. Moratoria have ended these springtime traditions in many states.

Many survey respondents described the economic importance of river herring in their local areas. River herring



still provide an economic boon to some communities in New York where striped bass attract many recreational fishermen in the late spring. Many respondents from New York said that live river herring make excellent striped bass bait. Some respondents owned bait and tackle shops and river herring provided an important seasonal component of their annual incomes. Others simply enjoyed the thrill of sport fishing with live bait. Many respondents said that river herring once supported businesses that provided major economic benefits to small communities. Many of these businesses and the employment opportunities they provide disappeared as fishing regulations changed over the past few decades.

Assessing threats to river herring

Survey respondents thought river herring faced a variety of different threats. The five most frequently mentioned threats, in descending order, were: predation, overfishing/incidental catch at sea, pollution, inland overfishing, and access to habitat. This stands in contrast to a recent ranking of threats by a NMFS river herring status review team. The status review team, which consisted of nine NMFS employees, ranked a number of threats to river herring based on their expert judgment. The categories of threats they considered were not completely analogous to the categories of threats used in this report; however, a comparison between the two rankings is worthwhile. The NMFS status review team identified the top range-wide threat to both alewives and bluebacks as “dams and other barriers”. Rounding out the top five range-wide threats to alewives, according to NMFS staff, were: water quality, incidental catch, predation, and dredging. Rounding out the top five range-wide threats to bluebacks were: climate change, water quality, incidental catch, and predation (USOFR 2013).

The “dams and other barriers” category used by the NMFS status review team can be considered equivalent to the “access to habitat” category used in this report. Though NMFS staff identified this as the most important threat to river herring, it was the fifth most frequently mentioned threat by survey respondents. Predation was the most frequently mentioned threat by survey respondents, but was ranked by NMFS staff as the fourth most important for alewives and the fifth most important for bluebacks. Climate change and dredging were identified by NMFS staff as within the top five threats; however, only 5 survey respondents (3% of the total) mentioned climate change and no survey respondents mentioned dredging.

“The dams down here in south Jersey have been in place for a couple of hundred years, all of them. So these fish have been able to maintain with the dams in place and they’ve had people catching them. Back when the local farmers, even the local Indians, they caught as many as they could to use as fertilizer, which is a lot more pressure than a few guys using them for striped bait. They took out truckloads, wagon loads for years and years and they seemed to be here. Then all of a sudden there was a big drop off. I really believe the ocean intercept, in one form or another, is what’s made the big dent in the population...”

Commercial fisherman from New Jersey

There are likely many reasons why phone survey respondents held different opinions than NMFS staff on the greatest threats to river herring. Survey respondents were asked to answer questions based on their own personal observations and opinions. Respondents who had not seen declines in river herring abundances tended to describe threats which they could observe directly, such as predation. Respondents who had seen declines in river herring abundances tended to describe threats which could have caused those relatively recent declines. Some respondents said that because dams have restricted access to spawning habitat for centuries, they could not have caused recent declines in abundances. Respondents mostly described threats whose impacts had increased within their lifetimes. The NMFS status review team, on the other hand, attempted to evaluate threats over a much longer time frame.

Survey respondents’ focus on recent threats should not be overlooked. Though dams and other

obstructions undoubtedly pose challenges for the recovery of river herring populations, more recent threats will also need to be addressed if river herring populations are to recover to anything close to historic abundances.

Many respondents expressed skepticism of NMFS’ ability to restore river herring populations because many of the impediments to recovery, such as farm runoff and coastal development, are largely outside of NMFS’ power to regulate. Some respondents were frustrated that because fishermen are the easiest threat for NMFS to regulate, they are forced to make sacrifices while other threats go unaddressed and fish

“The National Marine Fisheries Service doesn’t have any authority – the only thing they can do is regulate the taking of fish under their control and regulate fishermen. They can’t regulate some other guy up the road that’s poisoning the river and killing them all. But yet if I catch too many they can regulate me. That’s not going to work! If you want to save fish, you have to do what it takes.”

Commercial fisherman from Massachusetts

populations do not recover.

Issues of representation and bias

We found no significant differences in answers to survey questions between respondents who were identified through fishing license lists and those who were identified through other methods, with the one exception that respondents identified from fishing license lists tended to have fished for river herring more recently than those who were identified through other methods. The respondents identified through other methods cannot be considered a random sample of potential respondents; however, the lack of differences in their responses suggests that their responses were not biased.

We cannot assume that our findings reflect the observations and opinions of all river herring fishermen from Maine to South Carolina. We believe we successfully documented responses from a representative cross-section of recreational and commercial river herring fishermen from New York, but not from any of the other states. We obtained a comprehensive list of potential respondents from New York and documented a very high number of responses compared to other states in the survey area. For similar reasons, we believe we likely captured a reasonably representative cross-section of commercial fishermen from Maine, Virginia, and North Carolina, though we do not believe the responses of recreational and personal use fishermen from those states can be considered representative. We do not consider the responses from any other states to be representative of all river herring fishermen in those states.

CONCLUSIONS

This phone survey documented many detailed and varied observations of river herring from Maine to South Carolina. The survey responses suggest that each run is unique and that river herring abundances have not changed uniformly throughout the east coast. If we are to restore these species to historic abundances throughout their range, we will need to address multiple threats. It is imperative to understand which threats pose the greatest impediments to recovery on a local level.

We did not compare survey responses to the published scientific literature; however, such an exercise would be worthwhile. The information documented by this survey may validate some quantitative scientific data, and it may contradict others. Areas of contradiction will warrant further evaluation. By examining fishermen's knowledge in conjunction with quantitative scientific data, we can obtain a more complete understanding of the natural world than if we were to examine either way of knowing separately. For this reason, it is important to consider the observations and opinions of fishermen when making fisheries management decisions that

can impact both human and fish communities, such as Endangered Species Act listing determinations and other major regulatory changes. We hope this report will serve as an example of the value of fishermen's knowledge for data-poor species.

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Many individuals, organizations, and media outlets helped to publicize the survey effort (Appendix B). This made it possible to survey more individuals than would have been possible if the call list had been generated only from fishing license lists. A few individuals deserve special recognition in this regard. Robert Eckert of New Hampshire Fish and Game made sure that every licensed fisherman in New Hampshire with an email address knew about the survey and he also sent many announcements by mail. Bob Adams (New York DEC), Lisa Barno (New Jersey DEP), Alan Bianchi (North Carolina DMF), Claire Enterline (Maine DMR), Gary Glanden (Delaware Fish and Wildlife), Kathy Hattala (New York DEC), Samantha Hoover (Virginia MRC), Stephanie Iverson (Virginia MRC), David Libby (Maine DMR), and Genine Lipkey (Maryland DNR) made sure the call list contained as many names and phone numbers from their respective states as possible.

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APPENDIX A: SURVEY SCRIPT

The following script closely matches what was said to all survey respondents. The script varied slightly based on the local names that the respondent used for river herring, whether the state in which the respondent lived had a ban on river herring harvest at the time of the survey, and whether or not the individual had fished for river herring in the past year. The survey questions were phrased in the past tense if the individual had no intention of fishing for river herring in the foreseeable future and in the present tense if they planned to fish for them in the near future. Several questions about observed changes were phrased as yes/no questions. Usually the respondent elaborated on their answer. If they did not, the interviewer asked them to describe the changes that they noticed (not shown in the script below).

Hi, [name of potential respondent]. My name is Julia. I'm calling on behalf of NOAA's National Marine Fisheries Service. I'm doing a phone survey of people who have fished for river herring. Have you ever fished for river herring?

Great! If you are willing, I would like to do a short survey over the phone with you. I'll tell you more about it before you decide if you want to participate or not.

Basically, we are doing this survey because we want to get a better idea of how river herring populations are doing along the east coast. We recognize that the people who fish for them have detailed knowledge of the fish in your local areas and so we are reaching out to people like you from Maine to South Carolina with the goal of documenting some of your observations. We hope that this survey will help us better understand what's actually happening out there on the water, how river herring are doing, and how things have changed through time, as well as the different threats they face in different areas. We want to use the results of this survey to make to help us in our efforts to restore these populations throughout their range. This survey isn't geared towards a particular outcome, but because NOAA does so much work related to river herring, we think this will help us be better informed in all of our work.

The survey is done over the phone and only takes about 15 minutes. Does this sound like something you would be interested in doing?

Great! Is it okay with you if I record this conversation? Thank you.

There's just one more thing that I want you to know about before we officially begin the survey. When we report on the results of this survey we're planning to combine everyone's answers into summaries. We do not plan on sharing your individual responses with people outside of NOAA. However, because NOAA is a government agency we are subject to the provisions of the Freedom of Information Act, which means that anyone can request information from us so I can't legally promise that we will be able to keep your individual responses within NOAA. It's possible that someone outside of NOAA could request to see your responses. If that happens we would send them the information without your name and other personally identifying

information attached to it. That's something I want you to be aware of before you agree to participate in this interview. Is that okay with you?

You don't have to answer all of the questions. You can skip any of them. "I don't know" is also an acceptable answer to any of the questions.

Does that all sound good to you? Do you have any questions for me? Feel free to interrupt me at any time if you have any questions or if you want to tell me something that I don't ask about.

The first question on my list is: When it comes to river herring, would you describe yourself as a commercial harvester, a recreational harvester, a personal use harvester, or something else?

When did you last fish for river herring?

For about how many years have you fished for river herring?

Have you ever fished for them in any states besides [state of residence]?

Within [state of residence], did you fish for them at multiple locations?

What type of water body did you fish for them in?

What type of gear did you use?

Do you distinguish between multiple different types of river herring? What do you call them and how do you tell them apart? Do you tend to catch more of one kind than the other(s)?

When answering the next few questions, please answer based on your own personal observations, rather than what you may know from outside sources.

Based on your observations made while fishing, at what time of year did the river herring usually first show up in your area?

When did the run usually end?

Over the years that you fished for them, did you notice any changes in the timing of the runs?

Over the years that you fished for them, did you notice any changes in the size of the individual river herring?

Over the years that you fished for them, did you notice any changes in their overall abundance?

Did you ever notice any changes in the relative abundance of alewives compared to bluebacks?

Based on your observations made while fishing, how would you describe the status of the river herring populations in your area?

What do you think are the biggest threats to these species, if any? How do you think we should address those threats?

Your answer to this question might be similar to what you've already said, and that's okay, but in your opinion, what is the most important thing that we could do to help the river herring populations grow and maintain themselves at a sustainable level?

That was the last survey question, but is there anything else that you think is important for us to know about.

One last thing is when I am done with this whole survey effort I am planning to write up a final report that summarizes what everybody said. When that report is ready I want to send a copy of it to everyone who I talked to. Do you want me to send you a copy either by email, or I could send you a hard copy, or I could do both?

Thank you so much for taking the time to talk with me. Have a good evening.

APPENDIX B: METHODS FOR GENERATING THE CALL LIST

Most of the names and phone numbers on the final call list were provided by the Atlantic Coastal Cooperative Statistics Program, state natural resource management agencies, and town natural resource departments. We also sought recommendations from tribal natural resource departments, Sea Grant extension staff, scientists, and other individuals who are knowledgeable about fisheries in their local areas. We sent announcements about the survey to many organizations whose membership includes commercial or recreational fishermen. Announcements were shared by email and were published in several blogs, magazines, and local papers, often without the prior knowledge of any NMFS staff. The following lists contain all known venues through which announcements about the survey and requests for information were shared. Announcements were likely shared through many additional venues.

State-Federal Agencies and Programs

- Atlantic Cooperative Statistics Program
- Atlantic States Marine Fisheries Commission
- ASMFC and NMFS River Herring Technical Expert Working Group
- NMFS Marine Recreational Information Program

State Agencies

- Maine Department of Marine Resources
- New Hampshire Department of Fish and Game
- Massachusetts Division of Marine Fisheries
- Rhode Island Department of Environmental Management
- Connecticut Department of Energy and Environmental Protection
- New Jersey Division of Fish and Wildlife
- Delaware Division of Fish and Wildlife
- Maryland Department of Natural Resources
- Virginia Marine Resources Commission
- North Carolina Division of Marine Fisheries
- South Carolina Department of Natural Resources

Town Governments

- Town of Bourne, Massachusetts Natural Resources Department
- Town of Barnstable, Massachusetts Natural Resources Department
- Town of Bridgewater, Massachusetts Conservation Commission
- Town of Falmouth, Massachusetts Marine and Environmental Services Department
- Town of Harwich, Massachusetts Department of Natural Resources
- Town of Middleborough, Massachusetts Town Clerk's Office
- Town of Wellfleet, Massachusetts Shellfish Department
- Town of Yarmouth, Massachusetts Natural Resource Office

Tribal Governments

- Narragansett Indian Tribe of Rhode Island

- Mashantucket Pequot Tribal Nation
- Monhegan Tribe of Indians of Connecticut
- Mashpee Wampanoag Tribe
- Wampanoag Tribe of Gay Head (Aquinnah) of Massachusetts
- Penobscot Indian Nation
- Passamaquoddy Tribe
- Catawba Indian Nation
- Nipmuc Nation
- Eastern Pequot Tribal Nation
- Nanticoke Lenni-Lenape Tribal Nation
- Ramapough Lunaape Nation
- Powhatan Renape Nation
- Lenape Indian Tribe of Delaware
- Nanticoke Indian Tribe
- Piscataway Nation
- Waccamaw-Siouan Tribe
- Cheroenhaka Indian Tribe
- Nottoway Indian Tribe
- Chickahominy Tribe
- Nansemond Tribe
- Upper Mattaponi Tribe
- Patawomeck Indians of Virginia
- Rappahannock Tribe
- Waccamaw Tribe
- Wassamasaw Tribe of Varnertown Indians

Sea Grant Programs

- Connecticut Sea Grant
- Maine Sea Grant
- New Hampshire Sea Grant
- Rhode Island Sea Grant
- South Carolina Sea Grant

Organizations and online communities

- 1@32 campaign
- American Fisheries Society Northeast Division
- Anglers' Conservation Network
- Bass Barn
- Berkeley Striper Club
- Connecticut River Watershed Council
- Connecticut Surfcasters' Association
- Delaware River Fisheries Cooperative
- Delaware River Shad Fishermen's Association
- Forked River Tuna Club

- Hi-Mar Striper Club
- Maine Coastal Conservation Association
- Manasquan River Marlin and Tuna Club
- Milford Striped Bass Club
- New Hampshire Coastal Conservation Association
- New Jersey Beach Buggy Association
- New Jersey Coast Angler's Association
- NJfishing.com
- North Carolina Coastal Conservation Association
- North Carolina Fisheries Association
- Rhode Island Lobstermen's Association
- Rhode Island Party and Charter Boat Association
- Rhode Island Saltwater Anglers' Association
- River Herring Network
- River Herring Rescue
- Salt Water Anglers of Bergen County
- South Carolina Coastal Conservation Association
- Stripers Forever
- StripersOnline.com
- Virginia Coastal Conservation Association
- Westport Fishermen's Association

Newspapers and magazines

- The Asbury Park Press
- The Coastal Times
- The Fisherman
- New England Boating