Socioeconomic Analysis of the Atlantic Menhaden Commercial Bait and Reduction Fishery

A Report to the

Atlantic States Marine Fisheries Commission

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Executive Summary

Industry Perspectives: Composition and Salient Themes

Highlights:

- Interviews with menhaden industry members revealed a consensus around three themes: increased menhaden stock, increased menhaden bait demand, and increased oil and meal demand.
- Industry interviews revealed that the 2013 decrease in total allowable catch (TAC) and associated state quotas had variable impacts depending on operation size.
- Industry interviews revealed that commercial fishing communities were viewed alternatively either as important local economic drivers or in decline.
- Industry surveys had a low response rate and missing observations for a number of questions, limiting use of the data in additional economic analyses.
- Fishermen surveyed generally managed small-scale operations (0-2 employees) for commercial bait markets and/or personal use; bait dealers surveyed reflected a broader spectrum of operation sizes.

Primary data, both quantitative and qualitative, were collected to characterize the socioeconomic dimensions of Atlantic menhaden industry members. Interview and survey data described participation in the menhaden fishery, industry vessel and gear characteristics, substitute products, subsidies, and other sources of employment. Interview and survey data also provided information on recent market changes, 2013 state-quota impacts, and industry members' fishing communities. Interviewees were chosen to reflect the occupational diversity of the commercial-menhaden industry and its supply chain; study participants included those involved in the reduction fishery — commercial fishermen and a reduction-facility manager — and those involved in the bait fishery — bait harvesters, bait dealers, bait shop owners and employees, and other bait distributors. The survey was limited to commercial menhaden fishermen and bait dealers.

Industry interviews revealed a consensus around three themes: increased menhaden stock, increased menhaden bait demand, and increased oil and meal demand. Interviewees noted increased stocks of Atlantic menhaden over the past few years. Fishermen and bait dealers attributed increased demand for menhaden bait to shortages of other forms of bait, primarily herring. Menhaden oil and meal producers and purchasers cited growth of global aquaculture, animal feed, pet food, and human supplement industries as the key factor in stimulating reduction-product demand.

The 2013 decrease in TAC and associated state quotas had variable impacts depending on operation size; smaller-scale operations that can operate under the 6,000 pound bycatch rule were not adversely impacted, while many medium- and larger-scale operations decreased their menhaden landings, associated workforce, and income from menhaden. Interviewees reported that some states suffered in the allocation process because their TAC was based on reported historic landings.

Commercial fishing communities were viewed either as important local economic drivers or in decline. For many interviewees, particularly for those working in large-scale operations, commercial fishing represented the primary source of well-paying jobs in their community. Other interviewees, typically those with small-scale operations, noted a decline in commercial fishing and fishing culture in their communities.

Industry surveys had a low response rate and missing observations for a number of questions, limiting use of the data in additional economic analyses. The industry survey partially was designed to collect data for an efficiency analysis of the bait sector. Such an analysis was not possible given the small sample size, as well as incomplete data on operation costs.

Fishermen surveyed generally managed small-scale operations (0-2 employees) for commercial bait markets and personal use; bait dealers surveyed reflected a broader spectrum of operation sizes. Fishermen surveyed reported a very low percentage of their income coming from menhaden, with the majority (54 percent) stating that the harvest of Atlantic menhaden made up less than 10 percent of their earnings. Bait dealers surveyed reported a more even distribution in regard to the percentage of their income from menhaden.

ACCSP Secondary Data Analysis

Highlights:

- County level data analysis showed that landings are sensitive to trips and ex-vessel price is sensitive to landings but the effect is small.
- State level data analysis showed that landings are less sensitive to trips, relative to county level data, and ex-vessel price is insensitive to landings.
- Coastwide data analysis showed that menhaden landings have decreased over time, while effort and price has increased over time.
- Analysis of Virginia bait fishery effort finds little change over the past 10 years.

Each of the landings data sets provided by the ACCSP included information on pounds landed, ex-vessel revenues and trips. We focused our county level analysis of the determinants of landings and ex-vessel price on the bait fishery.

The total number of Atlantic Coast counties with menhaden bait landings ranged from 41 to 55 during the period 2000 to 2015. According to the county-level data, the average price per ton was $265. The relationship between trips and landings was positive and proportional. In other words, the percentage change in landings was equal to the percentage change in trips. The relationship between landings and price per ton was negative and small.

The average price per ton ranged from a low of $163 in Virginia to a high of $924 in Florida in the state level landings data. States' average annual landings ranged from a low of 305 pounds in New Hampshire to a high of 189,000 tons in Virginia. Average annual trips per state ranged from a low of 15 in New Hampshire to a high of 3,360 in North Carolina. The annual number of menhaden trips taken per state had a smaller impact on landings when data was aggregated to the state level and included reduction fishery trips. The results suggested that a 10 percent increase in trips would lead to only a 4 percent increase in landings. We found no relationship between landings and ex-vessel price using state level data.

At the Atlantic coast-wide level, average annual landings was 280,000 tons, with a minimum of 185,000 and a maximum of 408,000. The average annual number of trips was 6,760. The average price per ton was $319, with a range of $199 to $433. We found a negative trend in landings and a positive trend in effort over the past 30 years. Ex-vessel price had increased over time. Beginning at $269 per ton, price had increased on average $39 per ton each year.

The annual average number of hours spent on the water ranged from two to 120 per trip, with an overall average of 23 to 28 in the Virginia bait fishery. The total number of crew ranged from one to eight over the time period, with an average of almost two. The relationship between crew size and time spent on the water was positive but small. There was little evidence to suggest any changes in effort in the Virginia bait fishery over this time period.

Economic Impact Analysis

Highlights:

- Economic impacts in the bait sector from the 6.45 percent increase in total allowable catch for 2017 were estimated at $1.5 million, with 18 jobs created.
- Most of the economic impacts in the bait sector accrued in New Jersey and Virginia.
- Economic impacts in the reduction sector from the 2017 total allowable catch increase were $4.8 million, with 81 jobs created.
- Additional estimates were made that would allow analysis of the impacts of differential state quota changes from 1 percent to 30 percent.
- We found little evidence that changes in the menhaden total allowable catch had affected income and employment using county level data from NOAA.

The economic impacts were estimated with multipliers from the Bureau of Economic Analysis' input-output model of the economy. We estimated direct, indirect and induced impacts, with the direct and indirect impact estimates being the most reliable. Economic impacts in the bait sector from the 6.45 percent increase in total allowable catch for 2017 were estimated. The direct and indirect change in total output (gross spending) was estimated to be $1.5 million, with $431,000 in earnings and $974 thousand in value added — net spending without double counting — for the Atlantic coast-wide bait fishery. The estimated number of full and part-time jobs created was 18. Most of the impacts accrued to the New Jersey and Virginia bait fisheries.

In the reduction sector, the 6.45 percent TAC increase was estimated to increase direct and indirect economic effects by $4.1 million in Northumberland County, Virginia. Earnings in that county were estimated to increase by $1.1 million, with 70 additional full and part-time jobs, and the value added was $2.8 million. The direct and indirect economic effects in the rest of Virginia were estimated to be $705,000 in gross output, $317,000 in earnings, 11 additional full and part-time jobs, and $370 thousand in value added.

From the baseline increase of 6.45 percent in 2017, we estimated economic impacts due to other increases and decreases in the total allowable catch. For example, the direct and indirect change in output due to a 5 percent change, either an increase or a decrease in total allowable catch, was estimated to be $1.2 million in the bait sector. Earnings changed by $355,000 and value added changed by $804 thousand. The estimated change in the number of full and part-time jobs created was 15.

A 5 percent change in total allowable catch in the reduction sector from the 2017 baseline was estimated to change output by $3.4 million in Northumberland County, Virginia. Earnings were estimated to change by $917,000, with 75 additional full and part-time jobs. The change in value added was $2.8 million. The direct and indirect effects in the rest of Virginia were estimated to be $581,000 in gross output, $262,000 in earnings, 86 additional full and part-time jobs, and $394 thousand in value added.

In order to provide an alternative estimate of economic impacts from changes in menhaden landings, we estimated the effect of bait landings on employment and income in coastal counties from 2005 to 2013 using data from NOAA. We found little evidence that bait landings have a measurable economic impact on coastal counties.

Public Opinion Survey

Highlights:

- Survey respondents from the general public of eight menhaden states were more likely to vote for increased menhaden quotas that generate ex-vessel revenue, create more jobs and do not negatively impact the environment.
- Respondents were more likely to vote for decreased menhaden quotas that do not generate large losses in ex-vessel revenue, lead to fewer job losses and positively impact the environment.

- Respondent votes revealed that they recognize tradeoffs among economic and ecosystem values with alternative menhaden quotas.
- Survey respondents supported increased quotas in about 80 percent of the increased-quota scenarios, considering the full range of economic and ecosystem impacts.
- Respondent votes were correlated with attitudinal variables and respondent characteristics in expected ways.

We conducted an internet survey with a panel of over 2,000 respondents from Florida, Maine, Maryland, New Jersey, New York, North Carolina, Rhode Island and Virginia. Respondents were placed in a hypothetical situation in which they voted on increased and decreased menhaden quotas with varying changes in ecosystem impacts. The motivation for the vote was to better inform menhaden board members about the opinions from the general public in their state.

We found that increases in ex-vessel revenue and commercial fishing jobs increases the probability that a respondent would vote in favor of a quota increase. Increased quotas that make water quality worse and negatively affect gamefish and water bird populations led to a drop in the probability of a vote for increased quotas. Similarly, we found that decreases in ex-vessel revenue and commercial fishing jobs lowered the probability of a vote for decreased quotas. Decreased quotas that improve water quality and positively affect gamefish and water birds led to an increase in the probability of a vote for decreased quotas.

The model of public opinion suggests that respondents were willing to trade off $13 million, $5 million and $5 million in coast-wide ex-vessel revenue in exchange for a change in the impacts on water quality, gamefish and water birds, respectively. For example, respondents voted to forgo $13 million in commercial fishing revenue to gain better water quality, or they voted to accept $5 million in revenue as compensation for negative impacts to game fish. Respondents were willing to trade off 610, 228 and 234 commercial fishing jobs in exchange for a change in the impacts on water quality, gamefish and water birds, respectively.

We used the model to simulate voting probabilities under various ecosystem-based management scenarios in the quota increase scenario. Considering the full range of economic and ecosystem impacts, survey respondents supported increased quotas almost 80 percent of the time. In other words, about 80 percent of the scenarios would have passed a referendum vote with 50 percent or more in favor of the increased quota. In the scenarios that generated enough votes to pass the referendum, the average ex-vessel revenue was $9 million, with 534 jobs gained. The percentage of scenarios with negative impacts for water quality, game fish and water birds was 40 percent, 45 percent and 45 percent in the scenarios with majority support.

We found that concern about the overfishing of menhaden, membership in recreational, environmental, or conservation organizations, and employment in the commercial fishing or a related industry had influence over votes for decreasing quotas. The less important a respondent thought the menhaden fishery was for their state's economy, the more likely the respondent was to vote in favor of a menhaden quota decrease. We also found that the less important respondents considered managing menhaden at the ecosystem level, the less likely they were to support a quota decrease. The results suggest that respondent opinions about the importance of bait for recreational fishing, bait for commercial fishing, food for other fish, and food for birds affected respondents' inclination to support a quota decrease. We found little evidence that socioeconomic factors have much influence on votes in the decrease quota scenarios.

In considering scenarios in which the quota would be increased, recreational fishermen were more likely to vote for the proposal. Respondents that think menhaden are important for their individual state's economy, and those who knew about menhaden prior to taking the survey, were less likely to vote in favor of a quota increase. Those respondents who answered that fish meal, fish oil and bait for recreational fishing were very important uses for menhaden were more likely to vote for the increased quota.

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1 Introduction

In this project we collected and analyzed primary and secondary socioeconomic data, both quantitative and qualitative, regarding the U.S. Atlantic menhaden commercial fishery. The goal is to provide a document that characterizes the socioeconomic dimensions of menhaden fisheries stakeholders and can be used to support economic analysis of alternative menhaden allocations.

In this research we addressed the distributional consequences of management change on the Atlantic menhaden commercial bait and reduction fisheries. We provide the high priority outputs as detailed in Tables 1 and 2 of the ASMFC Request for Proposals to the extent that the data allow. In particular we present findings in landings and revenues from the bait fishery by state and year. We estimated employment and participation in the fishery and identified subsidies, exits and substitute products. We considered the processing and distribution sectors, including the demand and supply side of the markets. For the reduction fishery we present results considering trends in landings, revenues, costs and participation in the fishery. Other factors considered include jobs supported by the reduction fishery, and market impacts.

In addition to the collection and analysis of quantitative data, we employ qualitative data to explore social equity and identify political and social resources upon which those fishery stakeholders rely. Interviews with menhaden fishermen, bait dealers, and end users serve to link the harvesting and processing and distribution sectors across the supply chain and investigate how regulatory changes, market shifts, and industry networks impact economic resilience.

In the remainder of this report we describe some of the previous socioeconomic research conducted on menhaden fishery, describe and analyze industry perspectives gleaned from interviews and surveys with industry members, describe and analyze the limited landings data supplied by the ACCSP, present an economic impact analysis of the bait and reduction sectors, and describe and analyze data from the public opinion survey.

2 Literature Review

There are only a few published articles that focus on the Atlantic menhaden fishery in the economics literature.

2.1 Reduction Sector

Several studies analyze the menhaden fishery over the last 30 years, following the first menhaden fishery management plan in 1981. Blomo (1987, 1988) and Blomo, Orbach and Maiolo (1988) estimate the impacts from ASMFC management plans on the menhaden fishery using a bioeconomic model with temporal and spatial variation. The biological component of the model accounts for menhaden catch as the product of yield per recruit and the number of recruits. The economic component is the difference in total revenue and total cost. Total revenue is the sum of fish meal and fish oil revenue where these are the product of price, yield per catch and menhaden catch. The cost function is the sum of fishing effort cost and reduction plant operating cost. Fishing cost is the product of fishing days and daily cost. Reduction plant cost is the product of daily costs and operating days. The ASMFC policy examined was a shorter fishing season (i.e., elimination of the winter season in North Carolina) to increase yield per recruit. Simulations find that the shorter fishing season would reallocate catch and revenues toward states north of North Carolina and lead to greater industry profits.

Dudley (2012) examines several empirical issues in the menhaden fishery related to efficiency analysis. First, he considers whether fish meal and fish oil prices are part of an international, national, regional or local market. He finds that U.S. fish meal prices are not correlated with international market prices and that U.S. fish oil prices are positively correlated with international prices.

Second, Dudley examines whether Omega Protein gained market power with the closure of Beaufort Fisheries. Using stock market price data and event study methods, he finds that stock prices for Omega Protein rose with the close of Beaufort Fisheries. This suggests that investors felt that Omega Protein gained some market power and would be able to raise prices for menhaden products or lower the costs of inputs.

Dudley then examines the economic effects of changes in regulations affecting the menhaden fishery using inverse demand models for fish oil and fish meal. He finds that the price elasticity of demand for menhaden meal is between -1.2 and -1.4.[1] Menhaden oil is more responsive to price changes with a price elasticity of demand between -4.1 and -4.2. He uses these demand elasticities to estimate the effect of reduced harvesting rates described in Addendum V to Amendment 1 to the Atlantic Menhaden Fishery Management Plan (ASMFC 2011). The loss of welfare to menhaden meal and oil consumers from reduced harvest rates is estimated to be $26 to $27 million ($2010).

Kirkley et al. (2011) examines the social and economic impacts of changes in the reduction fishery on the Reedsville and Northumberland County regional economy. The goal of this study was to assess the tradeoff between market and nonmarket benefits of the fishery if the Chesapeake Bay menhaden quota was reallocated. Kirkley et al. find that the complete loss of the reduction industry would generate a 14 percent and 8 percent decline in county income and employment, respectively. In addition, an economic impact model finds that shutting down the Chesapeake menhaden fishery would lead to a loss of $10 million in income. Reducing the

[1] The price elasticity of demand is equal to the percentage change in quantity (i.e., pounds) divided by the percentage change in price. A price elasticity of -1.2 indicates that a 10% increase in price would lead to a 12% decrease in quantity).

Atlantic Ocean menhaden quota from 141 to 50,000 metric tons would reduce sales from $60 to $21 million and profits from $14 to $2 million. The rationale given for the decrease in the menhaden quota in the reduction sector is an increase in the economic impacts in the recreational fishing industry for species that depend on menhaden as prey.

Kirkley et al. (2011) find little empirical evidence in the economics literature to support the linkage between recreational fishing benefits and menhaden stock. Using a crude empirical model, they find no evidence that menhaden stock is correlated with recreational landings. Another rationale for a decrease in the menhaden quota is an increase in social (or "non-market") values of a healthy menhaden stock. Kirkley et al. (2011, 2012) conducted a survey of Virginia and Maryland households to estimate these nonmarket values of changes to the reduction sector quota. They find that a decrease in the menhaden catch is valued at $28 in net benefits and quota maintenance with research into the ecosystem benefits of menhaden is valued at $50 for each Virginia and Maryland household. In the aggregate there is a gain in net benefits of $110 million for maintaining the status quo relative to a quota decrease.

2.2 Fish Meal and Oil Markets

Two recent papers describe how the fish oil and fish meal markets are changing. Asche, Atle, and Tveteras (2013) estimate changes in the relative prices of fish and soybean meal using time-series data. They find that the price ratio between fish meal and soybean meal is stable. This suggests that fish meal and soybean meal are economic substitutes, as expected (soybean oil does not have the same level of omega-3s; its incorporation in aquaculture feeds means that society loses some of the health benefits of eating farmed fish). In response to an increasing demand for fish meal and a relatively fixed supply of fish meal, the supply of soybean meal is increasing in response to higher meal prices. Shepherd and Bachis (2014) examine the markets for fish oil and fish meal, motivated by the increased demand for fish oil. The increasing demand for fish oil combined with a constant supply is leading to higher prices. This is leading to an increase in the demand for substitute oil products.

Dudley (2012) estimates that the price elasticity of demand for menhaden meal is about -1.3 and about -4.1 for oil. This means that for every 1% change in the price, consumption changes by 1.3 percent and 4.1 percent. However, with a large global market for these products where the U.S. makes a minor contribution (Shepherd and Jackson 2013), U.S. exporters do not have market pricing power. The current international prices for fish oil and meal are likely insensitive to changes in Atlantic quotas. In this case welfare (i.e., efficiency) analysis should proceed by analyzing supply changes due to quota changes against a constant price. The rent is estimated as the difference between price over cost for the supply change. Given that we have found insufficient information to estimate the costs of fishing effort and production of fish meal and oil we are unable to conduct this analysis.

2.3 Nonmarket Values of Menhaden

Menhaden may also have "nonmarket" values that do not appear in the national income and product accounts. There are only a few known studies in the nonmarket valuation literature that explicitly consider menhaden. Whitehead, Haab and Parsons (2003) estimate the social benefits of avoiding fish kills that predominately affect menhaden in North Carolina and Virginia. While there was no scientific evidence that fish kills negatively affected seafood safety, the public was concerned about risk from eating contaminated seafood at the time of the study. The contingent valuation method was used to estimate willingness to pay for a mandatory seafood inspection program in response to menhaden fish kills. The aggregate value of the seafood inspection program was estimated to be large but this has little bearing on the current study, given the misperception about the connection between menhaden fish kills and seafood safety.

Kirkley, et al. (2012) examine the results of the survey of Maryland and Virginia residents reported in Kirkley et al. (2011). They focus on a comparison of the random dial telephone and internet panel. There are three versions of the survey: (1) a quota maintenance/scientific study scenario and (2) a 10 percent Chesapeake Bay quota reduction and (3) a 50 percent quota reduction. The percentage of respondents who are somewhat concerned or very concerned (combined) about the quota reduction is 55%. The amount of the reduction in quota increases respondent concern in the telephone and internet samples. Respondents are then asked if they would vote in favor of proposals at a randomly assigned increase in their household income tax. The percentage of respondents who would vote for the proposal is 41%. Those in the internet sample are less likely to vote for the proposal relative to the telephone survey sample. Those in the internet sample are less likely to vote for the quota reduction if they are concerned about its effects on the Virginia economy. In the aggregate there is a gain in net benefits of $110 million for maintaining the status quo relative to a quota reduction.

A negative externality of electricity production is the harm to aquatic organisms. Power plants withdraw "cooling water" from nearby waterways to deal with excessive heat produced at their facilities. Problematically, the cooling water is drawn from sources that serve ecological purposes for fisheries (e.g., habitat and nursery), including but not limited to the Atlantic menhaden (May & Van Rossum 1995). Richkus and McLean (2000) estimate that a significant number of menhaden are lost from impingement (fish being trapped against screens) and entrainment (being fatally drawn into a facility), also known as I&E, at power plants each year. The authors examine impingement trends among power plants located on Maryland's Chesapeake Bay in the 1970's. They find that Atlantic menhaden are among the species that dominate impingement counts and that the composition of impingement has remained relatively constant from year to year and impingement mortality for menhaden is considered to be 100 percent. To approximate the impingement impact of the three mesohaline plants in the region, the authors multiplied the 1976 impingement totals (1.8 million) by the recorded average weight of an impinged menhaden at Calvert Cliffs (0.043 pounds) and produced the total impinged weight estimate of 76,000 pounds.

Gentner (2009) estimates the economic costs of impingent and entrainment at the Bay Shore power plant in Ohio which impinges about 50 million fish and entrains about 200 million eggs, 2 billion larval fish and 14 billion juveniles. Biological models are used and estimate that the power plant results in the loss of 55 million predator and prey fish species. About 15 percent of those are fish species valued by commercial fishermen and recreational anglers (e.g., walleye). Benefit transfer methods are used and estimate the cost of these fish lost and I&E. The annual economic cost is estimated to be between $21 and $30 million.

To combat this problem, the U.S. Congress added Section 316 to the Clean Water Act which required that the "location, design, construction and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact" (May and Van Rossum, 1995). Griffiths et al. (2012) summarize the U.S. Environmental Protection Agency (EPA) economic study of 316(b). To evaluate the policy's potential benefits, the EPA used a biological model to estimate the increase in commercial and recreational harvest landings resulting from a reduction in fish mortality due to impingement and entrainment in seven case study regions. Commercial fishing benefits were estimated using predictions of the increased commercial harvest and market data on fish prices. Recreational fishing benefits were estimated using a recreational demand model derived from data in Michigan and benefit-transfer analysis. The EPA did not produce a quantitative estimate of the nonmarket benefits of 316(b), however the potential benefits were discussed qualitatively.

The EPA subsequently conducted a stated preference survey of I&E that was included in the benefits analysis (USEPA 2014) that supported the final 316(b) rule. Barnhouse et al. (2016) assess the controversial reception of the survey. The survey addressed several adverse environmental consequences of I&E, such as reduced taxonomic and genetic diversity, in a manner that was not quantified and did not indicate a degree of magnitude. In the choice set, respondents were asked to state their willingness and pay (WTP) for hypothetical improvements in fish populations or aquatic ecosystem conditions. The survey indicated a tradeoff between I&E and ecosystem health, but did not provide an explicit conceptual model linking fish mortality and any of the environmental attributes. Scientists reviewing the survey materials noted that evidence was not provided of the link between ecosystem health and I&E and thus asserted that the survey valuation results were unreliable. Economists reviewing the files claimed that the stated preference approach may have resulted in inflated nonmarket values in comparison to what alternative methods would produce. Ultimately, the stated preference survey estimates were not included in the EPA's benefit totals. Barnhouse et al. (2016) discuss that the stated preference approach could have been credible had there been more quantifiable data and conceptual models for the respondents to work with, which is feasible considering the countable and scientific nature of evaluating the impact of I&E.

3 Industry Perspectives: Composition and Salient Themes

Primary data, both quantitative and qualitative, were collected to characterize the socioeconomic dimensions of Atlantic menhaden industry members. Interview and survey data were collected to describe participation in the menhaden fishery, industry vessel and gear characteristics, substitute products, subsidies, and other sources of employment. The interview and survey instruments also were designed to collect information on recent market changes, 2013 state-quota impacts, and industry members' fishing communities. In addition participant observation, informal interviews, and content analysis of original documents were conducted to triangulate the interview and survey data. These multiple lines of inquiry serve to ensure convergent validation — that is, the use of several data-collection techniques helps confirm trends found in the primary data. It should be noted that interviewees and survey respondents represent those currently in the industry; data were not collected on anyone who may have exited the industry prior to this study.

Social and economic dimensions of the menhaden fishery were characterized with established indicators following Clay et al. (2013), Pollnac et al. (2008), Smith and Clay (2010), Tuler et al. (2008), and other recent literature. Broadly, the dimensions explored relate to financial viability, distributional outcomes, stewardship, governance, and well-being in the bait fishery, all salient socioeconomic factors to fisher communities and other fishery stakeholders (Clay et al. 2013).

In the initial proposal, case studies were intended to focus explicitly on the bait industry within three distinct geographic regions. The industry perspectives research conducted encompasses both bait and reduction sectors to better capture the breadth of the menhaden fishery. Additionally a focus on small-, medium-, and large-scale fishing and bait enterprises became the primary lens to understand industry differences rather than a geographic focus. Industry members in various geographic regions are highly connected through markets; it did not make sense to separate them.

3.1 Industry Interview Data

Semi-structured interviews were conducted with 43 Atlantic menhaden commercial fishermen, bait dealers, and bait users in seven states: Maine, Maryland, New Jersey, New York, North Carolina, Rhode Island, and Virginia. Ten additional informal interviews were conducted with management personnel from Atlantic menhaden-fishing and processing facilities, as well as with purchasers of reduction oil and meal products. Interviewees were chosen to reflect the occupational diversity of the commercial-menhaden industry and its supply chain; study participants included those involved in the reduction fishery — commercial fishermen and a reduction-facility manager — and those involved in the bait fishery — bait harvesters, bait dealers, bait shop owners and employees, and other bait distributors. They were identified with the help of state fisheries and environmental agency databases, the National Sea Grant College Program network, and from the acquaintances of existing subjects using the snowball sample method.[2]

The interview data were especially valuable in characterizing the bait industry considering the limited secondary data available. Additionally, the data captured the complexity of supply-chain relationships for both the reduction and bait fishery, a component missing from previous studies. The interview data complements the survey instrument by adding a rich description of industry characteristics and relationships, as well as the policy impacts experienced by fishery participants.

Two interview instruments initially were designed to collect data from commercial-reduction and bait-fishery participants. The instruments varied slightly so that questions were relevant for each sector. Questions pertaining to information that would vary from year to year, such as landings or bait sold, were asked in regard to 2015, the most recent year that complete data was available. Interviews took place in regions where menhaden had significant landings and/or was a significant input to other bait fisheries. Several fisheries social scientists and ASMFC board members reviewed the interview instruments. The instruments also were piloted with several fishermen and bait dealers to improve question clarity. See Appendices A and B for the interview instruments.

North Carolina State University Institutional Review Board approval was obtained prior to interview data collection. Steps to ensure confidentiality of study participants were taken, including de-linking personal information to subjects' responses, securely storing data documents within locked locations, and properly disposing of study data after study completion (i.e., audio recordings deleted). The semi-structured interviews, which lasted one to two hours, were audio recorded and transcribed verbatim. The number of interviews conducted was based on data saturation; as new themes ceased to emerge, the interview process was discontinued. Appendix C displays the list of interviewees, their occupation, place of residence, and interview date.

Interviews were transcribed and then summarized by coding the data into salient themes. The interview data were coded into analytic and grounded categories. The analytic categories resulted from the research questions guiding this study, while the grounded categories were data-driven. Codes could be acts, activities, meanings, perspectives, processes, strategies, participation, relationships, social structure or settings. In order to ensure consistency within and across coding, multiple coders were used to extract relevant themes from the interviews.

[2] A snowball sample results when existing study participants suggest other potential participants who are then contacted and may join the sample.

The data were displayed in matrices to summarize and tabulate the evidence underlying the impressions, themes, concepts, and relationships regarding the socioeconomic dimensions of the commercial menhaden fishery. A chain of evidence was established to explicitly show the links between the research questions asked, the data collected, and the conclusions drawn. Themes from the interview data primarily were related to three topics: 1) market changes, 2) 2013 state-quota impacts, and 3) the fishing community.

3.1.1 Characteristics of Interviewees

Among the semi-structured interviews, 29 interviewees were commercial fishermen[3], eight interviewees sold menhaden as bait, five interviewees both fished and sold menhaden as bait, and one interviewee was employed as a manager at the reduction facility. Table 1 lists the interviewees' occupations and states of residence.

Table 1. Total Respondents by State and Occupation (n=43)

State	Fishermen (F)	Bait Dealer (BD)	Fishermen/Bait Dealer	Management
Maine	1	3		
Maryland	1	1	1	
New Jersey	9		1	
New York	3		2	
North Carolina	3	1		
Rhode Island	5	2		
Virginia	7	1	1	1
Subtotal	29	8	5	1

The majority of interviewees were males aged 45 and up, who had been fishing for menhaden for more than 25 years or selling bait for at least 20 years. Three females were interviewed, all working as bait dealers. The majority of interviewees either had received a high-school degree or had some college education. The interviewees had an average annual income of $70,000 to $79,999, and a median annual income of $50,000 to $59,999. Almost half of the interviewees had a combined household income of $100,000 or more. Table 2 provides information on interviewee demographics.

[3] There were three types of commercial fishermen interviewed: 1) those who only fish for menhaden, 2) those who fish for a mix of species including menhaden, and 3) those who primarily fish for species other than menhaden (e.g. crab, lobster), but fish for menhaden to use as bait.

Table 2. Interviewee Demographics							
Gender		Age		Income		Education	
n=43		n=41		n=34		n=41	
Male	40	20-24	1	30,000-39,999	3	Less than High School	2
Female	3	25-34	3	40,000-49,999	1	High School/GED	18
		35-44	7	50,000-59,999	5	Some College	9
		45-54	10	60,000-69,999	3	2-year College Degree	2
		55-64	16	70,000-79,999	4	4-year College Degree	9
		65 or over	4	80,000-89,999	2	Master's Degree	1
				90,000-99,999	0		
				100,000 or more	16		

Interviewees were categorized as working in small-, medium-, or large-scale operations, according to the number of employees and vessel crew. Operations employees could be full or part time; many were seasonal. Employment by small-scale operations of 0-2 employees characterized 14 interviewees, medium-scale operations of 3-9 employees characterized 10 interviewees and large-scale operations of 10 or more employees characterized 19 interviewees. Large-scale fishing operations generally used purse seines, while small- and medium-scale fishing operations relied on gill and pound nets. The fishermen interviewed reflected great diversity in vessel type and gear used, which directly related to pounds landed and duration of the menhaden fishing season. Boat sizes ranged from less than 30 feet to more than 75 feet. Small boats included skiffs and large boats included carriers and purse seiners. Interviewees reported using purse seines, gill nets, and pound/trap nets as their main gear for catching menhaden. As expected, smaller crew sizes often were associated with smaller gear types, such as gill and pound/trap nets.

Annually, about one-third of interviewed fishermen spent at least six months fishing for menhaden, one-third fished between three and six months, and the remaining one-third fished three months or less. Pounds landed in 2015, as reported by the menhaden fishermen, ranged from less than 10,000 to over five million, with a median value in the range of 50,000-99,999 pounds. The majority of fishermen landed less than 180,000 pounds; the largest landings — associated with large-scale operations in Virginia — skewed the average. Six fishermen reported landings less than 10,000 pounds, signifying they likely were using the bycatch allowance of 6,000 pounds per day, which is most often bait caught for personal usage. Table 3 displays information on the numbers of weeks fishing, crew size/number of employees, pounds landed/sold, vessel size and gear type reported by the interviewees.

Table 3. Interviewee Characteristics, Fishermen (F) and Bait Dealers (BD)

Weeks Fishing			Crew Size/ Employees			Pounds Landed/Sold			Vessel Size			Gear Type		
n = 29			n = 43			n = 29			n = 27			n = 27		
	F	*BD*		*F*	*BD*		*F*	*BD*		*F*	*BD*		*F*	*BD*
1-4	1		0-2	14		1-9,999	6		Less than 30 feet	9		Purse Seine	8	
5-8	7		3-9	7	3	10,000-24,999	2		30-49 feet	5	1	Seine Net	3	
9-12	4		10+	14	5	25,000-49,999	3	1	50-74 feet	3		Gill Net	6	
13-16	3					50,000-99,999	2		Greater than 75 feet	9		Trap/ Pound Net	9	
17-20	1					100,000-249,999	4					Cast Net	1	
21-24	4					250,000-499,999	2	1						
24 +	9					500,000-999,999	1							
						1,000,000-4,999,999	0							
						5,000,000 or more	7							

The majority of interviewees had fished for menhaden or worked in the bait business for most of their careers. More than half of interviewees were third-, fourth- or fifth-generation fishermen. When asked about network or group involvement, close to one-third (12 interviewees) reported being part of a fishery-related group, ranging in scale from local, regional, state and federal organizations. However, many reported having left such organizations out of discontent with the process and results. The majority of interviewees indicated they had not benefited in the past, or were not currently benefiting, from any fisheries subsidies. Of those who reported receiving subsidies (eight interviewees), types used included low-interest programs, disaster relief, and episodic subsidies. Ten fishermen reported non-fishing related income. Other sources of income came from tugboat work, hauling scrap metal, rental properties, charter-fishing tours, boat servicing, and making snow at a ski resort. Table 4 provides information on the number of years spent fishing, generations in the business, participation in subsidy programs and fishing networks, and additional income sources for the interviewees.

Table 4. Interviewee Characteristics, Fishermen (F) and Bait Dealers (BD)														
Year Fishing			Generation			Subsidies			Networks			Additional Income Sources		
n = 38			n = 26			n = 25			n = 43			n = 23		
	F	*BD*		*F*	*BD*		*F*	*BD*		*F*	*BD*		*F*	*BD*
Less than one year			1st	6		Yes	8		Yes	9	3	Yes	10	
1-5 years	1	1	2nd	4		No	17		No	25	6	No	13	
6-10 years	1		3rd	8										
11-15 years	5	1	4th	6										
16-20 years	3	1	5th	1	1									
21-25 years	4	2												
More than 25 years	16	3												

3.1.2 Analysis of Interview Data: Salient Themes

The interview data were analyzed for salient themes on the topics of market changes, 2013 state quota impacts, and the fishing community. Themes noted were (1) *Increased Stock*, (2) *Increase in Bait Demand*, (3) *Increase in Oil and Meal Demand*, (4) *No Personal Impact Due to State Quotas*, (5) *Disparate State Impacts Due to State Quotas*, (6) *Decreased Landings and Depressed Incomes Due to State Quotas*, (7) *Commercial Fishing Key,* and (8) *Commercial Fishing Decline*. What follows are interviewees' observations on each theme.

3.1.2.1 Increased Stock

Interviewees noted increased stocks of Atlantic menhaden over the past few years. A Maryland fisherman explained, "I turn more loose than I can keep." Sizeable schools of menhaden reach Maine waters, which was not the case just a few years ago. Fishermen attributed various factors to the stock increase, including the cyclical nature of most fisheries, warming waters, and state quota decreases — a 20 percent reduction of the Total Allowable Catch (TAC) from the 2009-2011 catch average instituted in 2013. Many attested that the increased stocks are evidence that the Atlantic menhaden fishery was healthy and not overfished. They described fish kills that have occurred as a result of the preponderance of menhaden schools and lack of oxygen when the fish come inshore to avoid predators. New York and Rhode Island fishermen reported using the episodic-event allowance to catch more than their initial quota allocation and harvest fish when a fish kill is occurring or eminent.

3.1.2.2 Increase in Bait Demand

Fishermen and bait dealers attributed increased demand for menhaden bait to shortages of other forms of bait, primarily herring. Accordingly, they were developing new markets for menhaden bait. Increased demand for menhaden bait frequently was associated with Maine lobster fishermen and the bait dealers who supply them. A New York fishermen/bait dealer explained how he spent time developing new markets saying, "I spend more time selling than fishing." Interviewees raised concerns over bait-market saturation: What is the ceiling on bait-market demand? The increase in demand for menhaden bait corresponded with quality and cost concerns, as bait buyers in the New England states primarily purchased bait from New Jersey and other Mid-Atlantic states. Bait had to be stored, flash-frozen and refrigerated, or salted, leading to product inconsistencies. Trucking costs also were significant according to interviewees, doubling bait cost depending on the distance. Fishermen and bait dealers believed that higher demand and the decrease in menhaden-bait supply due to state-quota decreases have led to increases in the price of menhaden bait.

3.1.2.3 Increase in Oil and Meal Demand

Menhaden oil and meal producers and purchasers cited growth of global aquaculture, animal feed, pet food, and human supplement industries as the key factor in stimulating reduction-product demand. They stated that demand for healthy sources of protein will only increase with global population growth. They contended that the only suitable alternatives to menhaden oil and meal for these industries was oil and meal from another fish species, typically anchovies from Peru and Chile. Most non-fish oils (e.g. rapeseed, flaxseed) were considered poor substitutes due to lower protein and omega-3 fatty acids contents; their lower prices reflect this. Algal oil was suggested as a viable substitute but current production costs are too high to be competitive. Purchasers noted increasing prices for menhaden oil and meal in the past ten years. A menhaden-meal purchaser who supplies animal and aquaculture feed companies explained, "It [meal price] adjusts according to major trends. In 2008, there were a lot of meals on the market, so the price was lower." Some menhaden meal purchasers reported price increases in the range of 70 to 150 percent since that time. Menhaden oil and meal purchasers explained that U.S. menhaden is considered a stable market compared to products available from other countries. Consistent product availability and quality have made menhaden oil and meal desirable products.

3.1.2.4 No Personal Impact Due to State Quotas

Fishermen satisfied by the bycatch allowance — 6,000 pounds of menhaden per day — often had not experienced any personal impact after the state quotas decreased in 2013. These small-scale fishermen relied on gill and pound nets and often fished for multiple species. Commercial bait dealers who buy and sell a more diverse mix of species also reported not being impacted by the state quotas. A North Carolina recreational bait dealer explained how he deals with many species, "I sell such a small percentage [of menhaden]." Fishermen not impacted by the quota often fished for menhaden to use as crab and fish bait; menhaden was not the ultimate species they target. Some fishermen not impacted had sold menhaden for commercial-bait markets. Those selling to bait markets even saw some financial gain as bait prices increased following the 2013 state quota decreases.

3.1.2.5 Disparate State Impacts Due to State Quotas

When the new state quotas were instituted in 2013, some states lost a disproportionate amount of their TAC according to interviewees. The quota decrease resulted in overall trust lost in the fishery regulatory process by fishermen and bait dealers alike. A Virginia fisherman described his perspective saying, "They're cutting you, and for what reason? Where's your science? No science. It was very unjust." Due to past-underreported landings, some states suffered in the allocation process because their TAC was based on reported historic landings. A relaxed reporting environment and fears of regulatory intrusion had contributed to a culture of underreporting according to small-scale fishermen in New York, Maryland, and New Jersey. A New Jersey fisherman gave an example saying, "You've got a lot of little guys in the [Delaware] Bay that catch their own bait for crabs and they weren't required to report that." The bycatch allowance ameliorated some initial concerns, as long as the fisherman did not require more than 6,000 pounds of menhaden per day for his operations. Menhaden bait dealers and users from states with a small proportion of the TAC and increased menhaden bait demand in recent years felt especially economically disadvantaged by the quota decreases. A Maine fisherman said, "It doesn't make sense to be trucking them [menhaden] all the way up and paying all that added expense when they're right in our backyard."

3.1.2.6 Decreased Landings and Depressed Incomes Due to State Quotas

Fishermen and bait dealers in medium- and large-scale enterprises noted decreased landings and depressed incomes due to the state quotas instituted in 2013. Fishermen described income losses as high as 20 to 50 percent of their previous salaries, as well as layoffs for their peers. A Rhode Island fisherman discussed challenges in retaining crewmembers with the income losses they incurred. They were fishing shorter periods of the year he explained, adding, "The quota has made it very difficult to pay [crew members] by salary." Some large-scale enterprises cut down by as many as 30 crewmembers, in addition to layoffs in associated processing and distribution facilities. A Virginia fisherman recalled how the 2015 fishing season ended early saying, "We could have fished another one and a half months…which is a lot of money at the end of the year. You feel like you're being punished." Managers of large-scale operations described significant fixed costs; for their businesses, losses from quota decreases cannot be managed simply by a reduction in the labor force. Finally, bait dealers attributed declining menhaden-bait sales and lost revenue to the new state quotas. Interviewees stated that ancillary businesses, both fishing-related (e.g. welding, net repair) and others, like grocery and hardware stores, were impacted as well.

3.1.2.7 Commercial Fishing Key

For many interviewees, particularly for those working in large-scale operations, commercial fishing represented the primary source of well-paying jobs in their community. In their communities, they noted thriving commercial-fishing ports with a mix of species landed and sold (e.g. Maryland crabs, Maine lobsters, New Jersey scallops and squid, North Carolina shrimp, Virginia flounder). Interviewees in Virginia, in particular, emphasized the outsized role and economic impacts of commercial fishing where they live. A Virginia fisherman explained, “Outside of fishing, you make eight dollars an hour.” Fishing is an intergenerational occupation; the majority of menhaden fishermen and bait dealers interviewed have family ties to the industry. They also viewed their co-workers as being like family, noting strong social bonds. Another Virginia fisherman described his relationship to his crew: “Those men on my boat are my family. They depend on me in the off-season. A crew is like a foundation on a house. You’re only as good what you have underneath you.” Many fishermen stated they were their family’s majority income earner, and often, they supported multiple families, including aging parents and adult children. They also considered the fishing industry critical to non-fishing community businesses and livelihoods. A Virginia fisherman pointed out, “Two-hundred and fifty jobs branch out to 2,000 jobs where I live. There are a lot of people counting on us in this community.” In some cases, they saw commercial fishing revenue as significant to the overall state’s economy. Local seafood was considered a tourist draw and key export in some states. A Maine bait dealer discussed the importance of the lobster and fishing industries and their multiplier effects to his state. “We're [the commercial fishing industry] critical to Maine's well-being, no question about it,” he described. “Most of our lobsters are exported. That brings money into Maine and then you know the trail. The lobsterman buys equipment and that makes jobs, and they pay us and we have 25 to 40 people working, and then they go to restaurants, and so on and so forth, and we all pay taxes on it.”

3.1.2.8 Commercial Fishing Decline

Many interviewees noted a decline in commercial fishing and fishing culture in their communities. Generally, interviewees in small-scale operations discussed industry decline more frequently than those in large-scale operations. A Maine fisherman lamented, “The fishing community is ruled by the loss of business.” High fixed costs on items like boats, trucks, and fishing equipment have made it difficult for some to continue fishing if traditional species are unavailable or not permitted to catch. Some fishermen were so discouraged by the regulatory restrictions on fishing that they did not believe the industry would exist at all in the future. A New Jersey fisherman said, “It’s a tough business. If somebody was just getting into it young now, I wouldn’t want to be there.” The decline in the commercial-fishery sector rarely was associated with an increase in other types of well-paying jobs. Other available jobs noted were in economic sectors like service and retail, farming, and tourism, primarily, as well as the retirement industry, military, and boat building in some places. Fishermen and bait dealers reported high levels of unemployment, underemployment and drug use among the labor force. A Rhode Island bait dealer described the decline in the lobster industry, “The commercial fishing port is not as large as it used to be. Used to be 150 lobster boats, now there are 35.”

3.2 Industry Survey Data

Industry surveys were conducted with Atlantic menhaden fishermen and Atlantic menhaden bait dealers in seven states along the East Coast. Survey data were primarily used to validate the interview data collected and secondary data sources. The states included in the survey sample were Maryland, Maine, North Carolina, New Jersey, New York, Rhode Island, and Virginia. Fishermen surveyed either specifically target Atlantic menhaden or they supplement their total harvesting activities with other species. Bait dealers surveyed included proprietors and managers of local bait and tackle shops that sell Atlantic menhaden as bait to recreational fishermen, as well as large wholesale seafood dealers that supply bait to the commercial-fishing industry.

Survey participants were recruited using contact lists of menhaden fishermen and bait dealers managed by state fisheries and environmental agencies. Approximately 2,000 individuals were identified for participation in the survey, which resulted in 255 surveys initiated. However, less than half of the participants completed the majority of questions asked. Thus, summary statistics and interpretation of survey data is restricted to the 106 participants who completed the majority of questions asked.

Two survey instruments were developed: one for menhaden fishermen and one for bait dealers. Demographic information was collected from all participants, including age, gender, household income, education level and years in the Atlantic menhaden industry. All participants were asked to report on current issues that affect the menhaden-fishing industry, as well as significant changes in their personal businesses. Menhaden fishermen were asked to report on the amount of menhaden they harvested, price of menhaden, the proportions of non-fishing related income, the proportion of menhaden harvested considered “bycatch” under the ASMFC bycatch rule, and information about vessel and crew size. Participating bait dealers were asked questions regarding the amount of menhaden sold, price of menhaden, substitutions for menhaden as bait, and proportions of their sales that included menhaden.

Fisheries social scientists and ASMFC menhaden board members reviewed the survey instruments. The surveys were piloted with several fishermen and bait dealers to improve question clarity. See Appendices D and E for copies of the survey instruments.

The survey instruments were developed into online questionnaires using the Qualtrics online platform. Contact information for potential participants varied by state. Some state agencies provided mailing and email addresses, while others only had mailing or email addresses. Hence, postcards and emails were sent to potential participants to instruct them on how to participate in the survey. The recruitment tool — postcard or email announcement — varied depending on the available contact information.

A modified version of the Dillman Tailored Design Method (Dillman 2014) was used to distribute the surveys. In states (MD, ME, NJ) where email information was provided for industry participants, email messages were sent. The Qualtrics survey platform was used to send an initial email to all participants in those states explaining why they were chosen to participate, the purpose of the study and the need for participation. A link was included in the email that allowed access to the online questionnaire.

Two weeks after the initial email was sent, a reminder email with a link to the questionnaire was sent through Qualtrics to remind potential participants to complete the survey. This email again expressed the importance of the study and each individual response.

Two weeks after sending the reminder email, a final notice was sent to potential respondents. This email served as a reminder, again stressing the importance of participation in this study. Dillman (2014) also suggests contacting non-respondents in a different form from the initial manner of contact. For this reason, the researchers made calls after the third email to potential participants to inform them of the study and remind them of the emails. Again, the importance of the study and participation was emphasized to potential participants.

In states unable to provide email information, postcards were sent to the mailing addresses listed for industry participants. The postcards included information about the purpose and importance of the study, the need for individual participation, and a link to access the questionnaire. Following a similar pattern to the email distribution, reminder postcards were sent out after two weeks and final reminder postcards were sent out four weeks after the initial mailing to all potential participants. The online questionnaires closed three weeks after the final reminder emails and postcards were sent.

3.2.1 Characteristics of Survey Respondents and Role in Menhaden Industry

This section summarizes the results of the industry surveys, including respondent characteristics and demographic information of the 105 participants that completed the majority of survey questions. The number of observations varies for each question as some respondents chose not to respond to a given question. About half of the fishermen survey respondents skipped questions on operation costs, limiting the use of the data for additional economic analyses. Survey questions generally pertained to Atlantic menhaden activities during the calendar year of 2015, the most recent year that complete data was available. Table 5 below shows the respondent distribution by state. The response rate for the industry survey was likely in the range of five to seven percent. Hundreds of postcards and emails were returned due to faulty addresses, and many individuals contacted had not commercially fished for menhaden in several years.

Table 5. Total Respondents by State, Absolute Number and Percentage

State	Fishermen	Bait Dealers	Total
Maryland	7 (10%)	2 (6%)	9 (9%)
Maine	1 (1%)	5 (14%)	6 (6%)
North Carolina	12 (17%)	7 (19%)	19 (18%)
New Jersey	23 (33%)	11 (31%)	34 (32%)
New York	7 (10%)	3 (8%)	10 (9%)
Rhode Island	5 (7%)	3 (14%)	8 (8%)
Virginia	14 (20%)	5 (34%)	19 (18%)
Total	69 (66%)	36 (34%)	105 (100%)

Participants were asked demographic questions in order to capture an image of the typical respondent. These questions included gender, age, education level and household income. There was a wide range of ages among the participants of this study. About two percent of individuals reported being in the 18-24 age bracket, while 21 percent of the respondents reported being over the age of 65. Most respondents, 31 percent, were between the ages of 55 and 64 (Table 6). The overwhelming majority — 93 percent — of respondents were male, while seven percent reported as female (Table 7). Participants also had a wide range of education levels, with 33 percent having completed high school and 37 percent having completed a four-year college-degree program or a graduate-degree program (Table 8). Combined household income also had a wide range of responses. While the most respondents, 30 percent, reported making $100,000 or more annually, the responses were evenly distributed between less than $30,000 and up to $100,000 (Table 9).

Table 6. Age of Participants, Absolute Number and Percentage

Age	Fishermen	Bait Dealers	Total
18 to 24	2 (4%)	0 (0%)	2 (2%)
25 to 34	1 (2%)	3 (10%)	4 (5%)
35 to 44	9 (16%)	4 (13%)	13 (15%)
45 to 54	15 (27%)	7 (23%)	22 (26%)
55 to 64	17 (31%)	10 (32%)	27 (31%)
65 or over	11 (20%)	7 (23%)	18 (21%)
Total	55 (64%)	31 (36%)	86 (100%)

Table 7. Gender of Participants, Absolute Number and Percentage

Gender	Fishermen	Bait Dealers	Total
Male	57 (97%)	27 (87%)	84 (93%)
Female	2 (3%)	4 (13%)	6 (7%)
Total	59 (66%)	31 (34%)	90 (100%)

Table 8. Level of Education of Participants, Absolute Number and Percentage

Education Level	Fishermen	Bait Dealers	Total
Less than High School	4 (10%)	1 (3%)	5 (7%)
High School / GED	14 (36%)	9 (29%)	23 (33%)
Some College	8 (21%)	6 (19%)	14 (20%)
2-year College Degree	1 (3%)	1 (3%)	2 (3%)
4-year College Degree	7 (18%)	12 (39%)	19 (27%)
Masters Degree	5 (13%)	2 (6%)	7 (10%)
Doctoral Degree	0 (0%)	0 (0%)	0 (0%)
Professional Degree (JD, MD)	0 (0%)	0 (0%)	0 (0%)
Total	39 (56%)	31 (44%)	70 (100%)

Table 9. Combined Household Income of Participants, Absolute Number and Percentage			
Income	Fishermen	Bait Dealers	Total
Less than $30,000	1 (4%)	1 (4%)	2 (4%)
$30,000 – $39,999	2 (7%)	0 (0%)	2 (4%)
$40,000 – $49,999	3 (11%)	1 (4%)	4 (8%)
$50,000 – $59,999	4 (15%)	2 (8%)	6 (11%)
$60,000 – $69,999	2 (7%)	0 (0%)	2 (4%)
$70,000 – $79,999	3 (11%)	3 (12%)	6 (11%)
$80,000 – $89,999	6 (22%)	3 (12%)	9 (17%)
$90,000 – $99,999	2 (7%)	4 (15%)	6 (11%)
$100,000 or more	4 (15%)	12 (46%)	16 (30%)
Total	27 (51%)	26 (49%)	53 (100%)

Many survey participants had a long history in the menhaden fishery. Participants were asked to report how many years they had been harvesting or selling menhaden. Most fishermen, 41 percent, and bait dealers, 50 percent, had been in the menhaden fishery for more than 25 years (Table 10). These findings confirm the older age of participants discussed previously. Only 12 percent of respondents in the study had been in the menhaden fishery less than five years.

Table 10. Time Spent in the Menhaden Industry, Absolute Number and Percentage			
Amount of Time	Fishermen	Bait Dealers	Total
Less than one year	1 (1%)	0 (0%)	1 (1%)
1-5 years	7 (10%)	4 (11%)	11 (11%)
6-10 years	11 (16%)	2 (6%)	13 (13%)
11-15 years	7 (10%)	5 (14%)	12 (12%)
16-20 years	6 (9%)	2 (6%)	8 (8%)
21-25 years	8 (12%)	5 (14%)	13 (13%)
More than 25 years	28 (41%)	18 (50%)	46 (44%)
Total	68 (65%)	36 (35%)	104 (100%)

Participants were asked to report the amount of menhaden landed or sold in 2015 (Table 11). Forty-six percent of fishermen surveyed landed less than 10,000 pounds in 2015 and about 25 percent between 10,000 and 49,999 pounds. Thus, the survey results appear to reflect the characteristics and perceptions of small-scale menhaden fishermen. In contrast, the interviewed fishermen were a more even distribution between small-, medium-, and large-scale operations. Bait-dealer respondents appear to better reflect a range of small-, medium-, and large-scale enterprises. Bait sold followed a bi-modal distribution, as 36 percent of bait dealers reported selling less than 25,000 pounds and 30 percent reported selling 1,000,000 pounds or more in 2015.

Table 11. Pounds of Atlantic Menhaden Sold and Landed in 2015, Absolute Number and Percentage			
Amount	Landed	Sold	Total
1 - 9,999 pounds	29 (46%)	8 (24%)	37 (38%)
10,000 - 24,999 pounds	9 (14%)	4 (12%)	13 (13%)
25,000 - 49,999 pounds	7 (11%)	3 (9%)	10 (10%)
50,000 - 99,999 pounds	4 (6%)	1 (3%)	5 (5%)
100,000 - 249,999 pounds	5 (8%)	3 (9%)	8 (8%)
250,000 - 499,999 pounds	3 (5%)	3 (9%)	6 (6%)
500,000 - 999,999 pounds	1 (2%)	2 (6%)	3 (3%)
1,000,000 - 4,999,999 pounds	2 (3%)	6 (18%)	8 (8%)
5,000,000 pounds or more	3 (5%)	4 (12%)	7 (7%)
Total	63 (64%)	34 (36%)	97 (100%)

Fishermen were asked about their vessel and crew size while harvesting Atlantic menhaden. The majority (55%) reported operating a vessel less than 30 feet in length (Table 12). The reported size of the crew while fishing for menhaden in 2015, as shown in Table 13, typically was small, with 36 percent of respondents being the sole individual on the vessel and 39 percent working with only one other individual. This further illustrates that the respondents represented small-scale operations. Only three fishermen reported working with a crew of eight or more while harvesting Atlantic menhaden.

Table 12. Vessel Size While Harvesting Atlantic Menhaden, Absolute Number and Percentage	
Vessel Size	Frequency
Less than 30 feet	36 (55%)
30 - 49 feet	20 (31%)
50 - 74 feet	7 (11%)
Greater than 75 feet	2 (3%)
Total	65 (100%)

Table 13. Crew Size While Harvesting Atlantic Menhaden, Absolute Number and Percentage

Crew Size	Frequency
1	22 (36%)
2	24 (39%)
3	6 (10%)
4	3 (5%)
5	0 (0%)
6	4 (7%)
7	0 (0%)
8	1 (2%)
9	0 (0%)
10	0 (0%)
11	0 (0%)
12	1 (2%)
13	1 (2%)
14	0 (0%)
15 or more	0 (0%)
Total	62 (100%)

Survey respondents were asked about the relative importance of menhaden activities to their total income stream (Table 14). Fishermen reported a very low percentage of their income coming from menhaden, with the majority (54%) stating that the harvest of Atlantic menhaden made up less than 10 percent of their earnings. This finding reaffirmed that respondents reflect small-scale menhaden fishermen with relatively low landing values. Only four percent of fishermen surveyed reported that over 90 percent of their income was strictly menhaden. Bait dealers surveyed were more evenly distributed with regards to the percentage of their income from menhaden. About 24 percent of bait dealers reported that over 90 percent of their income comes from menhaden, while 18 percent reported that less than 10 percent comes from menhaden.

Table 14. Percentage of Income from Menhaden, Absolute Number and Percentage			
Percentage	Fishermen	Bait Dealers	Total
1-10%	25 (54%)	6 (18%)	31 (39%)
11-20%	4 (9%)	6 (18%)	10 (13%)
21-30%	7 (15%)	3 (9%)	10 (13%)
31-40%	0 (0%)	3 (9%)	3 (4%)
41-50%	3 (7%)	1 (3%)	4 (5%)
51-60%	0 (0%)	1 (3%)	1 (1%)
61-70%	1 (2%)	1 (3%)	2 (3%)
71-80%	3 (7%)	1 (3%)	4 (5%)
81-90%	1 (2%)	4 (12%)	5 (6%)
91-100%	2 (4%)	8 (24%)	10 (13%)
Total	46 (57%)	34 (43%)	80 (100%)

Survey respondents were asked about the average price of menhaden sold in 2015 (Table 15, 16). Fishermen reported lower prices than bait dealers, as expected, based on a fisherman's position in the supply value chain. Thirty-seven percent of fishermen reported selling their harvested menhaden at $0.10 to $0.14 per pound and about 22 percent reported selling their catch for more than $0.25 per pound in 2015. The average price of menhaden landed in 2015 was 11 cents per pound according to the National Marine Fisheries Service (NMFS 2017). Because the fishermen surveyed generally reflect small-scale enterprises, prices could be higher given the low volume sold. Forty-three percent of bait dealers reported selling their menhaden at prices between $0.25 and $0.49 per pound and about 26 percent reported a price of less than 25 cents per pound in 2015. The interviewed bait dealers confirmed these reported price ranges. Interviewed dealers reported that price varies based on volume sold, level of processing, and trucking costs.

Table 15. 2015 Price of Menhaden Sold by Fishermen, Absolute Number and Percentage	
2015 Price Menhaden	Frequency
1 - 4 cents/pound	1 (2%)
5 - 9 cents/pound	7 (13%)
10 - 14 cents/pound	20 (37%)
15 - 19 cents/pound	12 (22%)
20 - 24 cents/pound	2 (4%)
25 cents/pound or more	12 (22%)

Table 16. 2015 Price of Menhaden Sold by Bait Dealer, Absolute Number and Percentage	
2015 Price Menhaden	Frequency
Less than 25 cents/pound	9 (26%)
25-49 cents/pound	15 (43%)
50-74 cents/pound	3 (9%)
75-99 cents/pound	1 (3%)
$1.00-$1.24/pound	2 (6%)
$1.25-$1.49/pound	1 (3%)
$1.50/pound or more	4 (11%)

Menhaden fishermen surveyed were asked about additional sources of income. Fishermen reported on the proportion of their total annual landings in 2015 that was menhaden (Table 17). Thirty-nine percent reported that less than 10 percent of their total annual landings were menhaden, while nine percent reported that over 90 percent of their landings were menhaden in 2015. Most fishermen surveyed did not exclusively depend on the menhaden fishery, and instead, they targeted other species throughout the year.

Table 17. Proportion of Total Pounds Landed that is Menhaden, Absolute Number and Percentage	
Proportion of Total Pounds Landed is Menhaden	Frequency
1-10%	21 (39%)
11-20%	3 (6%)
21-30%	5 (9%)
31-40%	2 (4%)
41-50%	3 (6%)
51-60%	2 (4%)
61-70%	1 (2%)
71-80%	5 (9%)
81-90%	7 (13%)
91-100%	5 (9%)

The majority of fishermen surveyed (61%) reported no annual income from non-fishing related activities (Table 18). About 17 percent reported one to 10 percent of their income coming from non-fishing related activities.

Table 18. Percentage of Non-fishing Related Income, Absolute Number and Percentage

Percentage of Non-fish Income	Frequency
0%	36 (61%)
1-10%	10 (17%)
11-20%	3 (5%)
21-30%	0 (0%)
31-40%	1 (2%)
41-50%	2 (3%)
51-60%	1 (2%)
61-70%	2 (3%)
71-80%	0 (0%)
81-90%	2 (3%)
91-100%	2 (3%)

Bait dealers were asked about substitutes for Atlantic menhaden bait (Table 19). They had the option of submitting as many substitute species as they wished, or choosing the option "No substitution." Many species were considered alternatives, but herring was by far the most popular substitute, cited by 12 bait dealers. However, 11 bait dealers reported no suitable substitute for Atlantic menhaden bait.

Table 19. Substitutions for Menhaden Bait, Absolute Number	
Bait Substitutions	**Frequency**
Herring	12
No Substitution	11
Clams	4
Croaker	4
Mullet	4
Mackerel	3
Shrimp	3
Squid	3
Butterfish	2
Skate	2
Artificial	1
Bloodworms	1
Blues	1
Cod Head	1
Eel	1
Pacific Rockfish	1
Redfish	1
Shad	1
Soft Bait	1

Fishermen and bait dealers were asked whether they considered various issues important to them (Table 20). Respondents ranked the issues on a scale of one to five, with one being extremely important and five being not at all important. Health of menhaden and habitat was considered extremely to very important (mean=1.84), and quotas were considered very to moderately important (mean=2.13). In contrast, crew or labor issues and competition among local fishermen were considered moderately to slightly important, with means of 3.65 and 3.77, respectively.

Table 20. Importance of Current Issues to the Atlantic Menhaden Industry						
	Extremely Important (1)	**Very Important (2)**	**Moderately Important (3)**	**Slightly Important (4)**	**Not at all Important (5)**	**Mean**
Health of menhaden and habitat	45	26	9	2	6	1.84
Quotas	48	12	9	7	12	2.13
Gear Restrictions	36	14	11	7	19	2.53
Overfishing	32	17	13	5	22	2.64
Cost of licensing and taxes	23	20	17	9	17	2.73
Record keeping (trip tickets, tax purposes)	17	15	25	13	16	2.95
Fuel Prices	21	16	13	12	26	3.07
Competition among fishermen from other states	16	13	18	5	37	3.38
Crew or labor issues	9	14	16	9	40	3.65
Competition among local fishermen	7	8	21	13	38	3.77

Fishermen and bait dealers indicated whether they had experienced a significant change of 25 percent or more in landings or fish sold from one year to the next from 2010 to 2015 (Table 21). Increases in landings or fish sold were noted somewhat uniformly throughout all six years, whereas decreases were noted more frequently in years 2013, 2014 and 2015. Respondents attributed reason(s) for a change in a given year (Table 22). The most frequently cited reason for a significant increase in sales or landings was availability of stock, followed by weather (e.g. recovery from Hurricane Sandy) and increasing market price of menhaden. The most frequently cited reasons for a significant decrease in sales or landings were availability of stock, change in state regulations (e.g. 2013 state quotas), and weather.

Table 21. Significant Change in Sales/Landings of Menhaden Since 2010						
	2010	2011	2012	2013	2014	2015
No Change	58	61	56	40	38	32
Increase	22	19	20	26	27	30
Decrease	5	3	7	19	17	20

Table 22. Reasons for Significant Increases and Decreases in Sales and Landings Since 2010		
Reasons for Significant Change	Increase	Decrease
Availability of stock	105	30
Change in state regulations - quota restrictions, gear restrictions, etc.	13	19
Competition	4	3
Fuel Prices	7	4
Changes in business – new equipment, abundance of labor force, etc.	10	1
Personal reasons – more time available, etc.	16	3
Weather	48	17
Market price of menhaden	43	5

4 ACCSP Data Summary

Each of the landings data sets provided by the ACCSP includes information on pounds landed, ex-vessel revenue and a “Record Count” variable, which is a proxy for the number of trips. The ex-vessel price per pound was approximated by dividing ex-vessel revenue by pounds landed. We adjusted for inflation by the consumer price index so that all values are expressed in 2015 dollars.

4.1 County Level Data

Given that the “second” county level data set included disposition of landings and covers the time period over which data is considered most reliable (post 1985), we focused most of our attention here. Also, given that the reduction fishery is a vertically integrated industry with ex-vessel prices estimated with limited variation by NMFS, we focused our analysis of the determinants of landings and ex-vessel price on the bait fishery.

There are 1,546 cases (county-year combinations) in the data. Sixty-one percent of these are for bait, 14% are for food and 21% are of unknown disposition. The remaining 4% of landings include personal use (n=28), reduction (n=21), kept (n=5), no catch (n=3), canned pet (n=1), animal food (n=1) and aquarium (n=1). Twenty-one cases are for the reduction fishery with sixteen years reported in Northumberland County, VA and five years of landings reported in Carteret County, NC. For the entire sample there are 3.6 million tons of menhaden landed.

In order to analyze the data as a panel (i.e., cross-section, time-series), we exclude 25 counties that appear in the data only once and several counties that are coded as “unknown.” We delete a number of outliers in order to improve the analysis. First, we delete one observation with a catch per unit effort (CPUE = pounds/trips) that is greater than two times the next largest CPUE (2.1 million pounds > 0.9 million pounds). Second, we observe that there are a number of cases with high ex-vessel prices per pound, where price is estimated as revenue divided by pounds. The mean price over 840 observations is $706 per ton with a range from $0.10 to $22,000. In order to trim outliers, we consider the state level annual distribution of prices from the third data set (reported below). We delete all of the county level observations in the 1% tails of the state distribution. Fifty-four cases are deleted with a price per ton greater than $1478 and 5 cases are deleted with a price per ton less than $79.

The remaining sample size available for the county level analysis is 777 (Table 23). The number of counties with menhaden bait landings varies from a low of 41 in year 2004 to a high of 55 in year 2015. The mean price per ton is $265 with a range from $82 to $1476. The mean tons landed is 673 with a range of 0.001 to 29,627. For comparison, the mean price per ton reported in the reduction fishery is $172 per ton with a range from $135 to $234. The mean tons landed is 128,000 with a range of 5,942 to 222,000 in the reduction fishery.

Table 23. County Level Data Summary: 2000-2015

	Bait Sector			
Variable	Mean	Std Dev	Min	Max
Price per ton ($2015)	265	139	82.23	1476
Landings (tons)	673	3059	0	29627
Trips	130	363	1	4490
Counties		87		
Years		16		
Sample Size		777		

Given the limitations imposed by these three variables, we estimated a system of equations with landings a function of effort and price a function of landings. Since market price is determined by both demand and supply conditions, we estimated the model as two-stage least squares with the menhaden landings variable corrected for endogeneity. The predictive equation for landings is $Q = f(T)$ where Q is menhaden landings and T is trips. We estimated an inverse demand ex-vessel menhaden price function of the form: $P = f(Q)$, where P is the menhaden ex-vessel price. This ex-vessel price model is common in the literature, although our data limitations restrict our model to its simplest form (Park, Thurman and Easley 2004).

Each of the models is estimated using unbalanced panel data. We included year and county level fixed effects to account for idiosyncratic heterogeneity over time and space (i.e., omitted variables). These fixed effects account for all other county (i) level or time (t) period variation not available in the data. The functional form is log-linear which provided a better statistical fit and allowed the regression coefficients to be interpreted as elasticities. The regression model is:

$$lnQ_{it} = \alpha_i + \alpha_t + \alpha_1 lnT_M + e_{it}$$

$$lnP_{it} = \beta_i + \beta_t + \beta_1 \widehat{lnQ_M} + u_{it}$$

where the hat (^) indicates the variable is predicted from the landings model to account for the endogeneity of landings in the price model.

The results of the model are presented in Table 24. Landings are positively related to the number of trips. The elasticity is equal to one, which indicates that landings increase in proportion to the number of trips. In the price model the coefficient on the predicted landings is statistically significant. The coefficient indicates that a 10% increase in landings leads to a 0.5% decrease in price. For example, a 10% increase in landings would reduce the mean price by only $1.26 to $264.

Table 24. Landings and Price Models with Unbalanced Panel Two-Way Fixed Effects

	Ln(Landings)			Ln(Price)		
	Coeff.	S.E.	t-stat	Coeff.	S.E.	t-stat
Intercept	-2.21	0.81	-2.74	5.35	0.22	24.65
Ln(Trips)	1.06	0.04	27.18			
Predicted Ln(Tons)				-0.05	0.01	-5.13
R^2		0.895			0.566	
Counties		87			87	
Years		16			16	
Sample Size		777			777	

4.2 State-Level Data

The state (and management unit Potomac River Fisheries Commission (PRFC) by state) level landings data for 2000 to 2015 is summarized in Appendix G. Maine and New Hampshire are the only states without landings for each of the 16 years of the time series. Massachusetts has landings for each year but those from 2000-2004 are not available from ACCSP. The mean price per ton ranges from a low of $163 to a high of $924. The mean annual landings range from 305 pounds to 189,000 tons. Trips range from a low of 15 to a high of 3360.

The state-level landings and ex-vessel price model specification is similar to the county level model (Table 25). We specified state-level landings as a function of trips and price as a function of landings. In addition to aggregation at the state level, these data and model include the reduction sector. This may explain why the landings model has different results at the state level relative to the county level. The trips coefficient is statistically significant but the coefficient is much smaller. Since overall landings are much greater and most trips in the data have a lower catch per trip than in the reduction fishery, the coefficient suggests that a 10% increase in trips would lead to only a 3.9% increase in landings. The same coefficient in the county-level bait model was 2.5 times larger. The coefficient on the landings variable in the ex-vessel price determination model is not statistically different from zero.

Table 25. Landings to Price Models with Unbalanced Panel Two-Way Fixed Effects						
	Ln(Tons)			Ln(Price)		
	Coeff.	S.E.	t-stat	Coeff.	S.E.	t-stat
Intercept	5.26	0.62	8.43	4.79	0.68	7.08
Ln(Trips)	0.39	0.09	4.32			
Predicted Ln(Tons)				0.04	0.09	0.47
R^2	0.897			0.601		
States	14			14		
Years	16			16		
Sample Size	199			199		

4.3 Coastwide Data

We next aggregated the state-level data to the Atlantic Coast level for comparison with other data summaries used by ASMFC. The data summary is reported in Table 26. The average annual landings is 280,000 tons with a minimum of 185,000 and a maximum of 408,000. The average annual number of fishing trips is 6760 with a range from 1914 to 14,133. The average price per ton is $319 with a range of $199 to $433.

Table 26. Atlantic Coast Data Summary				
	Mean	Std Dev	Min	Max
Landings	279,990	69,147	184,801	408,235
Trips	6760	3646	1914	14,133
Price	319	67	199	433
Years	30			

A linear trend analysis was conducted with these variables and the results are presented in Table 27. The Durbin-Watson (DW) test statistic in each model indicates positive autocorrelation, which is common in time-series data. Positive autocorrelation can lead to inflation of measures of model (R^2) and coefficient (t-ratio) goodness of fit. Since our goal is data description and not hypothesis testing or forecasting we do not address this statistical problem.

Table 27. Linear Trend Models with Atlantic Coast Data: 1986-2015									
	Landings			Trips			Price		
	Coeff.	S.E.	t-stat	Coeff.	S.E.	t-stat	Coeff.	S.E.	t-stat
Intercept	379,066	15,314	24.75	706.46	461.94	1.53	269.49	23.30	11.57
Trend	-6391.98	862.64	-7.41	390.56	26.02	15.01	3.19	1.31	2.43
R^2	0.66223			0.8985			0.1746		
DW	1.15			1.13			1.13		
Years	30			30			30		

First, the landings model indicated that there is a negative trend over the 30 years of the time series. Beginning with landings of 380,000 tons, annual landings have fallen by 6392 tons each year. The trend is the opposite for effort in the menhaden fishery. Beginning with an estimated 706 trips at the beginning of the time period, trips increased by 391 each year. Finally, ex-vessel price has increased over time. Beginning at $269 per ton, price has increased by $3.19 per ton each year on average.

The data summary and trend analysis masks significant variations in these variables over the past 30 years. These are illustrated in Appendix I. The landings data show that landings fluctuated around 350,000 tons from 1986 to the mid-1990s and then fell over a four year time period. Since about 2000, landings have fluctuated around 225,000 tons. In contrast there has been a fairly steady rise in menhaden trips. From a low of 230 in 1985, trips increased to over 1000 in 1986 and have increased to about 13,000. The only interruption in this trend was in the mid-2000s when trips fell for 2 years, recovered and began to grown again. Ex-vessel price fluctuated around an upward trend from 1985 to the mid-1990s and has fluctuated around a downward trend since that time.

4.4 Effort

Measures of effort in the Virginia bait fishery are hours spent on the water and crew size for 2005 to 2015. The effort data is summarized in Table 28. The sample size, i.e., annual number of trips, ranged from 1299 to 3941. The average number of hours spent on the water ranged from 2 to 120 per trip in each year. The mean hours ranged from 23.27 to 27.52. The number of crew ranged from 1 to 8 over the time period. The mean crew size ranged from 1.69 to 1.91.

Table 28. Virginia Fishing Effort					
			Hours		
Year	Trips	Mean	Std Dev	Min	Max
2005	1339	27.09	19.16	2	120
2006	1299	27.03	20.83	2	120
2007	2060	26.67	17.51	2	120
2008	2261	26.12	17.67	2	120
2009	2327	23.27	15.20	2	120
2010	2291	25.12	17.06	2	120
2011	2093	26.85	18.28	2	120
2012	2950	25.59	17.58	2	120
2013	2944	27.52	19.21	2	120
2014	3941	26.95	18.00	2	120
2015	3260	27.47	17.84	2	120
			Crew		
Year	Trips	Mean	Std Dev	Min	Max
2005	1339	1.82	0.94	1	4
2006	1299	1.81	0.86	1	5
2007	2060	1.83	0.94	1	5
2008	2261	1.79	0.87	1	4
2009	2327	1.89	1.01	1	7
2010	2291	1.86	0.87	1	6
2011	2093	1.78	0.84	0	6
2012	2950	1.69	0.81	1	6
2013	2944	1.70	0.85	1	6
2014	3941	1.87	0.89	1	8
2015	3260	1.91	0.89	1	5

We estimated a model of the determinants of time on the water per trip (Table 29). The model is estimated with one-way (time) fixed effects. We find that for each 10% increase in crew size, time on the water increased by 0.14%. The time trend suggests that time on the water increased by 0.008% with each additional year. To summarize, we find little evidence to suggest there have been significant changes in effort in the Virginia bait fishery over this time period.

Table 29. Determinants of Time on Water			
	Ln(Hours)		
	Coeff.	S.E.	t-stat
Intercept	2.948	0.011	269.01
Ln(Crew)	0.140	0.009	27.18
Trend	0.008	0.001	5.67
R^2	0.01		
Sample Size	26,762		

5 Economic Impacts Analysis

The allocation analysis utilized was an economic impact analysis, a shift from the economic efficiency analysis originally proposed in Harrison and Whitehead (2016) due to data limitations and other complications. In contrast to economic efficiency analysis, economic impact analysis considers the total changes in income and employment due to changes in quotas without consideration of marginal changes in these impacts. Given data limitations and the focus on menhaden quota by ASMFC we directed our analysis to the economic impacts of alternative menhaden quotas. Economic impacts are the changes in income that arise from changes in economic activity. With economic impact analysis, comparisons across sector are difficult as quota changes act as scalars, simply increasing or decreasing estimates of economic activity, relative to efficiency analysis which attempts to assess behavioral and market changes. But, economic impact analysis is appropriate for better understanding the distributional implications of alternative quotas. Additional information on the shift from economic efficiency analysis to economic impact is outlined in Appendix E.

Kirkley et al. (2011), used an IMPLAN model developed for the NMFS (Kirkley 2009) and calibrated for the regional economy, estimated the economic impacts on the Northumberland County, VA region of reducing menhaden quotas in the Chesapeake Bay. IMPLAN was originally developed by the U.S. Forest Service for regional economic planning and is now commercial software. Due to the expense of IMPLAN, we use multipliers from the Regional Input-Output Modeling System (RIMS) II that was developed by the Bureau of Economic Analysis (BEA) in the U.S. Department of Commerce. Both IMPLAN and RIMS II are input-output models, a system of linear equations that equate demand and supply for inputs and outputs in an economy. Richman and Schwer (1995) found that IMPLAN and RIMS II multipliers differ in their "off the shelf" versions but models calibrated for a local economy are similar.

IMPLAN users purchase the input-output model as computer software and are able to go "under the hood" to tailor the model to specific purposes. RIMS II users purchase tables of sector specific multipliers for self-defined regions or states directly from the BEA at a relatively low cost (https://www.bea.gov/regional/rims/). The RIMS II multipliers are from a 2007 national input-output model developed by the BEA. We used the multipliers that were released in December 2016 that have been updated with 2015 earnings and other data.

We treated the changes in expenditures into the local economy due to changes in menhaden quotas as a final demand change in the bait and reduction sectors of the commercial fishing industry. The RIMS II final demand industry used in this study is "114000 Fishing, Hunting and Trapping" which is one of 3 detailed industries in the "Forestry, Fishing and Related Activities" industry aggregation. There are 64 industry aggregations and almost 400 detailed industries in the RIMS II tables (these are available upon request).

The RIMS II multiplier tables report Type I and Type II multipliers. The direct and indirect effects of changes in local spending are included in the Type I multipliers. The direct effect is the first round of spending by commercial fishermen on inputs into the production activity (i.e., the direct effect multiplier is 1). The indirect effect includes the subsequent rounds of spending by firms supporting the commercial fishing industry. For example, the direct effect would include expenditures on fishing gear. The indirect effect would include spending by firms in the fishing gear industry. Type II multipliers are larger than Type I multipliers because they include the direct, indirect and induced effects of spending changes. Induced effects result from the spending changes of households who are affected by direct and indirect effects.

The final demand region is the individual state for the bait fishery. For the reduction fishery the final demand region is Northumberland County and the rest of Virginia. Northumberland County impacts are subtracted from Virginia impacts to avoid double counting for the rest of Virginia. The induced effects estimated by the Type II multipliers are biased upwards since the statewide region is much larger than the coastal regions where commercial fishermen spend their earnings. We calculated both Type I and Type II impacts but consider the direct and indirect effects (Type I) to be more reliable.

We estimated changes in output, earnings, employment and value added with the Type I and II multipliers generated by changes in the menhaden quotas. These multipliers are presented in Tables 30 and 31. Output is a gross measure of the estimated change in spending due to the change in quotas. Earnings is an estimate of the changes in disposable personal income. Employment is an estimate of the changes in full-time and part-time jobs. Value-added is a measure of the estimated net change in spending. Value added is equal to output minus the value of intermediate inputs used in the industry. It is similar to a measure of regional Gross Domestic Product (GDP) for which earnings is one component and avoids the double-counting suffered by gross output estimates.

Table 30. Type I Multipliers for Fishing, Hunting to Trapping Industry				
	Output	Earnings	Employment	Value Added
Connecticut	1.2274	0.3508	13.9051	0.8102
Delaware	1.2581	0.3245	17.4571	0.8124
Florida	1.2321	0.372	19.8284	0.8158
Maine	1.1899	0.3565	11.2417	0.7903
Maryland	1.1994	0.3425	18.5404	0.7974
Massachusetts	1.1836	0.3274	10.0629	0.7908
New Hampshire	1	0	0	0
New Jersey	1.2871	0.3689	11.0385	0.8363
New York	1.1882	0.3444	18.885	0.7923
North Carolina	1.2367	0.366	19.6112	0.8129
PRFC	1.2305	0.3634	20.5537	0.8115
Rhode Island	1.1916	0.3432	10.7411	0.7917
Virginia	1.2305	0.3634	20.5537	0.8115
Northumberland	1.0511	0.2827	17.8186	0.7174

Table 31. Type II Multipliers for Fishing, Hunting to Trapping Industry				
	Output	Earnings	Employment	Value Added
Connecticut	1.5827	0.4546	15.4137	1.0242
Delaware	1.5669	0.4031	19.7407	0.9949
Florida	1.6960	0.5152	24.1768	1.0964
Maine	1.5504	0.4717	14.696	1.005
Maryland	1.5847	0.4522	21.3414	1.0287
Massachusetts	1.5407	0.4316	12.6832	1.0044
New Hampshire	1	0	0	0
New Jersey	1.7562	0.4999	14.2425	1.1134
New York	1.5531	0.4435	21.2966	1.1857
North Carolina	1.6855	0.5013	23.5111	1.077
PRFC	1.6412	0.4804	23.835	1.2346
Rhode Island	1.5331	0.4383	13.4251	0.9959
Virginia	1.6412	0.4804	23.835	1.2346
Northumberton	1.1107	0.2978	18.341	0.7541

In order to better understand the impact estimates, suppose the quota change leads to a change of final demand (D). The Type I output is $Y_I = D \times M_I$, where M_I is the Type I multiplier. The Type II output is $Y_{II} = D \times M_{II}$, where M_{II} is the Type II multiplier. Kirkley et al. report impacts where $Total = Direct + Indirect + Induced$. We report our results as $Total = Y_{II}$, $Direct = D$, $Indirect = Y_I - D$, and $Induced = Y_{II} - Y_I$. Similar translations from RIMS II to IMPLAN are made for earnings, employment and value added. In contrast, Kirkley et al. reports direct (D), indirect ($Y_I - D$) and induced ($Y_{II} - Y_I$) impacts separately. The RIMS II multipliers do not allow an estimate of the direct impacts on earnings, employment and value added.

As a hypothetical example of the comparison, consider the Type I multipliers for Connecticut and a $100,000 increase in spending (Table A). Gross output would be expected to increase by $122,740 ($100,000 × 1.2274), earnings would increase by $35,100 ($100,000 × 0.3508), and value added would increase by $81,000 ($100,000 × 0.8102). Employment would increase by 1.39 full- and part-time jobs ($100,000 × 13.9051 ÷1,000,000).

Now consider the Type II multipliers for Connecticut. With a $100,000 increase in spending, gross output would be expected to increase by $158,270 ($100,000 × 1.5827), earnings would increase by $45,460 ($100,000 × 0.4546), and value added would increase by $102,420 ($100,000 × 1.0242). Employment would increase by 1.54 full- and part-time jobs ($100,000 × 15.4137 ÷1,000,000).

Table A		
	Type I	Type II
Direct	100,000	100,000
Output	122,740	158,270
Earnings	35,100	45,460
Employment	1.39	1.54
Value Added	81,000	102,420

Given this example from RIMS II, the total, direct, indirect and induced impacts are organized as below by Kirkley et al (Table B). Direct output is $100,000. Indirect output is the difference between the Type I impacts and direct impacts or $22,740. Induced impacts is the difference between the Type II and Type I impacts, $35,530. Similarly, direct plus indirect earnings are $35,100 and induced earnings are the difference between the Type II and Type I earnings above.

<table>
<tr><th colspan="5">Table B</th></tr>
<tr><th></th><th>Direct</th><th>Indirect</th><th>Induced</th><th>Total</th></tr>
<tr><td>Output</td><td>100,000</td><td>22,740</td><td>35,350</td><td>158,270</td></tr>
<tr><td>Earnings</td><td colspan="2">35,100</td><td>10,360</td><td>45,460</td></tr>
<tr><td>Employment</td><td colspan="2">1.39</td><td>0.15</td><td>1.54</td></tr>
<tr><td>Value Added</td><td colspan="2">81,000</td><td>21,420</td><td>102,420</td></tr>
</table>

Considering this translation of RIMS II to IMPLAN and back, the Type I multipliers implied by the direct, indirect and induced impacts reported by Kirkley et al. (2011) are 1.1942 and 1.3122 for Northumberland County. The RIMS II Type I and II multipliers are 1.0511 and 1.1107, respectively, for Northumberland County. With these relative values, Type I direct and indirect effects reported here are about 88% of those that would result from the IMPLAN model developed by Kirkley et al. The Type II total effects (the sum of the direct, indirect and induced effects) for Northumberland County are about 85% of those estimated by the Kirkley et al. model.

The Type I multipliers implied by the direct, indirect and induced impacts estimated by Kirkley et al. are 1.2629 and 1.4708 for Virginia. The Type I and II multipliers are 1.2305 and 1.6412 from RIMS II for Virginia. The direct and indirect effects reported here are about 97% of those that would result from the IMPLAN model developed by Kirkley et al. The total effects are about 112% of those estimated by the Kirkley et al. model.

In general, the RIMS II economic impacts are conservative relative to the Kirkley et al. IMPLAN model developed for the Northumberland County region. The only exception is the total effect for Virginia, which is due to the RIMS II Type II multipliers at the state level being greater than the coastal region affected by menhaden landings. Again, the total effects at the state level estimated in this report are overestimated due to this regional effect. For Virginia, the overestimate is about 12%. The solution to the overestimation at the state level would be constructing menhaden bait regions for each Atlantic state.

5.1 Results

We estimated the changes in economic impacts from changes in quotas in the bait fishery with the equation:

$$\Delta Y = (\Delta TAC \times P) \times M$$

where ΔY is the change in the outcome measure (output, earnings, employment, value added), ΔTAC is the change in the total allowable catch (quota), P is the retail price and M is the multiplier. The final demand change in the bait sector is estimated as the product of the change in TAC (quota) and retail bait price, the change in final demand is estimated as ΔTAC×P.

The change in the total allowable catch is computed as differences from the 2017 baseline (ASMFC 2016) under various scenarios. We estimated the impacts of 6.45% increase in the 2017 TAC over the 2016 TAC and positive and negative 1% to 30% changes from the 2017 TAC.

5.1.1 Bait Fishery

We estimated the retail bait price with an estimate of the markup over dealer cost. Dealer cost is estimated as the ex-vessel price per pound from the ACCSP data presented in Appendix G. The mean ex-vessel price per pound is $0.0925 in 2015. Based on the regression results in the previous section, we assume that the bait fishery ex-vessel price is insensitive to landings within the range of policy relevant quotas.

The markup over cost is estimated from the dealer and fishermen surveys conducted for this project. The ex-vessel price per pound is coded at the midpoint of the price range reported by the 28 bait fishermen who completed the survey and provided full data. The price is weighted by pounds landed (also coded at the midpoint of the ranges presented in the survey) and divided by total landings in the survey. The mean ex-vessel price per pound is $0.129. A similar approach is used to estimate the bait dealer price for 34 dealers who reported pounds sold and price. The mean retail price per pound is $0.274. The ratio is an estimate of the bait markup. The estimated markup is 212%.

The estimates of Type I and Type II impacts in the bait sector from the 6.45% quota increase are presented in Tables 32 and 33. The spreadsheet calculations are illustrated in Appendix J with multipliers from Table 30 (the multipliers for the PRFC are assumed to be equal to the Virginia multipliers). The direct and indirect (i.e., Type I) change in total output is estimated to be $1.5 million with $431 thousand in earnings and $974 thousand in value added for the Atlantic Coast. The estimated number of full and part-time jobs created is 18. Most, 85%, of these impacts accrue in New Jersey and Virginia. In New Jersey, the change in total output is $747 thousand with $214 thousand in earnings and $485 thousand in value added. The estimated number of full and part-time jobs created is 6. The changes in Virginia are $522 thousand in total output with $154 thousand in earnings and $344 thousand in value added. The estimated number of full and part-time jobs created is 9. The earnings per full and part-time job created is $33 thousand in New Jersey and $19 thousand in Virginia.

Table 32. Type I Impacts of the 6.45% 2017 TAC Change in the Bait Sector

State	Output	Earnings	Employment	Value Added
Connecticut	1,111	317	0.01	733
Delaware	862	222	0.01	556
Florida	1,148	347	0.02	760
Maine	2,430	728	0.02	1,614
Maryland	85,389	24,384	1.32	56,770
Massachusetts	51,479	14,240	0.44	34,395
New Hampshire	2	-	-	-
New Jersey	747,142	214,141	6.41	485,459
New York	3,417	990	0.05	2,279
North Carolina	31,608	9,354	0.50	20,776
PRFC	39,620	11,701	0.66	26,129
Rhode Island	1,107	319	0.01	736
Virginia (Bait)	521,608	154,045	8.71	343,995
Total	1,486,923	430,788	18.17	974,201

Table 33. Type II Impacts of the 6.45% 2017 TAC Change in the Bait Sector				
State	Output	Earnings	Employment	Value Added
Connecticut	1,432	411	0.01	927
Delaware	1,073	276	0.01	681
Florida	1,581	480	0.02	1,022
Maine	3,166	963	0.03	2,053
Maryland	112,820	32,194	1.52	73,237
Massachusetts	67,011	18,772	0.55	43,685
New Hampshire	2	-	-	-
New Jersey	1,019,447	290,184	8.27	646,312
New York	4,466	1,275	0.06	3,410
North Carolina	43,078	12,812	0.60	27,526
PRFC	52,844	15,468	0.77	39,752
Rhode Island	1,424	407	0.01	925
Virginia (Bait)	695,704	203,641	10.10	523,346
Total	2,004,049	576,885	21.96	1,362,876

The direct, indirect and induced (i.e., Type II) increases in total output, earnings and value added are estimated to be $2 million, $577 thousand and $1.4 million with the 6.45% increase in the TAC. The estimated number of full and part-time jobs created is 22. In New Jersey, the change in total output is $1 million with $290 thousand in earnings and $485 thousand value added. The changes in Virginia are $522 thousand in total output with $154 thousand in earnings and $344 thousand. The estimated number of full and part-time jobs created is 8 in New Jersey and 10 in Virginia. The earnings per job created is $35 thousand in New Jersey and $20 thousand in Virginia. As described before, these Type II estimates are likely overestimated by about 12%.

In Tables 34 and 35 are estimates of economic impacts due to 5% increases and decreases in the TAC from the 2017 baseline. The impacts are symmetric, i.e., increases and decreases are the same digits with opposite signs. The direct and indirect (i.e., Type I) change in gross output due to a 5% change in the TAC is estimated to be $1.2 million coastwide. With 5% changes in the TAC, earnings would change by $355 thousand and value added would change by $804 thousand. The estimated change in the number of full and part-time jobs created is 15. The direct, indirect and induced (i.e., Type II) changes in total output, earnings and value added are estimated to be $1.7 million, $476 thousand and $1.1 million with a 5% change in the TAC. The estimated number of full and part-time jobs created is 18.

In Appendix J are the Type I economic impacts associated with incremental 1% to 30% changes in the TAC for each state except New Hampshire. These tables could be used to examine the impacts of different quotas across Atlantic states.

Table 34. Type I Impacts (+/-) of 5% TAC Changes (+/-) in the Bait Sector				
State	Output	Earnings	Employment	Value Added
Connecticut	916	262	0.01	605
Delaware	711	183	0.01	459
Florida	948	286	0.02	628
Maine	2,005	601	0.02	1,332
Maryland	70,463	20,121	1.09	46,846
Massachusetts	42,480	11,751	0.36	28,382
New Hampshire	1	0	0.00	0
New Jersey	616,537	176,708	5.29	400,598
New York	2,820	817	0.04	1,880
North Carolina	26,083	7,719	0.41	17,144
PRFC	32,694	9,655	0.55	21,561
Rhode Island	914	263	0.01	607
Virginia (Bait)	430,428	127,117	7.19	283,862
Total	1,227,000	355,484	14.99	803,905

Table 35. Type II Impacts (+/-) of 5% TAC Changes (+/-) in the Bait Sector				
State	Output	Earnings	Employment	Value Added
Connecticut	1,182	339	0.01	765
Delaware	886	228	0.01	562
Florida	1,305	396	0.02	843
Maine	2,613	795	0.02	1,694
Maryland	93,098	26,566	1.25	60,434
Massachusetts	55,297	15,490	0.46	36,049
New Hampshire	1	0	0.00	0
New Jersey	841,241	239,458	6.82	533,332
New York	3,686	1,052	0.05	2,814
North Carolina	35,548	10,573	0.50	22,714
PRFC	43,606	12,764	0.63	32,803
Rhode Island	1,175	336	0.01	764
Virginia (Bait)	574,091	168,044	8.34	431,862
Total	1,653,729	476,042	18.12	1,124,636

5.1.2 Reduction Fishery

We estimated economic impacts in the reduction fishery by following the logic and assumptions used by Kirkley et al. (2011). Kirkley et al. estimated the final demand change due to the production of fish oil and fish meal due to menhaden landings on the Northumberland County and rest of Virginia economy in 2008. We assumed that the reduction fishery ex-vessel price is insensitive to landings since there is little variation in the price estimate by NMFS, relative to the bait fishery, and too few observations to estimate an economic model. The ex-vessel price used for the Kirkley et al. analysis is $0.06 per pound. Kirkley et al. estimated a baseline final demand change of $60 million associated with menhaden landings of 311 million pounds. These estimates are presented in the upper half of Table 36.

In the lower half of Table 36 are estimates of baseline impacts by scaling up each number for landings of 316 million pounds (the 2015 estimate of Virginia purse seine landings was obtained from the NMFS website). The scaling factor is equal to 1.016 (316/311). With this scaling the final demand (output) for the reduction sector is estimated to be $61 million in 2015. The indirect and induced impacts on Northumberland County are estimated to be $11.8 million and $7 million. The total impacts are presented for the state of Virginia. The additional indirect and induced output effects are $4.2 million ($16.0 minus $11.8) and $5.5 ($12.7 minus $7.2) million. Direct, indirect and induced earnings for Northumberland County are $9.2 million, $4.6 million and $2.5 million. For the rest of Virginia, these are $3.5 million ($12.8 minus $9.3), $1.7 million ($6.3 minus $4.6) and $1.6 million ($4.1 minus $2.5), respectively. Baseline employment is 221, 76 and 56 full and part-time jobs for direct, indirect and induced impacts in Northumberland County. Additional employment in the rest of Virginia is 83, 50, and 52 full and part-time jobs for direct, indirect and induced impacts.

Table 36. Baseline Economic Impacts in the Reduction Sector				
Kirkley et al. 2008 Baseline Economic Impacts (311 million lbs)				
Virginia				
	Direct	Indirect	Induced	Total
Employment	299	114	106	528
Earnings	12,562,000	6,191,000	3,988,000	22,741,000
Output	59,919,000	15,750,000	12,459,000	88,128,000
Northumberland County				
	Direct	Indirect	Induced	Total
Employment	217	75	55	519
Earnings	9,117,000	4,487,000	2,441,000	16,045,000
Output	59,919,000	11,639,000	7,066,000	78,624,000
2015 Baseline Economic Impacts (316 million lbs)				
Virginia				
	Direct	Indirect	Induced	Total
Employment	304	116	108	528
Earnings	12,775,670	6,296,304	4,055,833	23,127,807
Output	60,938,175	16,017,895	12,670,918	89,626,988
Northumberland County				
	Direct	Indirect	Induced	Total
Employment	221	76	56	353
Earnings	9,272,073	4,563,320	2,482,519	16,317,913
Output	60,938,175	11,836,970	7,186,187	79,961,332

The final demand is increased by 6.45% to simulate the effects of the 2017 6.45% increase in the TAC and present results in the RIMS II format (Table 37). The 6.45% TAC increase is estimated to increase Type I (direct and indirect effects) output by $4.1 million in Northumberland County. Earnings are estimated to increase by $1.1 million with 70 additional full and part-time jobs. The value added is $2.8 million. The direct and indirect effects in the rest of Virginia are estimated to be $705 thousand in gross output, $317 thousand in earnings, 11 additional full and part-time jobs and $370 thousand in value added.

Table 37. Economic Impacts of the 6.45% 2017 TAC Increase in the Reduction Sector				
	Type I Impacts			
	Output	Earnings	Employment	Value Added
Northumberland County	4,131,361	1,111,156	70	2,819,750
Rest of Virginia	705,134	317,192	11	369,861
Virginia Total	4,836,495	1,428,348	81	3,189,611
	Type II Impacts			
	Output	Earnings	Employment	Value Added
Northumberland County	4,365,620	1,170,507	72	2,963,999
Rest of Virginia	2,085,137	717,712	22	1,888,611
Virginia Total	6,450,757	1,888,218	94	4,852,610

The 6.45% TAC increase is estimated to increase Type II (direct, indirect and induced effects) output by $4.4 million in Northumberland County. Earnings are estimated to increase by $1.2 million with 72 additional full and part-time jobs. The value added is $3.0 million. The direct, indirect and induced effects in the rest of Virginia are estimated to be $2 million in gross output, $718 thousand in earnings, 22 additional full and part-time jobs and $1.8 million in value added. Based on the earlier comparison between IMPLAN and RIMS II multipliers, these estimates are likely biased upwards by about 12%.

In Table 38 are estimates of economic impacts due to 5% increases and decreases in the TAC from the 2017 baseline for the reduction sector ($65 million final demand change). As above, the positive and negative impacts are symmetric. A 5% TAC change is estimated to change Type I output by $3.4 million in Northumberland County. Earnings are estimated to change by $917 thousand with 75 additional full and part-time jobs. The change in value added is $3.0 million. The direct and indirect effects in the rest of Virginia are estimated to be $582 thousand in gross output, $262 thousand in earnings, 11 additional full and part-time jobs and $394 thousand in value added.

Table 38. Economic Impacts (+/-) of 5% TAC Changes (+/-) in the Reduction Sector				
	Type I Impacts			
State	Output	Earnings	Employment	Value Added
Northumberland County	3,409,174	916,919	75	3,001,623
Rest of Virginia	581,872	261,745	11	393,717
Virginia total	3,991,046	1,178,664	86	3,395,341
	Type II Impacts			
State	Output	Earnings	Employment	Value Added
Northumberland County	3,602,483	965,895	77	3,155,177
Rest of Virginia	1,720,642	592,251	23	2,010,427
Virginia Total	5,323,124	1,558,146	100	5,165,604

A 5% TAC increase is estimated to increase Type II output by $3.6 million in Northumberland County. Earnings are estimated to increase by $966 thousand with 77 additional full and part-time jobs. The value added is $3.2 million. The direct and indirect effects in the rest of Virginia are estimated to be $1.7 million in gross output, $592 thousand in earnings, 23 additional full and part-time jobs and $2 million in value added. These estimates are likely biased upwards by about 12%.

In Appendix J are the estimated Type I economic impacts associated with incremental 1% to 30% changes in the TAC for Northumberland County and the rest of Virginia. These tables could be used to examine the impacts of different quotas across Atlantic states.

5.2 NOAA Coastal County Impact Data Analysis

In order to provide an alternative estimate of economic impacts from changes in menhaden landings we attempted to estimate the effect of bait landings on employment (i.e., jobs) and income in counties with menhaden landings. We used county level economic data on jobs and income from NOAA which is available on the BEA website (https://www.bea.gov/regional/docs/noaa.cfm). The time span covered is 2005 to 2013. A data summary of these variables and landings is presented in Appendix L. The number of counties represented in these data ranged from 47 to 53. We deleted counties that were represented in the data only once in order to estimate a two-way fixed effects model. There are 452 county-year combinations in the data. We deleted counties with landings in the reduction sector.

We estimated two-way fixed effects panel data models for jobs and income and the results are presented in Table 39. The only variable used to explain differences in jobs and income is menhaden bait landings. The coefficient on landings in the employment model is not statistically different from zero. The coefficient on landings in the income model is negative and statistically different from zero at the 90% confidence level. This result suggests that each 10% increase in menhaden landings leads to a 0.02% decrease in income. The magnitude is too small to consider this coefficient economically significant.

Table 39. Unbalanced Panel Two-Way Fixed Effects Determinants of Employment to Income

	Ln(Employment)			Ln(Income)		
	Coeff.	S.E.	t-stat	Coeff.	S.E.	t-state
Intercept	11.73917	0.0162	723.47	15.57569	0.0186	837.40
Ln(Landings)	-0.00101	0.00148	-0.68	-0.00294	0.00169	-1.74
R^2		0.01			0.01	
Counties		69			69	
Years		9			9	
Sample Size		452			452	

This analysis suggests that bait landings do not have a statistically significant economic impact on the coastal county. However, these results may be due to a number of other factors. First, bait sector landings may be too small to have a noticeable effect on aggregate county level employment and income. Also, there may be too little variation in landings within each county to justify regression analysis.

6 Public Opinion Survey

Stated preference surveys elicit preferences by asking survey respondents how they would behave in hypothetical situations. In our case, we described menhaden quota scenarios and asked respondents if they would vote in favor of increases or decreases in quotas to advise the ASMFC. In addition, the stated preference scenario was designed to estimate preferences for ecosystem-based fisheries management.

The survey design evolved from the Kirkley et al. contingent valuation scenario with individual payment to a discrete choice experiment scenario with public tradeoffs between ex-vessel revenue, jobs and ecosystem services (Carson and Czajkowski 2014). The "public value" approach we use follows the approach introduced by Blomquist, Newsome and Stone (2000, 2003, and 2004). More recently, Kaplowitz and Lupi (2012) use this approach in a discrete choice experiment to assess public preferences for best management practices for water quality.

In order to collect a large sample of data at relatively low cost we proposed an internet survey with a non-probability panel of respondents. We initially proposed use of the Survey Monkey panel but, as a result of price increases (more than a doubling), we used the Survey Sampling International panel. These panels are becoming popular in social science research but their ability to adequately represent the general public is still unresolved. Yeager et al. (2011) found that non-probability internet samples are less accurate than more representative probability samples for socioeconomic variables. Lindhjem, Henrik, and Stale Navrud (2011) reviewed the stated preference literature and find that internet panel data quality is no lower than more traditional survey modes and internet panel willingness to pay estimates are lower. In Kirkley et al. (2012) we found that the internet survey with a non-probability panel produces lower willingness to pay values to avoid reductions in menhaden quotas than a random digit dial telephone survey.

6.1 Survey Design

There are 31 questions in the survey (see Appendix M) [question numbers are in brackets]. Respondents are first asked for the Atlantic state in which they live [1]. Then we presented some information about the ASMFC and menhaden and asked about their knowledge of the ASMFC [2] and the Atlantic menhaden fishery [3]. We presented information about the annual landings and value of menhaden, and asked about the perceived importance of menhaden to the economy of the Atlantic coast [4]. We defined overfishing, showed the results of the 2012 menhaden stock assessment, and asked for concern about overfishing [5].

In order to gain insight into the perceived importance about the range of potential uses of menhaden we briefly described them (animal feed, human health supplement, bait, forage species and water quality improvement) and asked respondents to rate each of these on an importance scale [6]. We next described the 2016 menhaden quota at the state level (quota, price and revenue) and asked about the perceived importance of the menhaden quota to the respondent's home state [7].

In advance of stated preference questions that address ecosystem-based fisheries management we described the term and asked respondents how important they feel it is to manage menhaden at the ecosystem level relative to the individual species level [8]. After these preliminary questions, we described the stated preference voting questions with detailed instructions and asked respondents how well they understand them [9].

There are 3 quota increase scenarios and 3 quota decrease scenarios in the survey, each presented in a separate block. The 3 question blocks of increase or decrease quota scenarios are randomly ordered. In other words, one respondent might be presented with 3 quota increase scenarios followed by 3 quota decrease scenarios. Another respondent might receive the 3 quota decrease scenarios first followed by the quota increase scenarios.

In each scenario respondents are presented a "Current Quota" and told that "Landings throughout the Atlantic States are expected to be 410 million pounds and landings revenue (R) is expected to be \$[$R = P \times 410$] million at an average price of \$[P] per pound." The three quota change scenarios were differentiated by the ex-vessel price, \$[P], per pound. The mean, \$0.093, is the average annual ex-vessel price of Atlantic menhaden from 2001 to 2014 (in 2014 dollars inflated by the producer price index for farm products, processed foods and feeds). The year 2000 is excluded from this calculation as the 2000 price of \$0.13/pound is an outlier (\$0.023 per pound above the next highest price). The minimum price per pound is \$0.077 and the maximum is \$0.107. Within each of the increase/decrease quota question blocks, respondents were randomly assigned 3 possible quota changes: 10%, 20% or 30%.

Respondents were told in the instructions that "Changes in the landings of menhaden will lead to changes in the landing revenues that commercial fishing businesses receive when they sell their catch. Revenues are equal to pounds landed multiplied by the price per pound." The economic impact on each state is described by the change in ex-vessel revenue and industry jobs as a result of the quota change. The change in ex-vessel revenue across the Atlantic states was the product of the ex-vessel price and change in quota. The revenue changes ranged from a low of $3 million (10% quota change, minimum price) to a high of $13 million (30% quota change, maximum price).

In the instructions respondents are told that "Changes in the landings of menhaden will lead to changes in the number of jobs in the commercial fishing industry." The change in the number of jobs is estimated from market data from *Fisheries Economics of the United States* (NMFS, 2014). There is an estimated 34,828 jobs (without imports) in the mid-Atlantic commercial fishing industry (Delaware, Maryland, New Jersey, New York, and Virginia). Menhaden accounts for 7.05% of the commercial fishing revenue in the region. Applying this percentage to the total number of jobs we estimated that there are 2455 menhaden jobs in the mid-Atlantic. Since the mid-Atlantic region accounts for 99% of the menhaden landings in 2014, we estimated that there are about 2481 jobs supported by menhaden in the Atlantic States. We assumed that menhaden jobs are proportional to quota so that a 10% change in quota would lead to a 10% change in jobs. The job gains and losses due to the proposed quota changes are estimated to be 248, 496 and 744. We round these numbers to 250, 500 and 750 and randomly assign one of these three job gains/losses in each scenario.

There are three other attributes of the stated preference scenarios: water quality, populations of game fish species and water birds. These attributes relevant to ecosystem-based management were described in the instructions as: "There is the possibility that changes in menhaden landings will lead to changes in other parts of the ecosystem such as water quality, predator species like striped bass, weakfish and bluefish and waterbirds like osprey, pelicans and loons. There is currently much scientific uncertainty about these relationships. So, we describe the potential effects in very simple terms." There are 2 levels of these two attributes: no change and increase/decrease. For each of the quota scenarios there are 3 (quota) x 3 (job) x 2 (water quality) x 2 (game fish) x 2 (water birds) = 72 potential versions for each of the 3 price versions.

The choice question was framed as an advisory referendum vote to the ASMFC in the instructions: "You will be presented with several of these situations. Please consider each one independently. After each situation is presented you will be asked about which alternative you would vote for. For this question imagine that you have the opportunity to vote on the quota change in an advisory referendum to the ASMFC. If more than 50% of the households in [insert respondent state] vote for the quota change then the ASMFC would consider [insert respondent state] to be in favor." After the instructions and presentation of each scenario respondents are asked "Would you vote for or against the increased/decreased quota?" [11 – 16] An example of one of these questions is presented in Appendix N.

Following the choice questions we asked two debriefing questions. The first was intended to determine the amount of attention paid to each of the attributes [17] and the second was intended to determine how seriously respondents took the voting exercise [18]. The survey concluded with a number of questions about survey salience [19 – 23], socioeconomic factors [24 – 31] and an open-ended comment box [32].

ASMFC staff reviewed the survey for scientific accuracy and policy relevance. A revision of the survey was pretested with a sample of 59 respondents. No issues emerged in the pretest. The survey can be viewed online at: https://www.research.net/r/menhaden.

6.2 Data Summary

The survey targeted the two states with the largest menhaden quota: New Jersey and Virginia, and six other key menhaden states. The targeted number of completed responses was n = 2000 broken down as: VA (400), NJ (400), ME (200), FL (200), NC (200), MD (200), NY (200) and RI (200). The survey was fielded online in October using the SurveyMonkey platform and Survey Sampling International online panel. We received 2253 responses from the eight Atlantic Coast states. We received 495 and 475 responses from New Jersey and Virginia. We received 227, 217, 216, 236, 229 and 158 responses from Florida, Maine, Maryland, New York, North Carolina and Rhode Island. The samples are balanced by gender and ethnicity in each state except for Maine for which the panel was too small to achieve this balance. The survey data was weighted by state population in our regression analysis.

Ten percent of the sample knew “a lot” about the ASMFC before the survey, 15% knew “some”, 16% knew “a little” and 59% knew “nothing”.[4] Before we asked respondents about how much they knew about Atlantic menhaden we presented a color image of a menhaden to 51% of respondents. The remaining 49% did not see the image. Nine percent of the sample knew “a lot” about Atlantic menhaden before the survey, 15% knew “some”, 15% knew “a little” and 52% knew “nothing”.

Forty-seven percent of the respondents thought the Atlantic menhaden commercial fishery was very important to the economy, 45% thought it was somewhat important, 5% thought it was somewhat not important and 3% thought it was not important. Twenty-seven percent of the respondents were very concerned about overfishing of menhaden, 38% were somewhat concerned, 27% were not too concerned and 8% were not at all concerned.

Forty-four percent of respondents thought that menhaden were very important for fish meal, 42% for fish oil, 27% as bait for recreational fishing and 35% as bait for commercial fishing. Fifty-nine percent thought that menhaden were very important as food for other fish species, 53% as food for water birds, and 62% for water quality.

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[4] The univariate data summary for each survey question is presented in Appendix O.

Forty-two percent thought that the Atlantic menhaden commercial fishery was very important to their state, 40% thought it was somewhat important, 14% thought it was somewhat not important and 5% thought it was not important. Fifty-three percent thought it was very important to manage menhaden at the ecosystem level instead of the individual species level, 42% thought it was somewhat important, 4% thought it was somewhat not important and 2% thought it was not important.

After reading the instructions, 45% said that they understood them very well, 45% said they understood them somewhat well and 8% said that they did not understand them very well. Two percent did not read the instructions. After the six choice questions, we asked respondents about how much they considered each of the factors when they were making decisions about how to vote. Sixty-three percent stated that they considered water quality "a lot" and 32% stated they considered it "some". Fifty percent considered the number of jobs a lot and 41% them some. Thirty-seven percent considered game fish populations a lot and 54% considered them some. Thirty-three percent considered water bird populations a lot and 57% considered them some. The factors that contribute to quota revenue were considered the least. Twenty-six percent and 21% considered the size of the quota and price per pound a lot. Eighteen percent and 29% did not consider the quota or price at all. While not one of the attributes, we also included overfishing in this list. Forty-one percent considered overfishing a lot and 49% considered it some.

Fifty-one percent of respondents strongly agreed and 28% somewhat agreed that results of the survey would be shared with the ASMFC. Thirty seven percent strongly agreed and 37% somewhat agreed that the results of the survey could affect ASMFC decisions about menhaden. Forty-four percent strongly agreed and 35% somewhat agreed with the statement that they understand all of the information presented on the proposed alternative menhaden quotas. Forty-nine percent strongly agreed and 33% somewhat agreed that public opinion surveys are a good way for citizens to express their preferences about fisheries policy.

Twenty percent of respondents were members of a recreational, environmental or conservation organization or association. Eleven percent of respondents were currently employed in the commercial fishing or a related industry. Twenty-four percent had participated in recreational saltwater fishing in the previous 24 months. Eighty-three percent of these respondents had participated in recreational saltwater fishing in their home state in the previous 12 months. These respondents fished an average of 22 days in their home state during the previous 12 months.

The average household size is 3 with 1 person below the age of 18. Fifty-two percent of the sample is female and 68% is white. About two-percent of the sample did not finish high school, 18% are high school graduates, 22% went to college but did not get a degree, 11% have an associate degree, 28% have a bachelor's degree, and 19% have a graduate or professional degree. Four percent of respondents have income less than $10,000, 3% have income between $10,000 and $14,999, 7% are between $15,000 and $24,999, 8% are between $25,000 and $34,999, 14% are between $35,000 and $49,999, 17% are between $50,000 and $74,999, 20% are between $75,000 and $99,999, 17% are between $100,000 and $149,999, 5% are between $150,000 and $199,999, and 3% have incomes of $200,000 or more.

6.3 Stated Preference Data Analysis

After removing individuals who explicitly stated that they did not read the survey directions, we have 2022 respondents, and 12,132 total observations since each respondent answered 6 choice questions. In Table 40 we report a summary of the choice experiment data. The sample size for each of the six choices is 2022.

Table 40. Stated Preference Data Summary

	Increase Quota				Decrease Quota			
	Low Price Scenario				Low Price Scenario			
Variable	Mean	Std.Dev.	MIN	MAX	Mean	Std.Dev.	MIN	MAX
For	0.43	0.50	0	1	0.42	0.49	0	1
Revenue	6.35	2.59	3.16	9.47	6.25	2.59	3.16	9.47
Jobs	499	205	250	750	490	205	250	750
Water quality	0.51	0.50	0	1	0.50	0.50	0	1
Game fish	0.52	0.50	0	1	0.50	0.50	0	1
Water birds	0.52	0.50	0	1	0.00	0.00	0	0
	Mid-Price Scenario				Mid-Price Scenario			
Variable	Mean	Std.Dev.	MIN	MAX	Mean	Std.Dev.	MIN	MAX
For	0.44	0.50	0	1	0.41	0.49	0	1
Revenue	7.55	3.10	3.81	11.44	7.64	3.11	3.81	11.44
Jobs	503	202	250	750	506	205	250	750
Water quality	0.52	0.50	0	1	0.51	0.50	0	1
Game fish	0.49	0.50	0	1	0.50	0.50	0	1
Water birds	0.50	0.50	0	1	0.49	0.50	0	1
	High Price Scenario				High Price Scenario			
Variable	Mean	Std.Dev.	MIN	MAX	Mean	Std.Dev.	MIN	MAX
For	0.45	0.50	0	1	0.41	0.49	0	1
Revenue	8.73	3.58	4.39	13.16	8.90	3.59	4.39	13.16
Jobs	498	203	250	750	504	204	250	750
Water quality	0.50	0.50	0	1	0.49	0.50	0	1
Game fish	0.48	0.50	0	1	0.49	0.50	0	1
Water birds	0.49	0.50	0	1	0.47	0.50	0	1

The variable “For” is equal to one if the respondent voted for the increased or decreased quota proposal and zero if the vote was “against” or “undecided.” Across the three quota increase scenarios, 43%, 44% and 45% of respondents voted to increase the menhaden quota by 10%, 20% or 30%. Fifteen percent were "undecided" and 41% of the votes were "against" the quota increases. Excluding undecided votes, a majority voted in favor of quota increases. Across the three quota decrease scenarios, 42%, 41% and 41% of respondents vote to decrease the menhaden quota by 10%, 20% or 30%. Eighteen percent are "undecided" and 41% of the votes are "against" the quota decreases. Excluding undecided votes, a slim majority vote against quota decreases. In the regression analysis we again code the undecided votes as a vote "against."

In the low, mid and high price scenarios the average ex-vessel revenue increase is $6.35 million, $7.55 million, and $8.73 million, respectively ("Revenue"). In the low, mid and high price scenarios the average ex-vessel revenue decrease is $6.25 million, $7.64 million and $8.90 million, respectively. In both increase and decrease scenarios, the mean employment change is close to 500 ("Jobs").

The ecosystem services variables take on values equal to 0 or 1. If the variable is equal to zero then the respondent is told that there is no environmental impact from the quota change. In other words, if the quota change would lead to no change in water quality, game fish populations or water bird populations then these variables are equal to 0. If the variable takes a value of 1 then the environmental impact is negative (in the increased quota scenarios) or positive (in the decreased quota scenarios). Each of the mean ecosystem service values are close to 0.50 ("Water quality," "Game fish," and "Water birds") representing a 50/50 split.

One exception to the ecosystem service value coding rule is the value of the water bird variable in the low priced decrease scenario. This variable is always coded zero as the result of careless error resulting in the value of the variable not being captured by SurveyMonkey. Implications and potential solutions for this mistake are discussed below.

6.3.1 Regression Results

We estimate multinomial logit (MNL) and random parameters logit models (RPL) as in Siikamäki and Larson (2015) with NLogit software (www.limdep.com). The multinomial, or conditional, logit model estimates a fixed coefficient as the estimate of the impact of the variable on the vote. The RPL models estimate the mean and standard deviation of each coefficient to capture heterogeneity in the sample (Hensher, Rose and Greene 2015). See Appendix P for a description of the econometric models.

In both quota increase models we find that increases in ex-vessel revenue and commercial fishing jobs increased the probability of a vote for a quota increase (Table 41). Increased quotas that make water quality worse and negatively affect gamefish and water bird populations led to a decrease in the probability of a vote for increased quotas. We include an alternative specific constant for the status quo alternative interacted with concern about overfishing (SQ_ASC*Overfish). While we informed respondents that increased quotas would not lead to overfishing, the positive coefficient indicates that respondents who still expressed concern about overfishing were more likely to vote against a quota increase.

Table 41. Determinants of Votes to Increase Quotas

	Multinomial Logit			Random Parameters Logit		
Variable	Coeff.	S.E.	t-stat	Coeff.	S.E.	t-stat
Revenue	0.0408	0.0066	6.18	0.0722	0.0147	4.92
Jobs	0.0007	0.0001	6.31	0.0012	0.0002	5.21
Water quality	-0.4245	0.0511	-8.30	-1.0537	0.1372	-7.68
Game fish	-0.1667	0.0511	-3.26	-0.4846	0.1127	-4.30
Shore birds	-0.1839	0.0512	-3.59	-0.5657	0.1159	-4.88
SQ_ASC*Overfish	0.6543	0.0525	12.47	0.7566	0.1392	5.43
Variable				Std. Dev.	S.E.	t-stat
Revenue				0.1951	0.0278	7.01
Jobs				0.0032	0.0004	8.47
Water quality				2.2720	0.2903	7.83
Game fish				1.4706	0.3054	4.82
Shore birds				1.7319	0.3008	5.76
SQ_ASC*Overfish				0.7127	0.4276	1.67
LL(B)	-4040.42			-3679.40		
LL(0)	-4192.26			-4204.63		
AIC	8092.80			7382.80		
Scenarios	3			3		
Respondents	2022			2022		
Sample Size	6066			6066		

The RPL results show that there is significant heterogeneity in the coefficients. We specify the distribution of the coefficients as normal. Each of the standard deviations are statistically different from zero at the p<0.01 level, except the standard deviation on concern about overfishing which is significant at the p=0.10 level. Each of the standard deviations is greater than the mean coefficients. The coefficients of variation ($CV = \sigma/\mu$) range from 2.16 to 3.06. This indicates that there is a portion of the sample with preferences of opposite sign of the mean preferences. For example, using the properties of the normal distribution, 36% and 35% of the distribution of the coefficients on revenue and jobs are less than or equal to zero. Thirty-two percent, 37% and 37% of the distribution of the coefficients on water quality, gamefish and water birds are greater than or equal to zero. The exception to this pattern of results is the coefficient for overfishing which has a CV of 0.94, which suggest that less than 14% have a coefficient that is less than or equal to zero. We tested the model with triangular and log normal distributions for the coefficients, which constrains all of the coefficient distribution to be the same sign. The triangular model produced meaningful results but did not fit the data as well as the model we report here. The lognormal model did not produce meaningful results.

We present the results for the decrease quota scenario in Table 42. We found that increases in lost ex-vessel revenue and lost commercial fishing jobs decreased the probability of a vote for the decreased quota. Decreased quotas that improve water quality and positively affect gamefish and water birds led to an increase in the probability of a vote for decreased quotas.

Table 42. Determinants of Votes to Decrease Quotas

	Multinomial Logit			Random Parameters Logit		
Variable	Coeff.	S.E.	t-stat	Coeff.	S.E.	t-stat
Revenue	-0.0174	0.0064	-2.72	-0.0325	0.0133	-2.45
Jobs	-0.0007	0.0001	-7.15	-0.0016	0.0002	-7.07
Water quality	0.3129	0.0500	6.26	0.6245	0.0941	6.64
Game fish	0.2121	0.0500	4.24	0.3419	0.0909	3.76
Shore birds	0.0665	0.0559	1.19	0.2369	0.0982	2.41
Variable				Std. Dev.	S.E.	t-stat
Revenue				0.2150	0.0343	6.27
Jobs				0.0045	0.0004	10.97
Water quality				0.9165	0.3229	2.84
Game fish				0.8868	0.3090	2.87
Shore birds				0.0638	0.9423	0.07
LL(B)	-4131.74			-3643.62		
LL(0)	-4170.02			-4204.63		
AIC	8273.50			7307.20		
Scenarios	3			3		
Respondents	2022			2022		
Sample Size	6066			6066		

The RPL results show that there is significant heterogeneity in the coefficients. Each of the standard deviations are statistically different from zero at the $p<0.01$ level, except the standard deviation on water birds. This is likely related to the coding error. Each of the statistically significant standard deviations are greater than the mean coefficients. The coefficients of variation range from 1.47 to 6.61. The CV is greater for the revenue coefficient in the decrease scenario and lower for the water quality coefficient, relative to the increase scenario. The CVs for the jobs and game fish coefficients are similar to those in the increase scenario model. Forty-four percent and 36% of the distributions of the revenue and jobs coefficients are greater than or equal to zero. Twenty-five percent and 35% of the distribution of the coefficients on water quality and game fish is less than or equal to zero.

6.3.2 Willingness to Pay and Willingness to Accept

The logit coefficients are not directly interpretable but are useful for determining tradeoffs among economic and ecosystem variables. Willingness-and-pay (WTP) and willingness-to-accept (WTA) changes in revenue and jobs are computed by taking the absolute value of the ratio of the coefficient of the attribute of interest divided by the coefficient of the revenue and jobs variable. Typically, in stated preference studies, the denominator in the WTP or WTA calculation is an individual monetary cost (e.g., income tax increase), however in our analysis we focus on the trade-off between ex-vessel revenue and commercial fishing jobs gained/lost in the economy. In this context, WTP is an estimate of the survey respondent's willingness to forgo, on behalf of society, additional ex-vessel revenue and jobs that would result from an increased quota. Symmetrically, WTA is the amount the respondent is willing to gain, on behalf of society, in revenue or jobs in order to forgo an increase in ecosystem services with a decreased quota. See Appendix P for a description of the calculation of WTP and WTA.

In the multinomial logit model, respondents are willing to accept \$10 million, \$4 million and \$4.5 million in additional ex-vessel revenue in exchange for negative impacts on water quality, gamefish and water birds, respectively, in the increase quota scenario (Table 43). Respondents are willing to accept 645, 253 and 279 additional commercial fishing jobs in exchange for negative impacts on water quality, gamefish and water birds, respectively. The estimates are between 35% and 74% higher in the random parameters logit model. Respondents are willing to accept \$15 million, \$7 million and \$8 million in additional ex-vessel revenue in exchange for negative impacts on water quality, gamefish and water birds in the increase quota scenario. Respondents are willing to accept 870, 400 and 467 additional commercial fishing jobs in exchange for negative impacts on water quality, gamefish and water birds, respectively.

Table 43. Willingness to Accept Revenue and Jobs for Attributes from Increase Scenario

	Multinomial Logit			Random Parameters Logit		
Attribute	WTA	SE	t-stat	WTA	SE	t-stat
Water quality	10.39	1.92	5.41	14.60	3.21	4.54
Game fish	4.08	1.32	3.09	6.71	1.87	3.58
Shore birds	4.50	1.36	3.31	7.84	2.08	3.78
				Jobs		
	Multinomial Logit			Random Parameters Logit		
Attribute	WTA	SE	t-stat	WTA	SE	t-stat
Water quality	644.83	115.03	5.61	870.40	180.37	4.83
Game fish	253.24	79.98	3.17	400.30	109.00	3.67
Shore birds	279.35	81.34	3.43	467.32	116.99	3.99

In the multinomial logit model, respondents are willing to forgo (pay) \$18 million, \$12 million and \$4 million in ex-vessel revenue in exchange for positive impacts on water quality, gamefish and water birds, respectively, in the decrease quota scenario (Table 44). Respondents are willing to forgo 449, 305 and 95 commercial fishing jobs in exchange for positive impacts on water quality, gamefish and water birds, respectively. The water bird estimate is not statistically different from zero, likely from measurement error in the water bird variable.

Table 44. Willingness to Pay Revenue and Jobs for Attributes from Decrease Scenario

	Multinomial Logit			Random Parameters Logit		
Attribute	WTP	SE	t-stat	WTP	SE	t-stat
Water quality	17.96	6.70	2.68	19.20	7.82	2.46
Game fish	12.17	4.80	2.54	10.51	4.65	2.26
Shore birds	3.81	3.15	1.21	7.28	3.70	1.97
			Jobs			
	Multinomial Logit			Random Parameters Logit		
Attribute	WTP	SE	t-stat	WTP	SE	t-stat
Water quality	449.30	82.69	5.43	387.68	68.87	5.63
Game fish	304.52	75.00	4.06	212.24	58.15	3.65
Shore birds	95.41	80.18	1.19	147.06	62.42	2.36

Multinomial logit model WTP and WTA is higher in three of the four reliable cases relative to the random parameters logit model. Respondents are willing to forgo $19 million in revenue for water quality improvement in the RPL model. This is 7% higher than the MNL model. Respondents are willing to forgo $10.5 million for positive game fish impacts, which is 14% lower than the MNL model. Respondents are willing to forgo $7 million for positive water bird impacts, but this is likely biased downward due to the measurement error in the water bird coefficient. Respondents are willing to forgo 388, 212 and 147 jobs to gain positive impacts on water quality, game fish and water birds. The water quality and game fish estimates are 14% and 30% lower than the MNL model estimates.

6.3.3 Referendum Vote Simulation

Another approach to understanding the stated preference results is to simulate voting probabilities under various scenarios. We conduct this simulation only with the increase scenario to avoid the coding error on the water bird variable in the decrease scenario and with the multinomial logit model due to the speed of the simulator in NLogit. We estimated 72 probabilities using each combination of the attributes, the minimum, mean and maximum ex-vessel revenue and each of the three jobs attribute levels. We set the variable measuring concern about overfishing to zero to simulate a general public that believes the fisheries science presented in the survey.

The scenarios and simulated votes are presented in Appendix Q. Fourteen of the 72 quota increase scenarios failed the referendum. In other words, the predicted votes for the increased quota is less than 50%. The mean ex-vessel revenue gain in these scenarios is $5 million and the mean job gains is 357. The percentage of scenarios with negative impacts for water quality, game fish and water birds is 93%, 71% and 71%. Fifty eight of the 72 quota increase scenarios passed the referendum with votes greater than 50%. The mean ex-vessel revenue gain in these scenarios is $9 million and the mean job gains is 534. The percentage of scenarios with negative impacts for water quality, game fish and water birds is 40%, 45% and 45%.

We treated Appendix Q as data in order to summarize these results with regression analysis. We found that if each of the variables is equal to zero, then the probability of a vote for a quota increase is 50%. This estimated probability is reassuring since if there are no benefits or costs to a proposal then there is no basis on which to vote for or against. Each $1 million increase in ex-vessel revenue increased the probability of a vote for the increased quota by 10%. Each 100 additional jobs increased the probability of a “for” vote by 2%. These results suggest that the general public, with no risk of overfishing, would vote so that quota increases would pass a referendum if these led to positive ex-vessel revenues or jobs gained. Negative impacts on water quality, game fish and water birds decreased the probability of a vote for a quota increase by 10%, 4% and 4%. This model is consistent with the WTA estimates presented above. The amount of ex-vessel revenue required to increase votes for the quota increase to over 50% is $10 million, $4 million and $4.5 million for negative impacts on water quality, game fish and water birds respectively. The number of jobs required to increase votes for the quota increase to over 50% is 648, 253 and 279 for negative impacts on water quality, game fish and water birds, respectively.

6.4 Water Bird Variable

We considered several different approaches to coding the water bird variable to mitigate the damage done by the coding error. We dropped the low price decrease scenario and estimated the decrease models with only two scenarios included. We coded the variable as 0.5 and randomly assigned 0 and 1 values instead of coding all of the values as 0. Each of these approaches led to a statistically insignificant coefficient on the water bird variable so we conducted the analysis with the variable coded as 0 and the realization that the variable suffers from significant measurement error.

6.4.1 Analysis of Combined Scenarios

Another approach to the above problem, which is more satisfactory, begins with the recognition that none of the WTP and WTA estimates are statistically different as the 95% confidence intervals are overlapping. This suggests that a combined model that constrains WTP and WTA to be equal is not inappropriate. We estimate this model by recoding the attribute variables so that the signs indicate their directional effect. For example, the dummy variable on decreases in water quality, game fish and water birds is coded with a negative sign in the increase quota scenario. Decreases in revenue and jobs in the decrease quota scenario are coded with negative signs. The dependent variable is a “for” vote so that the sign of each coefficient is expected to be positive. We estimated these models with and without the low price decrease scenario included. The mean coefficients are similar in each model. The only obvious difference is the statistical insignificance of the standard deviation on the water birds variable in the RPL model with all 6 scenarios included.

We present the results for the combined increase/decrease scenarios, excluding the low price decrease scenario, in Table 45. We find that changes in ex-vessel revenue and commercial fishing jobs had a positive effect on the probability of a vote “for” the decreased quota. Increased revenue and jobs increased the probability of a vote for an increased quota. Decreased revenue and jobs decreased the probability of a vote for the quota change. Similarly, respondents vote for the quota change if it had positive impacts on water quality, gamefish and shore birds and against the change if it had negative impacts.

Table 45. Determinants of Votes to Increase/Decrease Quotas

	Multinomial Logit			Random Parameters Logit		
Variable	Coeff.	S.E.	t-stat	Coeff.	S.E.	t-stat
Revenue	0.0304	0.0048	6.30	0.0372	0.0060	6.25
Jobs	0.0006	0.0001	8.07	0.0009	0.0001	9.01
Water quality	0.3886	0.0394	9.88	0.4910	0.0506	9.70
Game fish	0.1450	0.0392	3.70	0.1864	0.0484	3.85
Shore birds	0.1484	0.0394	3.76	0.1874	0.0492	3.81
ASC: SQ*Overfish	0.6093	0.0403	15.10	0.8427	0.0623	13.53
Variable				Std. Dev.	S.E.	t-stat
Revenue				0.0550	0.0112	4.90
Jobs				0.0007	0.0002	3.64
Water quality				0.6903	0.1024	6.74
Game fish				0.5164	0.1208	4.28
Shore birds				0.5622	0.1154	4.87
ASC: SQ*Overfish				0.9075	0.0927	9.79
LL(B)	-6799.97			-6609.65		
LL(0)	-6973.99			-7007.72		
	13611.90			13243.30		
Scenarios	5			5		
Respondents	2022			2022		
Sample Size	10,110			10,110		

The random parameters logit results show that there is significant heterogeneity in the coefficients. Each of the standard deviations are statistically different from zero at the p<0.01 level. Each of the standard deviations are greater than the mean coefficients. But, the heterogeneity is reduced in the combined sample with coefficients of variation that range from 0.85 to 3. The combined sample produces lower amounts of the distribution in the negative range compared to the individual increase and decrease models. Twenty-five percent and 12% of the distributions of the revenue and jobs coefficients are less than or equal to zero. Twenty-four percent, 36%, and 37% of the distribution of the coefficients on water quality, gamefish and shore birds is less than or equal to zero.

In the multinomial logit model, respondents are willing to trade off $13 million, $5 million and $5 million in ex-vessel revenue in exchange for a change in the impacts on water quality, gamefish and water birds, respectively (Table 46). Respondents are willing to trade off 610, 228 and 234 commercial fishing jobs in exchange for a change in the impacts on water quality, gamefish and water birds, respectively. The estimates from the RPL model are very similar with ex-vessel revenue estimates 3% to 5% higher and job estimates 6% to 7% lower than the MNL estimates.

Table 46. Willingness to Pay/Accept Revenue and Jobs for Attributes

	Revenue					
	Multinomial Logit			Random Parameters Logit		
Attribute	WTP	SE	t-stat	WTP	SE	t-stat
Water quality	12.78	2.20	5.81	13.21	2.31	5.72
Game fish	4.77	1.37	3.48	5.02	1.41	3.57
Shore birds	4.88	1.39	3.52	5.04	1.43	3.53
	Jobs					
	Multinomial Logit			Random Parameters Logit		
Attribute	WTP	SE	t-stat	WTP	SE	t-stat
Water quality	610.03	86.53	7.05	566.52	75.92	7.46
Game fish	227.66	62.40	3.65	215.01	56.44	3.81
Shore birds	232.92	62.73	3.71	216.24	57.14	3.78

6.5 Other Determinants of Votes

The RPL models are limited in their ability to incorporate "time invariant" variables (i.e., those that do not change across the three choice scenarios such as socioeconomic characteristics and attitudes). In this section we estimate discrete choice models that allow these variables to be included. The data shows that support for a policy, whether increase or decreases in the quota, is derived from more than just ecosystem and economic trade-offs. Prior knowledge of menhaden, and actual beliefs about the contribution menhaden have in various sectors of the economy and the ecosystem play a role in influencing votes for or against a quota change. Also, societal involvement in the fishing industry, both in the commercial and recreational sectors, effect voting propensities as well.

6.5.1 Decrease Scenario

Table 47 displays the random effects panel data ordinary least squares linear probability model (LPM) and logistic regression model results for the decrease scenario.[5] According to the logit results, the coefficient for revenue is insignificant, so WTP cannot be computed based on monetary cost, but the jobs coefficient is statistically significant. The results suggest that water quality improvement is worth about 728 jobs, game fish population increases are valued at about 354 jobs, and water-bird improvements are valued at about 163 jobs (note, the jobs and gamefish populations are statistically significant though the water bird population is not).

Table 47. Other Determinants of a For Vote in Decrease Scenario

	OLS (RE)	Logit (RE)
Constant	0.683***	1.410**
Revenue	-0.00248	-0.0184
Jobs	-0.000134***	-0.000998***
Water quality (=1)	0.0970***	0.727***
Game fish (=1)	0.0469***	0.353***
Water Birds (=1)	0.0212	0.163
First Scenario (=1)	0.0133	0.0996
First Question (=1)	0.0288**	0.214**
Concern about Overfishing	-0.0785***	-0.574***
Member (=1)	0.0931***	0.661***
Industry (=1)	0.0928**	0.695**
Angler (=1)	0.0405	0.301
Age	-0.00227***	-0.0169***
Female (=1)	-0.0602***	-0.432***
White (=1)	0.0214	0.17
Education	-0.00238	-0.0176
Income	0.000198	0.00141
Prior Knowledge of Menhaden	-0.0696***	-0.496***
State Importance	0.0256*	0.177*
Ecosystem-level Management Preferences	-0.0506***	-0.407***
Indicated Menhaden Are Very Important for:		
Fish Meal (=1)	-0.00734	-0.0776
Fish Oil (=1)	0.0125	0.0771
Bait for Recreational Fishing (=1)	0.0604**	0.478**
Bait for Commercial Fishing (=1)	-0.0437*	-0.322*
Food for Other Fish (=1)	0.102***	0.742***
Food for Birds (=1)	-0.0485*	-0.347*
Water Quality (=1)	0.0152	0.135
* p<0.05, ** p<0.01, *** p<0.001		

[5] Random effects models employ an individual specific error term to capture correlation in votes across respondents.

The LPM coefficients give a general sense of how propensities to support a quota decrease are affected by the various covariates. The job coefficient seems small at -0.000134, but when scaled by 750 jobs, it suggests a 10 percent decrease in the likelihood of a vote for a quota decrease. Going from the status quo to an improvement in water quality and fish populations are associated with a 9.7% and 4.7% increase in the likelihood of supporting a quota decrease policy, respectively.

While the results suggest that a respondent who was exposed to the set of three decrease scenario questions before the increase scenario questions ("first scenario") did not have an impact on voting behavior, the significance of the "first question" coefficient suggests that there is still an order effect within scenarios as respondents were more likely to vote for decreased quotas the first time they were exposed to such a question.

The negative coefficient on the variable pertaining to concern about overfishing indicates that as respondents became less concerned with overfishing of menhaden, they are less inclined to vote in favor of a quota decrease. The question was posed as a Likert scale question, ranging from very concerned (coded as 1) to not at all concerned (coded as 4). The LPM estimates that on average, a marginal increase of 1 unit corresponds to a 7.9% decrease in the likelihood of supporting the policy. A limitation of Likert scale coding, however, is that it estimates an average marginal effect and might not capture non-linear trends. For example, it is likely that the difference between very concerned and somewhat concerned might have a different marginal impact than the difference between not too concerned and not at all concerned.

The variable "member," which is a binary variable for whether the respondent is part of a recreational, environmental, or conservation organization suggested that such involvement corresponds to a 9.3% increased likelihood of supporting a quota decrease. Similarly, the variable "Industry," which is the indicator variable for whether the respondent is currently employed in the commercial fishing (or related) industry, indicates that members are 9.3% more like to vote for a decreased quota. Interestingly, although these two social variables had a statistically significant effect, being an angler did not seem to influence a respondent's decision to vote for a quota decrease.

Age had a statistically significant coefficient. Each decade decreases the probability of a vote in favor by 2.3%. The results indicate that being female is associated with a 6% decrease in the likelihood to support a quota decrease. Other socioeconomic covariates, including race ("white"), education, income, whether the respondent has children, and household size did not have significant impacts on voting behavior.

Prior knowledge of menhaden did influence voting results. Our results show that the less knowledge a respondent had about menhaden, the less likely they were to support a quota decrease. When asked about prior menhaden knowledge, the respondent could choose between “a lot,” “some” “a little,” and “nothing.” On average, a one-unit level decrease in knowledge, on average, is associated with a 7% decrease in probability of supporting a quota decrease policy.

While we did not find any state level effects individually, the results show that what did have an effect was a respondent believing that menhaden were important for their state. The less important a respondent thought the menhaden industry were for their state’s economy, the more likely the respondent was to vote in favor of the decrease. Specifically, an incremental decrease in perceived importance accounts for a 2.6% increased probability of voting for a quota decrease. We also found that the less important respondents considered managing menhaden at the ecosystem level to be, the less likely they were to support a quota decrease. Going down a step on the four-part importance scale is associated with, on average, a 5.1% decrease in the likelihood of supporting the policy change.

After a series of educational content pertaining to the menhaden fishery and before the voting questions, respondents were asked to indicate how important they thought menhaden were for the following uses: fish meal, fish oil, bait for recreational fishing, bait for commercial fishing, food for other fish, food for birds, and water quality. To assess the impact of these considerations, we generated indicator variables for whether the respondent considered each use very important. The results suggest that importance of menhaden for bait for recreational fishing, bait for commercial fish, food for other fish, and food for birds were the uses that affected respondents’ inclination to support a quota decrease.

6.5.2 Increase Scenario

Table 48 shows the results for the increase scenario. Unlike in the decrease scenario, the jobs coefficient is not statistically significant. It can be inferred that people are more concerned about the loss of existing jobs in an economy than they are about the addition of new jobs. Also, the revenue coefficient was not statistically significant. Because the two coefficients that could be used as the cost coefficient in a WTA computation were not significant, a WTA measure cannot be computed. However, the other coefficients still reveal much information about the voting trends.

Table 48. Other Determinants of a For Vote in Increase Scenario		
	OLS (RE)	Logit (RE)
Constant	0.704***	1.458***
Revenue	-0.00319	-0.0212
Jobs	-0.0000139	-0.0000985
Water quality (=1)	-0.142***	-1.002***
Game fish (=1)	-0.104***	-0.751***
Water Birds (=1)	-0.107***	-0.757***
First Scenario (=1)	0.0718***	0.514***
First Question (=1)	0.0496***	0.356***
Overfishing	-0.000168	0.0116
Member (=1)	0.0748**	0.542**
Industry (=1)	0.129***	0.936***
Angler (=1)	0.0664**	0.475**
Age	-0.00131*	-0.0095*
Female (=1)	-0.0313	-0.214
White (=1)	0.00873	0.0641
Education	0.0000702	0.000364
Income	0.000247	0.00173
Prior Knowledge of Menhaden	-0.0430*	-0.296*
State Importance	-0.0438***	-0.326***
Ecosystem-level Management Preferences	-0.0234	-0.18
Indicated Menhaden Are Very Important for:		
Fish Meal (=1)	0.0513*	0.358*
Fish Oil (=1)	0.0536**	0.388**
Bait for Recreational Fishing (=1)	0.0644**	0.422**
Bait for Commercial Fishing (=1)	0.0387	0.301
Food for Other Fish (=1)	0.00764	0.0357
Food for Birds (=1)	-0.0446*	-0.307*
Water Quality (=1)	-0.0351	-0.236
* p<0.05, ** p<0.01, *** p<0.001		

The magnitude of the trade-offs was greater in the increase scenario relative to the decrease scenario. For water quality decrease, game fish population decrease, and water bird population decreases, the marginal effects are estimated to be 14%, 10%, and 11% decreases in the likelihood to support a quota increase. The differences in magnitude suggest that respondents were more sensitive to damage to the environment than improvements to the current state.

Order effects mattered in two ways: (1) whether the respondent was presented with quota increase questions before the quota decrease questions and (2) whether a quota increase question was the first question within that set. Respondents were 7% more likely to vote in favor of a quota increase if they saw quota increase questions first. The chances of voting for a quota change was 5% greater the first time a respondent was exposed to a quota increase question. Unlike in the decrease scenario, concern for overfishing did not have an impact on propensities to support a quota change for the increase scenario.

The variable “member,” which is a binary variable for whether the respondent is part of a recreational, environmental, or conservation organization suggested that such involvement corresponds to a 7.5% increased likelihood of supporting a quota increase. Similarly, the variable “Industry,” which is the indicator variable for whether the respondent is currently employed in the commercial fishing (or related) industry, indicates that these respondents are 12.9% more likely to vote for the increase). Further, if the respondent has fished in the past 12 months, their likelihood of voting in favor of a quota increase is higher by 6.6%. Again, age has a statistically significant effect with each decade reducing the probability of a vote in favor of increased quotas by 1.3%. All other socioeconomic covariates were insignificant.

The results show that the less respondents knew about menhaden prior to taking the survey, the less likely they were to support a quota increase. Specifically, on average, an incremental increase in knowledge on a 4-level scale is estimated to increase the probability of supporting a quota increase by 4.3%. Perhaps counter-intuitively, respondents that think menhaden are important for their individual state’s economy were 4% less likely to vote in favor of a quota increase.

In reference to the indicator variables for what respondents reported as a “very important” use for menhaden, the uses that had a statistically significant positive impact on quota increase voting propensity were fish meal, fish oil and bait for recreational fishing. Importance of food for water birds had a negative effect.

7 Conclusions

In this study, we have developed information to inform the ASMFC fishery management plan for Atlantic menhaden from five types of data and analysis. We conducted interviews with commercial fishermen and bait dealers, and developed thematic issues of importance from the qualitative data. We conducted surveys of commercial fishermen and bait dealers to profile the economic importance of menhaden and gather opinions about important issues in the fishery. We analyzed secondary data from ex-vessel bait and reduction sector landings. We conducted economic impact analyses using state-level landings and ex-vessel revenues for the bait and reduction sectors. We also conducted a public opinion survey and measured public preferences for ecosystem-based management.

Interviews with menhaden industry members revealed a consensus around three themes: increased menhaden stock, increased menhaden bait demand, and increased oil and meal demand. Industry interviews revealed that the 2013 TAC decrease and associated state quotas had variable impacts depending on operation size. Finally, industry interviews revealed that commercial fishing communities were viewed alternatively either as important local economic drivers or in decline.

Industry surveys had a low response rate and missing observations for a number of questions, limiting use of the data in additional economic analyses. Fishermen surveyed generally managed small-scale operations (0-2 employees) for commercial bait markets and personal use; bait dealers surveyed reflected a broader spectrum of operation sizes. Fishermen surveyed reported a very low percentage of their income coming from menhaden, with the majority (54 percent) stating that the harvest of Atlantic menhaden made up less than 10 percent of their earnings. Bait dealers surveyed were more evenly distributed with regards to the percentage of their income from menhaden.

County level secondary data analysis showed that landings are sensitive to trips, and ex-vessel price is sensitive to landings but the effect is small. State level secondary data analysis showed that landings are less sensitive to trips, relative to county level data, and ex-vessel price is insensitive to landings. Coast-wide data analysis showed that menhaden landings have decreased over time, while effort and price has increased over time. Analysis of the Virginia bait fishery found little change over the past 10 years.

Economic impacts in the bait sector from the 6.45 percent increase in total allowable catch for 2017 were estimated as $1.5 million, with 18 jobs created. Most of the economic impacts in the bait sector were found to accrue in New Jersey and Virginia. Economic impacts in the reduction sector from the 2017 increase in total allowable catch were $4.8 million, with 81 jobs created.

Additional estimates were made to allow analysis of the impacts of differential state-quota changes, ranging from a low of 1 percent to a high of 30 percent. We found little evidence that changes in the menhaden total allowable catch affected county-level income and employment using data from NOAA.

Survey respondents were more likely to vote for increased menhaden quotas that generate economic benefits and do not negatively impact the environment. Respondents also were more likely to vote for decreased menhaden quotas that do not generate large economic losses and positively impact the environment.

Respondent votes revealed that they recognize tradeoffs among economic and ecosystem values with alternative menhaden quotas. Survey respondents supported increased quotas in almost 80 percent of the increased quota scenarios, considering the full range of economic and ecosystem impacts. We found that respondent votes also correlated with attitudinal variables and respondent characteristics in, mostly, expected ways.

We presented a range of results including menhaden industry perspectives, an analysis of economic impacts, and opinions from the general public that assess the impacts of changes in the total allowable catch for each state harvesting menhaden. Economic impact analysis has been conducted that would allow better understanding of uniform or non-uniform changes in the total allowable catch across states and sectors of the fishery. The analysis from qualitative and quantitative surveys of the fishermen and bait dealers who would be impacted revealed the potential impacts beyond jobs and incomes.

Public support for different levels of menhaden catch can be analyzed by considering tradeoffs between ex-vessel revenues and jobs in the menhaden fishery against the ecosystem-based endpoints. As the ASMFC ecosystem-based model is developed over the next several years, the inputs into the public opinion model should become less uncertain, and a better understanding of preferences for quota changes should emerge.

Our goal of conducting an efficiency analysis of menhaden allocation was hindered by data limitations. It is our hunch that the necessary data has been collected, but we are pessimistic that it exists in machine readable files with identifiers that allow linkages among the necessary components. This is probably due to the fact that the data has not been collected with an eye towards use in an economic study. Future data collection efforts in the menhaden fishery should be developed with biological and socioeconomic goals in mind. Our survey instruments provide guidance on the type of information that is needed for a socioeconomic study.

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9 Appendices

9.1 Appendix A. Interview Guide for Fisherman

Q1 How long have you been fishing for Atlantic Menhaden?

Q2 Do you fish for any other commercial species? What are those (e.g. herring, croaker, river herring)? And if so, what proportion of your annual commercial fishing sales is from Atlantic Menhaden? Do you catch menhaden specifically for these other fisheries?

Q3 What is your typical season for catching Atlantic Menhaden?

Q4 In 2015, how many weeks did you fish for Atlantic Menhaden?

Q5 What type of gear do you use for harvesting Atlantic Menhaden?

Q6 What type of gear do you use for other species you catch?

Q7 What type of vessel do you use to catch Atlantic Menhaden? Vessel size? Capacity? Crew size?

Q8 Where do you sell the Atlantic Menhaden that you catch? At what price per pound?

Q9 How do you feel the market for Atlantic Menhaden has changed overtime? (supply chain, availability) How do you feel Atlantic Menhaden prices have changed over time?

Q10 Were you affected by the state quotas put into place in 2013 for Atlantic Menhaden? If so, how?

Q11 Where do you harvest Atlantic Menhaden?

Q12 Which port do you use for your Atlantic Menhaden landings?

Q13 Please describe your fishing community. Is fishing a dominant economic sector where you live? What other economic sectors are important? Does a single species dominate the fishing community, or are multiple species pursued?

Q14 Are you involved in any groups or networks within the fishing community? In what roles?

Q15 How do you feel your fishing community would be affected if your state's quota of Atlantic Menhaden were increased by 10%? 25%? 50%? 75%? 100%?

Q16 How do you feel your fishing community would be affected if your state's quota of Atlantic Menhaden were decreased by 10%? 25%? 50%? 75%? 100%?

Q17 Do you benefit or have you benefited from any fisheries subsidies?

- Disaster aid—usually direct payments to fishermen, fishing communities or fishing related businesses following natural or man made fisheries collapses
- Surplus removal—US government purchases of surplus fish for national school lunch program and other federal nutrition programs
- Capital Construction Fund—federal program that effectively provides interest-free loans to use for fishing boat construction
- Fishing vessel and fishing permit buyback programs—designed to reduce fishing pressure
- Fisheries Finance Program—reduced-cost federal loans to build or rebuild vessels or shore-side fishing facilities for processing or distributing catch
- State dock and storage fees subsidy
- Fuel subsidy
- Fisheries research funding—for non-aquaculture, non-monitoring marine fisheries research on fish utilization, fishery products, bycatch and conservation

Q18 Is there an abundance of workers available in your industry? Do you have any challenges finding employees?

Q19 Do you believe that your operation is "at capacity"? (If menhaden availability increased, could your business easily absorb the additional availability? Crew, equipment, labor, time issues, etc.)

Q20 Are you employed by anyone? Or do you employ anyone? How many employees are in your company or work with you? Please describe the type of work they do and about how many employees do that work for how many weeks or months per year.

Q21 What are your annual operational costs while catching Menhaden?

- Vessel maintenance
- Fuel
- Labor Costs
- Licensing and business fees
- Office cost (e.g. rent, utilities)

Q22 Are there any other issues concerning menhaden you would like to discuss?

Q23 Are you employed in any capacity outside of the fishing industry? (Approx proportion of annual income outside of fishing)

About You: (Questions in this section refer to your personal background. This information is important for the purposes of this study. Please remember, all responses are anonymous and results will only be reported as summaries.)

Q24 What is your gender?

- ❍ Male (1)
- ❍ Female (2)

Q25 What is your current age?

- ❍ 18 to 19 (1)
- ❍ 20 to 24 (2)
- ❍ 25 to 34 (3)
- ❍ 35 to 44 (4)
- ❍ 45 to 54 (5)
- ❍ 55 to 64 (6)
- ❍ 65 or over (7)

Q26 What is your combined annual household income?

- Less than 30,000 (1)
- 30,000 – 39,999 (2)
- 40,000 – 49,999 (3)
- 50,000 – 59,999 (4)
- 60,000 – 69,999 (5)
- 70,000 – 79,999 (6)
- 80,000 – 89,999 (7)
- 90,000 – 99,999 (8)
- 100,000 or more (9)

Q27 What is the highest level of education you have completed?

- Less than High School (1)
- High School / GED (2)
- Some College (3)
- 2-year College Degree (4)
- 4-year College Degree (5)
- Masters Degree (6)
- Doctoral Degree (7)
- Professional Degree (JD, MD) (8)

Q28 What is the zip code of your primary residence?

9.2 Appendix B. Interview Guide for Bait Dealer

Q1 Do you sell Atlantic menhaden for bait? If so, how long have you been selling menhaden?

Q2 What proportion of your annual sales is from Atlantic Menhaden?

Q3 Who purchases Atlantic Menhaden from you? For what purposes?

Q4 Where do you purchase the Atlantic Menhaden that you sell as bait? At what price?

Q5 How do you feel the market for Atlantic Menhaden has changed overtime? (supply chain, availability) How do you feel that the prices of Atlantic Menhaden have changed over time?

Q6 Were you affected by the allotment put into place in 2013 for Atlantic Menhaden? If so, how?

Q7 If you had no Atlantic Menhaden to sell as bait, what would you sell as an alternative? What is the price of the alternative bait?

Q8 Please describe your fishing community. Is fishing a dominant economic sector where you live? What other economic sectors are important? Does a single species dominate the fishing community, or are multiple species pursued?

Q9 Are you involved in any groups or networks within the fishing community? In what roles?

Q10 How do you feel your fishing community would be affected if your state's allocation of Atlantic Menhaden were increased by 10%? 25%? 50%? 75%? 100%?

Q11 How do you feel your fishing community would be affected if your state's allocation of Atlantic Menhaden were decreased by 10%? 25%? 50%? 75%? 100%?

Q12 Do you believe that menhaden demand among bait users is greater than menhaden supply? (If menhaden availability increased, could your business easily absorb the additional availability?)

Q13 How many individuals do you employ and at what level/position?

Q14 How do you report your Atlantic Menhaden purchases/sales?

Q15 Are there any other issues concerning menhaden you would like to discuss?

About You: (Questions in this section refer to your personal background. This information is important for the purposes of this study. Please remember, all responses are anonymous and results will only be reported as summaries.)

Q16 What is your gender?
- ❍ Male (1)
- ❍ Female (2)

Q17 What is your current age?
- ❍ 18 to 19 (1)
- ❍ 20 to 24 (2)
- ❍ 25 to 34 (3)
- ❍ 35 to 44 (4)
- ❍ 45 to 54 (5)
- ❍ 55 to 64 (6)
- ❍ 65 or over (7)

Q18 What is your combined annual household income?
- ❍ Less than 30,000 (1)
- ❍ 30,000 – 39,999 (2)
- ❍ 40,000 – 49,999 (3)
- ❍ 50,000 – 59,999 (4)
- ❍ 60,000 – 69,999 (5)
- ❍ 70,000 – 79,999 (6)
- ❍ 80,000 – 89,999 (7)
- ❍ 90,000 – 99,999 (8)
- ❍ 100,000 or more (9)

Q19 What is the highest level of education you have completed?

- ❍ Less than High School (1)
- ❍ High School / GED (2)
- ❍ Some College (3)
- ❍ 2-year College Degree (4)
- ❍ 4-year College Degree (5)
- ❍ Masters Degree (6)
- ❍ Doctoral Degree (7)
- ❍ Professional Degree (JD, MD) (8)

Q20 What is the zip code of your primary residence?

9.3 *Appendix C. Description of Interviewees*

Interviewee	*Occupation*	*State*	*County of Residence*	*Date Interviewed*
1	Fisherman	Virginia	Lancaster	August 2016
2	Fisherman	Virginia	Northumberland	August 2016
3	Fisherman	Virginia		August 2016
4	Fisherman	Virginia	Northumberland	August 2016
5	Fisherman	Virginia		August 2016
6	Sport Bait Dealer	Virginia	Northumberland	August 2016
7	Fisherman/Bait Dealer	Virginia	Northumberland	August 2016
8	Fisherman	Virginia	Northumberland	August 2016
9	Management	Virginia	Northumberland	August 2016
10	Fisherman	Virginia	Northumberland	August 2016
11	Fisherman	New Jersey	Cape May	September 2016
12	Fisherman	New Jersey	Cape May	September 2016
13	Fisherman	New Jersey	Cape May	September 2016
14	Fisherman	New Jersey	Cape May	September 2016
15	Fisherman	New Jersey	Cape May	September 2016
16	Fisherman	New Jersey	Cape May	September 2016
17	Fishermen/Sport Bait Dealer	New Jersey	Atlantic	September 2016
18	Fisherman	New Jersey	Ocean	September 2016
19	Fisherman	New Jersey	Ocean	September 2016
20	Fisherman	New Jersey	Ocean	September 2016
21	Commercial Bait Dealer	Maryland	Dorchester	October 2016
22	Fisherman/Bait Dealer	Maryland		October 2016
23	Bait User	Maryland	Kent	October 2016
24	Fisherman	Rhode Island	Bristol	October 2016
25	Fisherman	Rhode Island	Newport	October 2016
26	Commercial Bait Dealer	Rhode Island	Washington	October 2016
27	Fisherman	Rhode Island	Newport	October 2016
28	Fisherman	Rhode Island	Washington	October 2016
29	Fisherman	Rhode Island	Washington	October 2016

30	Commercial Bait Dealer	Rhode Island		October 2016
31	Commercial Bait Dealer	Maine		October 2016
32	Commercial Bait Dealer	Maine	Androscoggin	October 2016
33	Fisherman	Maine	Cumberland	October 2016
34	Commercial Bait Dealer	Maine	Sagadahoc	October 2016
35	Fishermen/Bait Dealer Co-Op	New York	Suffolk	November 2016
36*	Fisherman	New York		November 2016
37*	Fisherman	New York		November 2016
38	Fisherman/Bait Dealer Co-Op	New York	Suffolk	November 2016
39	Fisherman	New York		November 2016
40	Commercial Bait Dealer	North Carolina	Carteret	November 2016
41	Fisherman	North Carolina		November 2016
42	Fisherman	North Carolina	Carteret	November 2016
43	Fisherman	North Carolina	Carteret	November 2016

*Interviews conducted by phone

9.4 Appendix D. Fishermen Survey

You are invited to participate in a research study about the Atlantic Menhaden fishery. You have been asked to participate because you fish for menhaden. The purpose of this study is to understand how Atlantic Menhaden affects the economic and social well-being of individuals in the fishing community. The results of this study will have management implications for the Atlantic States Marine Fisheries Commission. All your responses are anonymous and confidential and results will only be reported as summaries. In fact, the Qualtrics software we are using makes it impossible for us to link your answers to you or your email address. Participation in this study is voluntary. At any given time, you may choose to withdraw from this study or not complete particular questions. If you have any questions or concerns about this study, please contact the Principal Investigator Dr. Jane Harrison at North Carolina Sea Grant at (919) 513-0122 or jane_harrison@ncsu.edu. By clicking on the "Next" button, you indicate that you have read this consent form and voluntarily consent to participate.

1. Approximately how many years have you been fishing commercially for menhaden?

- ❍ Less than one year
- ❍ 1-5 years
- ❍ 6-10 years
- ❍ 11-15 years
- ❍ 16-20 years
- ❍ 21-25 years
- ❍ More than 25 years

2. In 2015, how many weeks did you fish for menhaden

- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7
- ❍ 8
- ❍ 9
- ❍ 10
- ❍ 11
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- ❍ 37
- ❍ 38
- ❍ 39
- ❍ 40
- ❍ 41
- ❍ 42
- ❍ 43
- ❍ 44
- ❍ 45
- ❍ 46
- ❍ 47
- ❍ 48
- ❍ 49
- ❍ 50
- ❍ 51
- ❍ 52

3. How many trips did you take in a typical week?

- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7

4. How long was a typical trip while fishing for menhaden in 2015?

- ❍ 1 day
- ❍ 2 day
- ❍ 3 days
- ❍ 4 days
- ❍ 5 days
- ❍ 6 days
- ❍ 7 days
- ❍ More than 7 days

5. How many crew members were on your vessel for a typical trip in 2015?

- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7
- ❍ 8
- ❍ 9
- ❍ 10 or more

6. In 2015, how many pounds of menhaden did you land?

- ❍ 1 - 9,999 pounds
- ❍ 10,000 - 24,999 pounds
- ❍ 25,000 - 49,999 pounds
- ❍ 50,000 - 99,999 pounds
- ❍ 100,000 - 249,999 pounds
- ❍ 250,000 - 499,999 pounds
- ❍ 500,000 - 999,999 pounds
- ❍ 1,000,000 - 4,999,999 pounds
- ❍ 5,000,000 pounds or more

7. What proportion of your menhaden landed (pounds) is considered bycatch under the menhaden management program?

- 0% (1)
- 1-10% (2)
- 11-20% (3)
- 21-30% (4)
- 31-40% (5)
- 41-50% (6)
- 51-60% (7)
- 61-70% (8)
- 71-80% (9)
- 81-90% (10)
- 91-100% (11)

8. In 2015, what was the average price per pound for the menhaden you sold?

- 1 - 4 cents/pound
- 5 - 9 cents/pound
- 10 - 14 cents/pound
- 15 - 19 cents/pound
- 20 - 24 cents/pound
- 25 cents/pound or more

9. In 2015, what percentage (if any) of your annual income came from non-fishing related employment?

- 0%
- 1-10%
- 11-20%
- 21-30%
- 31-40%
- 41-50%
- 51-60%
- 61-70%
- 71-80%
- 81-90%
- 91-100%

10. What is the size of your vessel?

- ❍ Less than 30 feet
- ❍ 30 - 49 feet
- ❍ 50 - 74 feet
- ❍ Greater than 75 feet

11. What type of gear do you typically use to catch menhaden? Check all that apply.

- ❑ Gill net
- ❑ Pound Net
- ❑ Purse Seine
- ❑ Trawl
- ❑ Fly Net
- ❑ Cast Net
- ❑ Fyke Net
- ❑ Other: ____________________

12. In 2015, what were your total operating costs while fishing for menhaden?

	US Dollars
Vessel Maintenance	
Fuel	
Labor Costs	
Licensing and business fees	
Office cost (If applicable: i.e. rent, utilities, etc.)	
Other:	

13. In which state or states do you land your menhaden? (List All)

14. In which county is the port or ports you typically operate from located? (List All)

15. Do you catch other commercial species?

- ❍ Yes (1)
- ❍ No (2)

Answer If Do you harvest other commercial species? Yes Is Selected

What other species do you catch? List all.

Answer If Do you harvest other commercial species? Yes Is Selected

What proportion of your annual commercial catch (pounds landed) is menhaden?

- ❍ 1-10%
- ❍ 11-20%
- ❍ 21-30%
- ❍ 31-40%
- ❍ 41-50%
- ❍ 51-60%
- ❍ 61-70%
- ❍ 71-80%
- ❍ 81-90%
- ❍ 91-100%

Answer If Do you harvest other commercial species? Yes Is Selected

Q19 What proportion of your annual commercial fishing revenue (US dollars) comes from menhaden?

- ❍ 0%
- ❍ 1-10%
- ❍ 11-20%
- ❍ 21-30%
- ❍ 31-40%
- ❍ 41-50%
- ❍ 51-60%
- ❍ 61-70%
- ❍ 71-80%
- ❍ 81-90%
- ❍ 91-100%

16. In the following years, have you experienced a significant (25% or more) increase or decrease from the year prior in the amount (pounds) of menhaden landed? For example: In 2010, did you experience a significant increase or decrease from 2009?

	.		
	Decrease	No Change	Increase
2010	❍	❍	❍
2011	❍	❍	❍
2012	❍	❍	❍
2013	❍	❍	❍
2014	❍	❍	❍
2015	❍	❍	❍

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease from the year p... 2010 - Click to write Column 1 - Increase Is Selected

You noted in the previous question that there was a significant increase in the amount of menhaden landed in 2010. What factors do you believe led to this increase? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – new equipment, abundance of labor force, etc.
- ❑ Personal reasons – more time available, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease from the year p... 2011 - Click to write Column 1 - Increase Is Selected

You noted in the previous question that there was a significant increase in the amount of menhaden landed in 2011. What factors do you believe led to this increase? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – new equipment, abundance of labor force, etc.
- ❑ Personal reasons – more time available, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease from the year p... 2012 - Click to write Column 1 - Increase Is Selected

You noted in the previous question that there was a significant increase in the amount of menhaden landed in 2012. What factors do you believe led to this increase? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – new equipment, abundance of labor force, etc.
- ❑ Personal reasons – more time available, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease from the year p... 2013 - Click to write Column 1 - Increase Is Selected

You noted in the previous question that there was a significant increase in the amount of menhaden landed in 2013. What factors do you believe led to this increase? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – new equipment, abundance of labor force, etc.
- ❑ Personal reasons – more time available, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease from the year p... 2014 - Click to write Column 1 - Increase Is Selected

You noted in the previous question that there was a significant increase in the amount of menhaden landed in 2014. What factors do you believe led to this increase? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – new equipment, abundance of labor force, etc.
- ❑ Personal reasons – more time available, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease from the year p... 2015 - Click to write Column 1 - Increase Is Selected

You noted in the previous question that there was a significant increase in the amount of menhaden landed in 2015. What factors do you believe led to this increase? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – new equipment, abundance of labor force, etc.
- ❑ Personal reasons – more time available, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease from the year p... 2010 - Click to write Column 1 - Decrease Is Selected

You noted in the previous question that there was a significant decrease in the amount of menhaden landed 2010. What factors do you believe led to this decrease? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – new equipment, abundance of labor force, etc.
- ❑ Personal reasons – more time available, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease from the year p... 2011 - Click to write Column 1 - Decrease Is Selected

You noted in the previous question that there was a significant decrease in the amount of menhaden landed in 2011. What factors do you believe led to this decrease? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - less restrictive regulations, quota increased, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – vessel damage, maintenance needed, labor force unavailable, etc.
- ❑ Personal reasons – illness, family responsibilities, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease from the year p... 2012 - Click to write Column 1 - Decrease Is Selected

You noted in the previous question that there was a significant decrease in the amount of menhaden landed in 2012. What factors do you believe led to this decrease? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - less restrictive regulations, quota increased, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – vessel damage, maintenance needed, labor force unavailable, etc.
- ❑ Personal reasons – illness, family responsibilities, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease from the year p... 2013 - Click to write Column 1 - Decrease Is Selected

You noted in the previous question that there was a significant decrease in the amount of menhaden landed in 2013. What factors do you believe led to this decrease? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - less restrictive regulations, quota increased, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – vessel damage, maintenance needed, labor force unavailable, etc.
- ❑ Personal reasons – illness, family responsibilities, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease from the year p... 2014 - Click to write Column 1 - Decrease Is Selected

You noted in the previous question that there was a significant decrease in the amount of menhaden landed in 2014. What factors do you believe led to this decrease? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - less restrictive regulations, quota increased, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – vessel damage, maintenance needed, labor force unavailable, etc.
- ❑ Personal reasons – illness, family responsibilities, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease from the year p... 2015 - Click to write Column 1 - Decrease Is Selected

You noted in the previous question that there was a significant decrease in the amount of menhaden landed in 2015. What factors do you believe led to this decrease? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - less restrictive regulations, quota increased, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – vessel damage, maintenance needed, labor force unavailable, etc.
- ❑ Personal reasons – illness, family responsibilities, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

17. Please select which months in 2015 you landed any menhaden.

- ❑ Jan
- ❑ Feb
- ❑ Mar
- ❑ Apr
- ❑ May
- ❑ Jun
- ❑ Jul
- ❑ Aug
- ❑ Sept
- ❑ Oct
- ❑ Nov
- ❑ Dec

18. Please select which months in 2015 you believe you could have landed more menhaden. That is, stock was available but the quota had already been met.

- ❑ Jan
- ❑ Feb
- ❑ Mar
- ❑ Apr
- ❑ May
- ❑ Jun
- ❑ Jul
- ❑ Aug
- ❑ Sept
- ❑ Oct
- ❑ Nov
- ❑ Dec

19. What proportion of menhaden landed do you sell to the following markets?

	Percentage (%)
Reduction (oil)	
Commercial bait	
Recreational bait	

The following section lists some typical issues facing individuals and communities involved in the menhaden fishing industry. Please rate your level of importance on each issue listed.

20. Please rate the following statements on a scale importance

	Extremely important (1)	Very important (2)	Moderately important (3)	Slightly important (4)	Not at all important (5)
Overfishing	❍	❍	❍	❍	❍
Health of menhaden and habitat	❍	❍	❍	❍	❍
Competition with local fishermen	❍	❍	❍	❍	❍
Competition with fishermen from other states	❍	❍	❍	❍	❍
Crew or labor issues	❍	❍	❍	❍	❍
Fuel prices	❍	❍	❍	❍	❍
Quotas	❍	❍	❍	❍	❍
Gear Restrictions	❍	❍	❍	❍	❍
Cost of licensing and taxes	❍	❍	❍	❍	❍
Record keeping (trip tickets, tax purposes)	❍	❍	❍	❍	❍
Other:	❍	❍	❍	❍	❍

About You: Questions in this section refer to your personal background. This information is important for the purposes of this study. Please remember, all responses are anonymous and results will only be reported as summaries.

21. What is your gender?

- Male (1)
- Female (2)

22. What is your current age?

- 18 to 19 (1)
- 20 to 24 (2)
- 25 to 34 (3)
- 35 to 44 (4)
- 45 to 54 (5)
- 55 to 64 (6)
- 65 or over (7)

23. What is your combined annual household income?

- Less than $30,000 (1)
- $30,000 – $39,999 (2)
- $40,000 – $49,999 (3)
- $50,000 – $59,999 (4)
- $60,000 – $69,999 (5)
- $70,000 – $79,999 (6)
- $80,000 – $89,999 (7)
- $90,000 – $99,999 (8)
- $100,000 or more (9)

24. What is the highest level of education you have completed?

- ❍ Less than High School (1)
- ❍ High School / GED (2)
- ❍ Some College (3)
- ❍ 2-year College Degree (4)
- ❍ 4-year College Degree (5)
- ❍ Masters Degree (6)
- ❍ Doctoral Degree (7)
- ❍ Professional Degree (JD, MD) (8)

25. What is your race/ethnicity?

- ❑ White (1)
- ❑ Black or African American (2)
- ❑ American Indian or Alaska Native (3)
- ❑ Asian (4)
- ❑ Native Hawaiian or Pacific Islander (5)
- ❑ Hispanic or Latino (6)
- ❑ Other (7)

26. What is the zip code of your primary residence?

Thank you for taking the time to complete this survey. In the coming months, we will be conducting in-depth interviews in your state about the socioeconomic impact of Atlantic Menhaden. Would you like to be interviewed?

- ❍ Yes
- ❍ No

Answer If Thank you for taking the time to complete this survey. In the coming months, we will be conducting in-depth interviews in your state about the socioeconomic impact of Atlantic Menhaden. ... Yes Is Selected

Q46 If you would like to be included in interviews about the menhaden fishery, use the space below to leave your contact information. As a reminder, your participation in this study is voluntary and responses to this survey will remain confidential and anonymous. Contact information you leave here will not be linked to your previous responses.

Name:
Email:
Phone:

9.5 Appendix E. Allocation Analysis and Data Limitations

For an allocation analysis across the bait and reduction sectors, the optimal allocation is that which equates the marginal rent across sectors. This is the sort of efficiency analysis that is preferred by economists for assessing reallocations of scarce resources (Edwards 1991). Efficiency analysis requires information on economic rent in each commercial fishing sector and consumer surplus in the recreational sector (Dichmont 2011). Economic rent is a payment in excess of the cost of an input, in this case the biologically-provided fishery. Rent may dissipate with landings due to increasing marginal cost of effort or declining per-unit revenues (i.e., ex-vessel prices fall as market supply increases). Rent is typically measured by profit in the commercial sector. In order to measure profit, information is needed on revenues and costs. Increases or decreases in menhaden quota will change both revenues and costs.

The output markets in the reduction fishery are for fish oil and meal. Changes in quotas can affect the supply of these products, which may lead to consumer benefits. Consumer benefits are known as the consumer surplus, which is the difference between the value of the product to the consumer and its cost (i.e., price). The difference is conceptually similar to the inverse of a producer profit. Consumer surplus is the product value that the consumer does not have to pay for.

In the recreational sector, the change in "consumer surplus" is an estimate of the efficiency of fishery management alternatives. In a study of a recreational fishery, consumer surplus is the difference between the gross value of a fishing trip and its cost. Demand functions can be estimated using the "travel cost method" and consumer surplus estimates developed for trips. If menhaden is an input into healthy game fish stocks, increasing menhaden stocks will increase game fish stocks, which may lead to more trips and game fish, and catch rates will increase. The product of the consumer surplus per trip and the changes in trips due to menhaden stock enhancement would provide an estimate of the recreational value of menhaden stock. Estimation of these potential benefits were beyond the scope of this project.

In contrast to economic efficiency analysis, economic impact analysis considers the total changes in income and employment due to changes in quotas without consideration of marginal changes in these impacts. Given data limitations and the focus on menhaden quota by ASMFC we directed our analysis to the economic impacts of alternative menhaden quotas. Economic impacts are the changes in income that arise from changes in economic activity. With economic impact analysis, comparisons across sector are difficult as quota changes act as scalars, simply increasing or decreasing estimates of economic activity, relative to efficiency analysis which attempts to assess behavioral and market changes. But, economic impact analysis is appropriate for better understanding the distributional implications of alternative quotas.

The literature review provided guidelines for our attempts to obtain data for an efficiency analysis of the bait and reduction sectors of the Menhaden fishery. Unfortunately, our experience has been characterized more by data limitations than the proposed data-rich analyses.

The Blomo et al. (1988) research is an example of efficiency analysis with estimates of rent changes due to shortened seasons. We face significant data limitations that preclude this type of analysis. The Dudley (2012) approach is limited for our analysis since it focuses on the reduction sector by considering the markets for final output. Dudley estimates the demand for menhaden outputs and simulates the change in consumer surplus that would result from quota changes. Given his estimated elasticities it is possible to estimate changes in consumer surplus in the output market but it is doubtful if changes in Atlantic quotas would make a large supply impact in the world markets for fish meal and oil. Plus, there is no comparable consumer surplus estimate in the bait sector.

Revenue comparisons are complicated by price differences across sectors. Revenue in the bait fishery is ex-vessel, the product of landings and dockside price. There is no explicit revenue in the reduction fishery since the commercial sector is vertically integrated with Omega Protein. The commercial sector fishes under contract not explicitly correlated with landings. We have found little evidence of declining prices in the bait sector over the range of quota changes being considered by the ASMFC. The National Marine Fisheries Service (NMFS) estimates ex-vessel revenue in the reduction sector but the method does not appear to be such that it is sensitive to market pressures (i.e., demand and supply conditions).

Another complication is the different gear types used in the menhaden fishery. For example, large-scale purse seine fishing has lower per unit costs than small scale gill nets. Rent will differ across gear. None of our secondary data has information on fishing gear other than differentiation between the bait and reduction sectors. In preliminary analysis we attempted to proxy for gear type with information on catch per unit effort. However, we abandoned this approach as too speculative. We collected information on gear in our survey of fishermen. Of the 28 bait fishermen who supplied complete data, seven different gears are represented with only three fishermen using purse seines. These limitations in our data preclude estimation of cost functions that will allow an estimate of the potential increasing marginal costs with higher catch.

Several secondary data sets were received from the Atlantic Coastal Cooperative Statistics Program (ACCSP) in response to our data requests. In order to develop an economic model of each fishery we requested pounds landed, ex-vessel revenue, year, state, county, disposition, numbers of trips, duration of trips, crew number, gear, origin and destination ports, and area fished. In response, the ACCSP provided four data sets for this study. The first data set contains county level annual landings (pounds, ex-vessel revenues, trips) from 1985 to 2015. The second contains county level annual landings (pounds, ex-vessel revenues, trips) broken out by disposition (bait, reduction, etc.) from 2000 to 2015. The third data set contains state level annual landings (pounds, ex-vessel revenues, trips) and disposition (bait, reduction, etc.) from 1950 to 2015. Revenue data is not available from 1950 to 1961. The ACCSP also provided effort data for the Virginia fishery. The effort data contains information on crew size and time spent on the water at the trip level for 2005 to 2015.

The economic analysis that can be supported by these data is limited, relative to what was described in the proposal (Harrison and Whitehead 2016). Limitations are due primarily to missing variables and the inability to link landings, trip and effort data. The data can be used to assess trends in landings, ex-vessel prices, effort and their interrelationships. Considering these limitations we focus our analysis of the secondary data on trends in the bait and reduction fisheries and economic impact analysis in the bait and reduction sectors.

The effort data is of limited use given the lack of identifiers to link them with other data. We also obtained trip level landings in the reduction sector from 1985 to 2015 from the NMFS Beaufort Lab and downloaded county level income and employment data from NOAA via the Bureau of Economic Analysis website. Analysis of the NOAA data could supplement our economic impact analysis but we find no evidence that fluctuations of bait landings affect employment and income in coastal counties.

Analysis of the NMFS Beaufort Lab data provided few additional insights beyond the data received from the ACCSP. These data could be used to estimate technological change in the reduction fishery by examining trends in catch per trip at the monthly level. However, without information on trip duration there is significant measurement error in this measure of fishing effort. With additional information on the vessel's home port, it would be feasible to estimate a model that could be used to examine the effect of industry concentration on the commercial fleet at the individual trip level. However, this analysis is beyond the scope of the current project.

We also collected primary data from (1) the bait and reduction fishery and (2) the public in major menhaden fishery states. Primary data collected included an industry survey, which contains questions on each of the necessary inputs to conduct an efficiency analysis of the bait sector. Unfortunately, analysis of these data are limited by a small sample size resulting from a low response rate, as well as incomplete data on operation costs. Only 69 fishermen responded to the industry survey, and of those about half reported cost information. We have complete information needed for the efficiency analysis on only 28 bait fishermen. Future data collection efforts in the commercial fishery could use these surveys as guides to the information needed to conduct an efficiency analysis.

The survey of the public elicits data that allows analysis of public opinion about the menhaden fishery and changes in menhaden quotas. These results could be considered a systematic effort at obtaining public comment on menhaden quotas. Our analysis allows a simulation of public support for changes in menhaden quotas in the context of ecosystem-based management with three endpoints: water quality, gamefish populations and water bird populations. The model is flexible so that as scientific information becomes available these endpoints could be considered or eliminated from the analysis.

9.6 Appendix F. Bait Dealer Survey

You are invited to participate in a research study about the Atlantic Menhaden fishery. You have been asked to participate because you are a bait dealer. The purpose of this study is to understand how Atlantic Menhaden affects the economic and social well-being of individuals in the fishing industry. The results of this study will have management implications for the Atlantic States Marine Fisheries Commission. All your responses are anonymous and confidential and results will only be reported as summaries. In fact, the Qualtrics software we are using makes it impossible for us to link your answers to you or your email address. Participation in this study is voluntary. At any given time, you may choose to withdraw from this study. If you have any questions or concerns about this study, please contact the Principal Investigator Dr. Jane Harrison at North Carolina Sea Grant at (919) 513-0122 or jane_harrison@ncsu.edu. By clicking on the "Next" button, you indicate that you have read this consent form and voluntarily consent to participate.

1. Approximately how many years have you operated as a bait dealer?

❍ Less than one year
❍ 1-5 years
❍ 6-10 years
❍ 11-15 years
❍ 16-20 years
❍ 21-25 years
❍ More than 25 years

2. Do you sell menhaden bait?

❍ Yes
❍ No

If No Is Selected, Then Skip To End of Survey

3. In 2015, how many pounds of menhaden did you sell for bait?

- ❍ 1 - 9,999 pounds
- ❍ 10,000 - 24,999 pounds
- ❍ 25,000 - 49,999 pounds
- ❍ 50,000 - 99,999 pounds
- ❍ 100,000 - 249,999 pounds
- ❍ 250,000 - 499,999 pounds
- ❍ 500,000 - 999,999 pounds
- ❍ 1,000,000 - 4,999,999 pounds
- ❍ 5,000,000 pounds or more

4. In 2015, what percentage of menhaden bait was sold for the following purposes:

	Percentage (%)
Commercial Lobster	
Commercial Crab	
Commercial Crawfish	
Other Commercial Fisheries: (Please describe)	
Recreational bait	

5. What proportion (percentage) of your 2015 bait sales (dollars) included menhaden?

- ❍ 1-10%
- ❍ 11-20%
- ❍ 21-30%
- ❍ 31-40%
- ❍ 41-50%
- ❍ 51-60%
- ❍ 61-70%
- ❍ 71-80%
- ❍ 81-90%
- ❍ 91-100%

6. In 2015 what was your average sales price per pound for menhaden?

- ❍ Less than 25 cents/pound
- ❍ 25-49 cents/pound
- ❍ 50-74 cents/pound
- ❍ 75-99 cents/pound
- ❍ $1.00-$1.24/pound
- ❍ $1.25-$1.49/pound
- ❍ $1.50/pound or more

7. When menhaden is preferred, but not available, what alternative types of bait do you sell?

8. How much revenue, in US dollars, would you expect to lose if your state (where your business primarily operates) had no menhaden available?

9. Since 2010, have you experienced a significant (25% or more) increase or decrease in the amount (pounds) of menhaden bait sold? (For example: In 2010, did you experience a significant increase or decrease from the year 2009?)

	.		
	Decrease	No Change	Increase
2010	❍	❍	❍
2011	❍	❍	❍
2012	❍	❍	❍
2013	❍	❍	❍
2014	❍	❍	❍
2015	❍	❍	❍

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease in the amount o... 2010 - Click to write Column 1 - Increase Is Selected

You noted in the previous question that there was a significant increase in the sale of menhaden bait in 2010. What factors do you believe led to this increase? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – new equipment, abundance of labor force, etc.
- ❑ Personal reasons – more time available, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease in the amount o... 2011 - Click to write Column 1 - Increase Is Selected

You noted in the previous question that there was a significant increase in the sale of menhaden bait in 2011. What factors do you believe led to this increase? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – new equipment, abundance of labor force, etc.
- ❑ Personal reasons – more time available, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease in the amount o... 2012 - Click to write Column 1 - Increase Is Selected

You noted in the previous question that there was a significant increase in the sale of menhaden bait in 2012. What factors do you believe led to this increase? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – new equipment, abundance of labor force, etc.
- ❑ Personal reasons – more time available, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease in the amount o... 2013 - Click to write Column 1 - Increase Is Selected

You noted in the previous question that there was a significant increase in the sale of menhaden bait in 2013. What factors do you believe led to this increase? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – new equipment, abundance of labor force, etc.
- ❑ Personal reasons – more time available, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease in the amount o... 2014 - Click to write Column 1 - Increase Is Selected

You noted in the previous question that there was a significant increase in the sale of menhaden bait in 2014. What factors do you believe led to this increase? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – new equipment, abundance of labor force, etc.
- ❑ Personal reasons – more time available, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease in the amount o... 2015 - Click to write Column 1 - Increase Is Selected

You noted in the previous question that there was a significant increase in the sale of menhaden bait in 2015. What factors do you believe led to this increase? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – new equipment, abundance of labor force, etc.
- ❑ Personal reasons – more time available, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease in the amount o... 2010 - Click to write Column 1 - Decrease Is Selected

You noted in the previous question that there was a significant decrease in the sale of menhaden bait in 2010. What factors do you believe led to this decrease? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – vessel damage, maintenance needed, labor force unavailable, etc.
- ❑ Personal reasons – illness, family responsibilities, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease in the amount o... 2011 - Click to write Column 1 - Decrease Is Selected

You noted in the previous question that there was a significant decrease in the sale of menhaden bait in 2011. What factors do you believe led to this decrease? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – vessel damage, maintenance needed, labor force unavailable, etc.
- ❑ Personal reasons – illness, family responsibilities, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease in the amount o... 2012 - Click to write Column 1 - Decrease Is Selected

You noted in the previous question that there was a significant decrease in the sale of menhaden bait in 2012. What factors do you believe led to this decrease? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – vessel damage, maintenance needed, labor force unavailable, etc.
- ❑ Personal reasons – illness, family responsibilities, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease in the amount o... 2013 - Click to write Column 1 - Decrease Is Selected

You noted in the previous question that there was a significant decrease in the sale of menhaden bait in 2013. What factors do you believe led to this decrease? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – vessel damage, maintenance needed, labor force unavailable, etc.
- ❑ Personal reasons – illness, family responsibilities, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease in the amount o... 2014 - Click to write Column 1 - Decrease Is Selected

You noted in the previous question that there was a significant decrease in the sale of menhaden bait in 2014. What factors do you believe led to this decrease? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – vessel damage, maintenance needed, labor force unavailable, etc.
- ❑ Personal reasons – illness, family responsibilities, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

Answer If Since 2010, have you experienced a significant (10% or more) increase or decrease in the amount o... 2015 - Click to write Column 1 - Decrease Is Selected

You noted in the previous question that there was a significant decrease in the sale of menhaden bait in 2015. What factors do you believe led to this decrease? (Select all that apply)

- ❑ Availability of stock
- ❑ Change in state regulations - quota restrictions, gear restrictions, etc.
- ❑ Competition
- ❑ Fuel Prices
- ❑ Changes in business – vessel damage, maintenance needed, labor force unavailable, etc.
- ❑ Personal reasons – illness, family responsibilities, etc.
- ❑ Weather
- ❑ Market price of menhaden
- ❑ Other (please describe): ____________________

10. Please select which months in 2015 you sold menhaden bait.

- ❑ Jan
- ❑ Feb
- ❑ Mar
- ❑ Apr
- ❑ May
- ❑ Jun
- ❑ Jul
- ❑ Aug
- ❑ Sept
- ❑ Oct
- ❑ Nov
- ❑ Dec

11. Please select which months in 2015 you believe you could have sold more menhaden bait, but it was unavailable.

- ❑ Jan
- ❑ Feb
- ❑ Mar
- ❑ Apr
- ❑ May
- ❑ Jun
- ❑ Jul
- ❑ Aug
- ❑ Sept
- ❑ Oct
- ❑ Nov
- ❑ Dec

12. In which state does your business primarily operate?

13. Do you purchase menhaden from any state other than where you primarily operate?

- ❍ Yes
- ❍ No

Answer If Do you purchase Atlantic Menhaden from any state other than your own? Yes Is Selected

From which states do you purchase menhaden to sell as bait? (Please list all)

The following section lists some typical issues facing individuals and communities involved in the menhaden fishing industry. Please rate your level of importance on each issue listed.

14. Please rate the following statements on a scale of importance

	Extremely important (1)	Very important (2)	Moderately important (3)	Slightly important (4)	Not at all important (5)
Overfishing	❍	❍	❍	❍	❍
Health of menhaden and habitat	❍	❍	❍	❍	❍
Competition among local fishermen	❍	❍	❍	❍	❍
Competition among fishermen from other states	❍	❍	❍	❍	❍
Crew or labor issues	❍	❍	❍	❍	❍
Fuel prices	❍	❍	❍	❍	❍
Quotas	❍	❍	❍	❍	❍
Gear Restrictions	❍	❍	❍	❍	❍
Cost of licensing and taxes	❍	❍	❍	❍	❍
Record keeping (trip tickets, tax purposes)	❍	❍	❍	❍	❍
Other:	❍	❍	❍	❍	❍

About You: Questions in this section refer to your personal background. This information is important for the purposes of this study. Please remember, all responses are anonymous and results will only be reported as summaries.

15. What is your gender?

- ❍ Male
- ❍ Female

16. What is your current age?

- ❍ 18 to 19
- ❍ 20 to 24
- ❍ 25 to 34
- ❍ 35 to 44
- ❍ 45 to 54
- ❍ 55 to 64
- ❍ 65 or over

17. What is your combined annual household income?

- ❍ Less than 30,000
- ❍ 30,000 – 39,999
- ❍ 40,000 – 49,999
- ❍ 50,000 – 59,999
- ❍ 60,000 – 69,999
- ❍ 70,000 – 79,999
- ❍ 80,000 – 89,999
- ❍ 90,000 – 99,999
- ❍ 100,000 or more

18. What is the highest level of education you have completed?

- ❍ Less than High School
- ❍ High School / GED
- ❍ Some College
- ❍ 2-year College Degree
- ❍ 4-year College Degree
- ❍ Masters Degree
- ❍ Doctoral Degree
- ❍ Professional Degree (JD, MD)

19. What is your race/ethnicity?

- ❑ White
- ❑ Black or African American
- ❑ American Indian or Alaska Native
- ❑ Asian
- ❑ Native Hawaiian or Pacific Islander
- ❑ Hispanic or Latino
- ❑ Other

20. What is the zip code of your primary residence?

Thank you for taking the time to complete this survey. In the coming months, we will be conducting in-depth interviews in your state about the Atlantic Menhaden fishery. Would you like to be interviewed?

- ❍ Yes
- ❍ No

Answer If Thank you for taking the time to complete this survey. In the coming months, we will be conducting in-depth interviews in your state about the Atlantic Menhaden fishery. Would you like to be ... Yes Is Selected

If you would like to be included in interviews about the menhaden fishery, use the space below to leave your contact information. As a reminder, your participation in this study is voluntary and responses to this survey will remain confidential and anonymous. Contact information you leave here will not be linked to your previous responses.

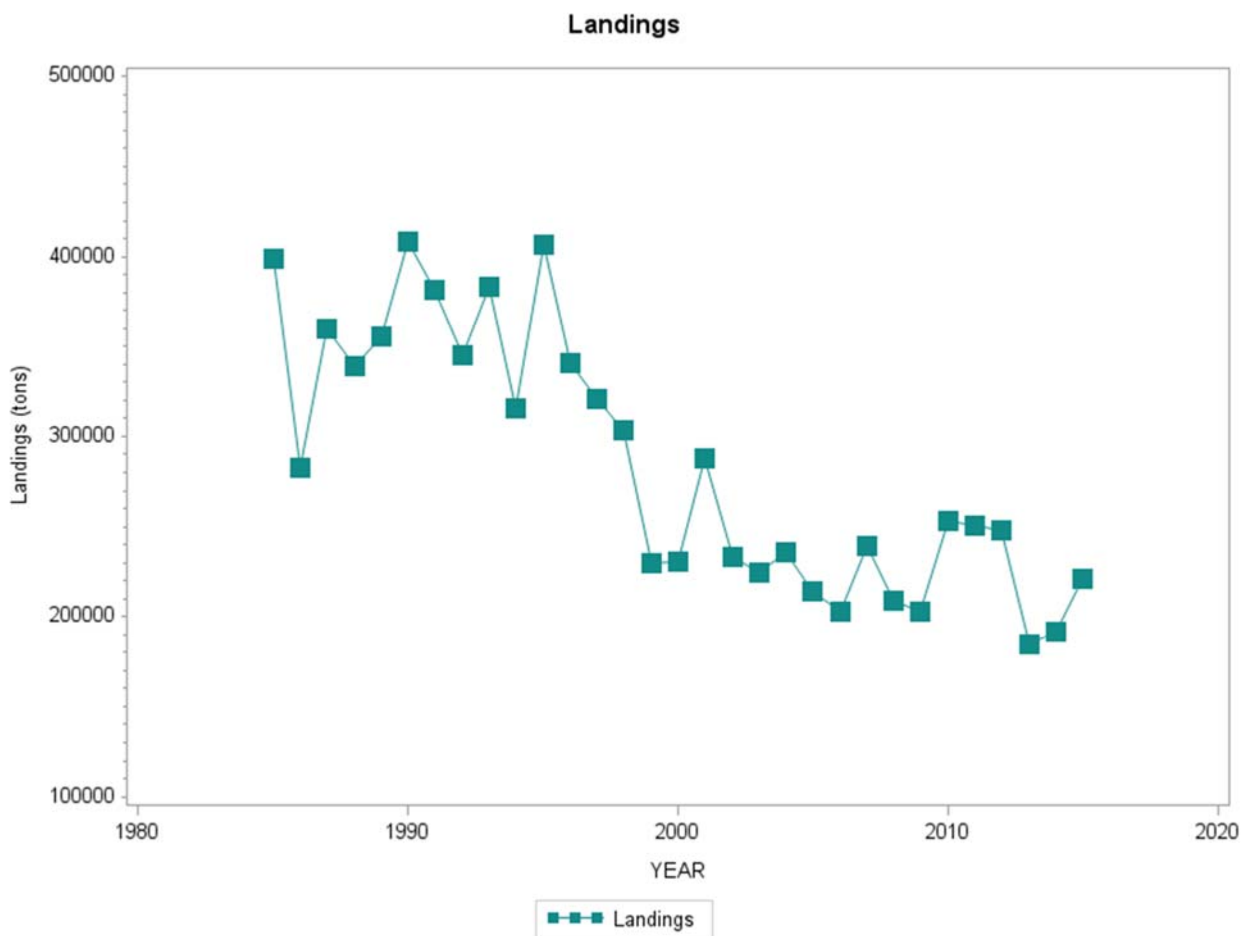
Name:
Email:
Phone:

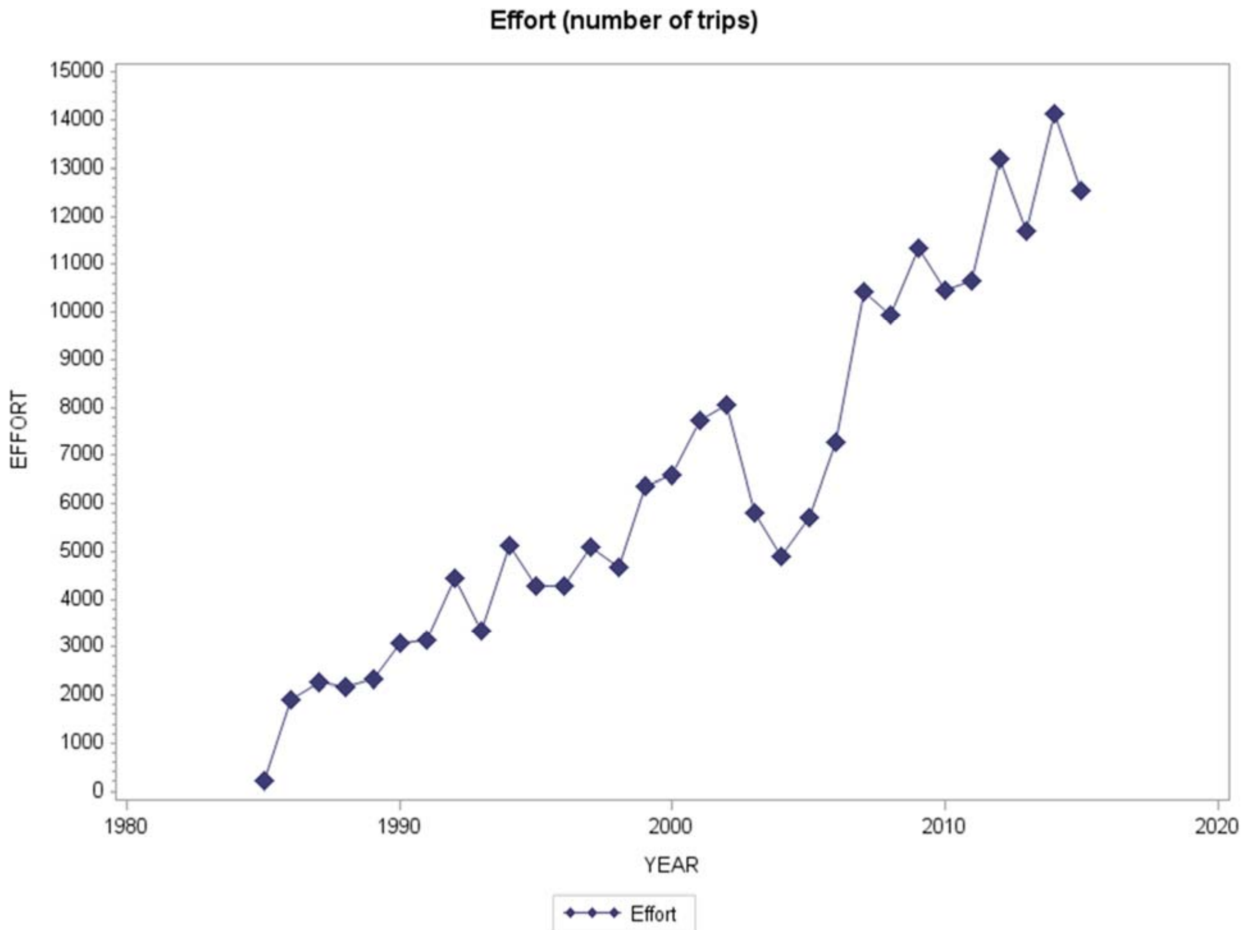
9.7 *Appendix G. State/Management Unit Level Annual Data*

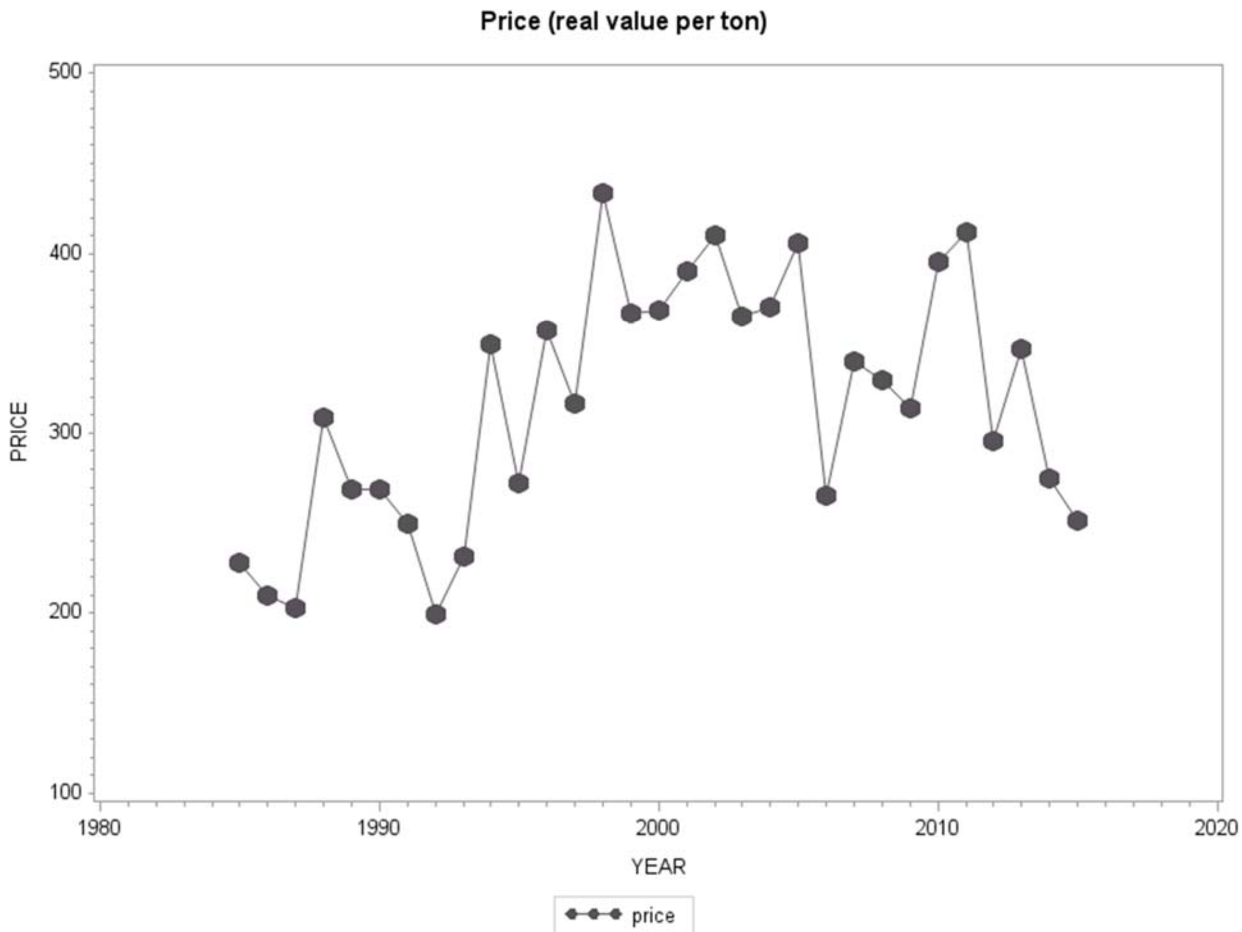
Data Summary									
	Connecticut					New Hampshire			
	Mean	Std Dev	Min	Max		Mean	Std Dev	Min	Max
Price	424	260	188	1191	Price	838	569	218	1665
Landings	86	165	3	569	Landings	0.2	0.1	0.0	0.2
Trips	146	126	18	399	Trips	15	10	4	27
Years	16				Years	6			
	Delaware					New Jersey			
	Mean	Std Dev	Min	Max		Mean	Std Dev	Min	Max
Price	224	53	176	385	Price	266	189	149	940
Landings	46	19	23	82	Landings	20040	10266	9012	42729
Trips	350	94	239	532	Trips	680	362	315	1576
Years	16				Years	16			
	Florida					New York			
	Mean	Std Dev	Min	Max		Mean	Std Dev	Min	Max
Price	924	358	544	1672	Price	349	119	214	675
Landings	67	52	11	189	Landings	193	199	3	707
Trips	271	219	49	847	Trips	307	213	13	600
Years	16				Years	16			
	Massachusetts					Rhode Island			
	Mean	Std Dev	Min	Max		Mean	Std Dev	Min	Max
Price	381	581	151	2129	Price	324	115	131	570
Landings	2050	1911	43	7049	Landings	201	287	4	1030
Trips	275	130	103	498	Trips	64	44	1	130
Years	11				Years	16			
	Maryland					Virginia			
	Mean	Std Dev	Min	Max		Mean	Std Dev	Min	Max
Price	243	63	99	372	Price	163	25	135	233
Landings	3674	2000	791	7356	Landings	189479	21029	158432	242257
Trips	1812	1534	100	4146	Trips	1732	1373	140	4090
Years	16				Years	16			
	Maine					PRFC (Maryland)			
	Mean	Std Dev	Min	Max		Mean	Std Dev	Min	Max
Price	315	109	232	530	Price	226	100	127	466
Landings	382	869	1	2155	Landings	717	335	350	1351
Trips	24	50	1	125	Trips	252	250	43	762
Years	6				Years	16			
	North Carolina					PRFC (Virginia)			
	Mean	Std Dev	Min	Max		Mean	Std Dev	Min	Max

Price	246	60	169	359	Price	208	85	127	379
Landings	9590	13142	227	34595	Landings	1107	493	542	2045
Trips	3360	1364	1649	6134	Trips	219	216	23	557
Years		16			Years		16		

9.8 Appendix H. Atlantic Coast Menhaden Landings, Effort and Price




Effort (number of trips)
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
EFFORT
1980
1990
2000
2010
2020
YEAR
Effort


Price (real value per ton)
500
400
300
200
100
PRICE
1980
1990
2000
2010
2020
YEAR
price

9.9 *Appendix I. Bait Reduction Economic Impact Spreadsheet Calculations*

	TAC (pounds)		Change in:		Type I Multipliers				Type I Impacts			
State	(1) 2016	(2) 2017	(3) Ex-Vessel Revenue	(4) Final Demand	(5) Output	(6)Earnings	(7) Employment	(8) Value Added	(9) Output	(10) Earnings	(11) Employment	(12) Value Added
Connecticut	71,538	76,152	427	905	1.2274	0.3508	13.9051	0.8102	1,502	429	0.02	992
Delaware	54,153	57,646	323	685	1.2581	0.3245	17.4571	0.8124	1,166	301	0.02	753
Florida	73,696	78,449	440	932	1.2321	0.372	19.8284	0.8158	1,553	469	0.02	1,029
Maine	161,467	171,882	963	2,042	1.1899	0.3565	11.2417	0.7903	3,287	985	0.03	2,183
Maryland	5,628,616	5,991,662	33,582	71,193	1.1994	0.3425	18.5404	0.7974	115,496	32,981	1.79	76,786
Massachusetts	3,438,660	3,660,454	20,516	43,494	1.1836	0.3274	10.0629	0.7908	69,630	19,261	0.59	46,522
New Hampshire	123	131	1	2	1	0	0	0	2	0	0.00	0
New Jersey	45,893,734	48,853,880	273,813	580,485	1.2871	0.3689	11.0385	0.8363	1,010,572	289,643	8.67	656,625
New York	227,367	242,032	1,357	2,876	1.1882	0.3444	18.885	0.7923	4,622	1,340	0.07	3,082
North Carolina	2,020,662	2,150,995	12,056	25,558	1.2367	0.366	19.6112	0.8129	42,752	12,653	0.68	28,102
PRFC	2,545,617	2,709,809	15,188	32,198	1.2305	0.3634	20.5537	0.8115	53,589	15,826	0.90	35,341
Rhode Island	73,457	78,195	438	929	1.1916	0.3432	10.7411	0.7917	1,497	431	0.01	995
Virginia (Bait)	33,513,958	35,675,608	199,953	423,900	1.2305	0.3634	20.5537	0.8115	705,519	208,359	11.78	465,282
Total	93,703,049	99,746,895							2,011,189	582,678	24.58	852,408
Note:												
Calculations: (3) = .0925*[(2)-(1)]; (4)=2.12*(3); (9)=(4)*(5); (10)=(4)*(6); (11)=(4)*(7); (12)=(4)*(8)												

Appendix J. Type I Economic Impacts in the Bait Fishery

Connecticut Type I Impacts				
%ΔTAC	Output	Earnings	Employment	Value Added
1	183	52	0.00	121
2	367	105	0.00	242
3	550	157	0.01	363
4	733	210	0.01	484
5	916	262	0.01	605
6	1100	314	0.01	726
7	1283	367	0.01	847
8	1466	419	0.02	968
9	1650	471	0.02	1089
10	1833	524	0.02	1210
11	2016	576	0.02	1331
12	2200	629	0.02	1452
13	2383	681	0.03	1573
14	2566	733	0.03	1694
15	2749	786	0.03	1815
16	2933	838	0.03	1936
17	3116	891	0.04	2057
18	3299	943	0.04	2178
19	3483	995	0.04	2299
20	3666	1048	0.04	2420
21	3849	1100	0.04	2541
22	4032	1153	0.05	2662
23	4216	1205	0.05	2783
24	4399	1257	0.05	2904
25	4582	1310	0.05	3025
26	4766	1362	0.05	3146
27	4949	1414	0.06	3267
28	5132	1467	0.06	3388
29	5315	1519	0.06	3509
30	5499	1572	0.06	3630

Delaware Type I Impacts				
%ΔTAC	Output	Earnings	Employment	Value Added
1	284	73	0.00	184
2	569	147	0.01	502
3	853	220	0.01	753
4	1138	293	0.02	1004
5	1422	367	0.02	1255
6	1707	440	0.02	1506
7	1991	514	0.03	1757
8	2276	587	0.03	2008
9	2560	660	0.04	2259
10	2844	734	0.04	2510
11	3129	807	0.04	2761
12	3413	880	0.05	3012
13	3698	954	0.05	3263
14	3982	1027	0.06	3514
15	4267	1100	0.06	3765
16	4551	1174	0.06	4016
17	4835	1247	0.07	4267
18	5120	1321	0.07	4518
19	5404	1394	0.07	4769
20	5689	1467	0.08	5020
21	5973	1541	0.08	5271
22	6258	1614	0.09	5522
23	6542	1687	0.09	5773
24	6827	1761	0.09	6024
25	7111	1834	0.10	6275
26	7395	1908	0.10	6526
27	7680	1981	0.11	6777
28	7964	2054	0.11	7028
29	8249	2128	0.11	7279
30	8533	2201	0.12	7530

Florida Type I Impacts				
%ΔTAC	Output	Earnings	Employment	Value Added
1	379	114	0	251
2	758	229	0.01	502
3	1137	343	0.02	753
4	1516	458	0.02	1004
5	1895	572	0.03	1255
6	2275	687	0.04	1506
7	2654	801	0.04	1757
8	3033	916	0.05	2008
9	3412	1030	0.05	2259
10	3791	1145	0.06	2510
11	4170	1259	0.07	2761
12	4549	1373	0.07	3012
13	4928	1488	0.08	3263
14	5307	1602	0.09	3514
15	5686	1717	0.09	3765
16	6065	1831	0.10	4016
17	6445	1946	0.10	4267
18	6824	2060	0.11	4518
19	7203	2175	0.12	4769
20	7582	2289	0.12	5020
21	7961	2404	0.13	5271
22	8340	2518	0.13	5522
23	8719	2632	0.14	5773
24	9098	2747	0.15	6024
25	9477	2861	0.15	6275
26	9856	2976	0.16	6526
27	10235	3090	0.16	6777
28	10614	3205	0.17	7028
29	10994	3319	0.18	7279
30	11373	3434	0.18	7530

Maine Type I Impacts				
%∆TAC	Output	Earnings	Employment	Value Added
1	802	240	0.01	533
2	1604	481	0.02	1066
3	2406	721	0.02	1598
4	3209	961	0.03	2131
5	4011	1202	0.04	2664
6	4813	1442	0.05	3197
7	5615	1682	0.05	3729
8	6417	1923	0.06	4262
9	7219	2163	0.07	4795
10	8021	2403	0.08	5328
11	8824	2644	0.08	5860
12	9626	2884	0.09	6393
13	10428	3124	0.10	6926
14	11230	3365	0.11	7459
15	12032	3605	0.11	7991
16	12834	3845	0.12	8524
17	13636	4086	0.13	9057
18	14438	4326	0.14	9590
19	15241	4566	0.14	10122
20	16043	4806	0.15	10655
21	16845	5047	0.16	11188
22	17647	5287	0.17	11721
23	18449	5527	0.17	12253
24	19251	5768	0.18	12786
25	20053	6008	0.19	13319
26	20856	6248	0.20	13852
27	21658	6489	0.20	14384
28	22460	6729	0.21	14917
29	23262	6969	0.22	15450
30	24064	7210	0.23	15983

Maryland Type I Impacts				
%ΔTAC	Output	Earnings	Employment	Value Added
1	28,185	8,049	0	18,738
2	56370	16097	0.87	37477
3	84555	24146	1.31	56215
4	112740	32194	1.74	74953
5	140925	40243	2.18	93692
6	169110	48291	2.61	112430
7	197295	56340	3.05	131168
8	225480	64388	3.49	149907
9	253666	72437	3.92	168645
10	281851	80485	4.36	187383
11	310036	88534	4.79	206122
12	338221	96582	5.23	224860
13	366406	104631	5.66	243598
14	394591	112679	6.10	262337
15	422776	120728	6.54	281075
16	450961	128776	6.97	299813
17	479146	136825	7.41	318552
18	507331	144873	7.84	337290
19	535516	152922	8.28	356028
20	563701	160970	8.71	374767
21	591886	169019	9.15	393505
22	620071	177067	9.59	412243
23	648256	185116	10.02	430982
24	676441	193164	10.46	449720
25	704626	201213	10.89	468459
26	732812	209261	11.33	487197
27	760997	217310	11.76	505935
28	789182	225358	12.20	524674
29	817367	233407	12.63	543412
30	845552	241455	13.07	562150

Massachusetts Type I Impacts				
%ΔTAC	Output	Earnings	Employment	Value Added
1	16,992	4,700	0	11,353
2	33984	9401	0.29	22706
3	50976	14101	0.43	34059
4	67968	18801	0.58	45412
5	84961	23501	0.72	56765
6	101953	28202	0.87	68118
7	118945	32902	1.01	79471
8	135937	37602	1.16	90824
9	152929	42302	1.30	102177
10	169921	47003	1.44	113530
11	186913	51703	1.59	124883
12	203905	56403	1.73	136236
13	220898	61103	1.88	147589
14	237890	65804	2.02	158941
15	254882	70504	2.17	170294
16	271874	75204	2.31	181647
17	288866	79904	2.46	193000
18	305858	84605	2.60	204353
19	322850	89305	2.74	215706
20	339842	94005	2.89	227059
21	356834	98705	3.03	238412
22	373827	103406	3.18	249765
23	390819	108106	3.32	261118
24	407811	112806	3.47	272471
25	424803	117506	3.61	283824
26	441795	122207	3.76	295177
27	458787	126907	3.90	306530
28	475779	131607	4.05	317883
29	492771	136307	4.19	329236
30	509764	141008	4.33	340589

New Jersey Type I Impacts				
%ΔTAC	Output	Earnings	Employment	Value Added
1	246,615	70,683	2	160,239
2	493229	141366	4.23	320478
3	739844	212049	6.35	480718
4	986459	282732	8.46	640957
5	1233073	353415	10.58	801196
6	1479688	424098	12.69	961435
7	1726303	494781	14.81	1121674
8	1972918	565464	16.92	1281914
9	2219532	636147	19.04	1442153
10	2466147	706831	21.15	1602392
11	2712762	777514	23.27	1762631
12	2959376	848197	25.38	1922870
13	3205991	918880	27.50	2083110
14	3452606	989563	29.61	2243349
15	3699220	1060246	31.73	2403588
16	3945835	1130929	33.84	2563827
17	4192450	1201612	35.96	2724066
18	4439064	1272295	38.07	2884305
19	4685679	1342978	40.19	3044545
20	4932294	1413661	42.30	3204784
21	5178908	1484344	44.42	3365023
22	5425523	1555027	46.53	3525262
23	5672138	1625710	48.65	3685501
24	5918753	1696393	50.76	3845741
25	6165367	1767076	52.88	4005980
26	6411982	1837759	54.99	4166219
27	6658597	1908442	57.11	4326458
28	6905211	1979126	59.22	4486697
29	7151826	2049809	61.34	4646937
30	7398441	2120492	63.45	4807176

New York Type I Impacts				
%ΔTAC	Output	Earnings	Employment	Value Added
1	1,128	327	0	752
2	2256	654	0.04	1504
3	3384	981	0.05	2256
4	4512	1308	0.07	3008
5	5639	1635	0.09	3760
6	6767	1962	0.11	4513
7	7895	2288	0.13	5265
8	9023	2615	0.14	6017
9	10151	2942	0.16	6769
10	11279	3269	0.18	7521
11	12407	3596	0.20	8273
12	13535	3923	0.22	9025
13	14663	4250	0.23	9777
14	15791	4577	0.25	10529
15	16918	4904	0.27	11281
16	18046	5231	0.29	12033
17	19174	5558	0.30	12786
18	20302	5885	0.32	13538
19	21430	6212	0.34	14290
20	22558	6538	0.36	15042
21	23686	6865	0.38	15794
22	24814	7192	0.39	16546
23	25942	7519	0.41	17298
24	27070	7846	0.43	18050
25	28197	8173	0.45	18802
26	29325	8500	0.47	19554
27	30453	8827	0.48	20306
28	31581	9154	0.50	21059
29	32709	9481	0.52	21811
30	33837	9808	0.54	22563

North Carolina Type I Impacts				
%ΔTAC	Output	Earnings	Employment	Value Added
1	10,433	3,088	0	6,858
2	20866	6175	0.33	13716
3	31299	9263	0.50	20573
4	41732	12351	0.66	27431
5	52165	15438	0.83	34289
6	62598	18526	0.99	41147
7	73031	21614	1.16	48005
8	83464	24701	1.32	54862
9	93897	27789	1.49	61720
10	104331	30877	1.65	68578
11	114764	33964	1.82	75436
12	125197	37052	1.99	82293
13	135630	40139	2.15	89151
14	146063	43227	2.32	96009
15	156496	46315	2.48	102867
16	166929	49402	2.65	109725
17	177362	52490	2.81	116582
18	187795	55578	2.98	123440
19	198228	58665	3.14	130298
20	208661	61753	3.31	137156
21	219094	64841	3.47	144014
22	229527	67928	3.64	150871
23	239960	71016	3.81	157729
24	250393	74104	3.97	164587
25	260826	77191	4.14	171445
26	271259	80279	4.30	178303
27	281692	83367	4.47	185160
28	292125	86454	4.63	192018
29	302558	89542	4.80	198876
30	312992	92630	4.96	205734

PRFC Type I Impacts				
%ΔTAC	Output	Earnings	Employment	Value Added
1	13,078	3,862	0	8,625
2	26155	7724	0.44	17249
3	39233	11587	0.66	25874
4	52310	15449	0.87	34498
5	65388	19311	1.09	43123
6	78466	23173	1.31	51747
7	91543	27035	1.53	60372
8	104621	30897	1.75	68996
9	117698	34760	1.97	77621
10	130776	38622	2.18	86245
11	143854	42484	2.40	94870
12	156931	46346	2.62	103494
13	170009	50208	2.84	112119
14	183086	54070	3.06	120743
15	196164	57933	3.28	129368
16	209242	61795	3.50	137992
17	222319	65657	3.71	146617
18	235397	69519	3.93	155241
19	248474	73381	4.15	163866
20	261552	77243	4.37	172490
21	274629	81106	4.59	181115
22	287707	84968	4.81	189739
23	300785	88830	5.02	198364
24	313862	92692	5.24	206988
25	326940	96554	5.46	215613
26	340017	100416	5.68	224237
27	353095	104279	5.90	232862
28	366173	108141	6.12	241486
29	379250	112003	6.33	250111
30	392328	115865	6.55	258736

Rhode Island Type I Impacts				
%ΔTAC	Output	Earnings	Employment	Value Added
1	365	105	0.00	243
2	731	211	0.01	486
3	1096	316	0.01	728
4	1462	421	0.01	971
5	1827	526	0.02	1214
6	2193	632	0.02	1457
7	2558	737	0.02	1700
8	2924	842	0.03	1942
9	3289	947	0.03	2185
10	3654	1053	0.03	2428
11	4020	1158	0.04	2671
12	4385	1263	0.04	2914
13	4751	1368	0.04	3156
14	5116	1474	0.05	3399
15	5482	1579	0.05	3642
16	5847	1684	0.05	3885
17	6212	1789	0.06	4128
18	6578	1895	0.06	4370
19	6943	2000	0.06	4613
20	7309	2105	0.07	4856
21	7674	2210	0.07	5099
22	8040	2316	0.07	5342
23	8405	2421	0.08	5584
24	8771	2526	0.08	5827
25	9136	2631	0.08	6070
26	9501	2737	0.09	6313
27	9867	2842	0.09	6556
28	10232	2947	0.09	6798
29	10598	3052	0.10	7041
30	10963	3158	0.10	7284

Virginia Type I Impacts				
%ΔTAC	Output	Earnings	Employment	Value Added
1	172171	50847	3	113545
2	344342	101694	5.75	227090
3	516514	152540	8.63	340635
4	688685	203387	11.50	454179
5	860856	254234	14.38	567724
6	1033027	305081	17.26	681269
7	1205199	355928	20.13	794814
8	1377370	406775	23.01	908359
9	1549541	457621	25.88	1021904
10	1721712	508468	28.76	1135449
11	1893884	559315	31.63	1248994
12	2066055	610162	34.51	1362538
13	2238226	661009	37.39	1476083
14	2410397	711856	40.26	1589628
15	2582569	762702	43.14	1703173
16	2754740	813549	46.01	1816718
17	2926911	864396	48.89	1930263
18	3099082	915243	51.77	2043808
19	3271253	966090	54.64	2157352
20	3443425	1016937	57.52	2270897
21	3615596	1067783	60.39	2384442
22	3787767	1118630	63.27	2497987
23	3959938	1169477	66.14	2611532
24	4132110	1220324	69.02	2725077
25	4304281	1271171	71.90	2838622
26	4476452	1322018	74.77	2952167
27	4648623	1372864	77.65	3065711
28	4820795	1423711	80.52	3179256
29	4992966	1474558	83.40	3292801
30	5165137	1525405	86.28	3406346

9.10 *Appendix K. Type I Economic Impacts in the Reduction Fishery*

Northumberland County Type I Impacts				
%∆TAC	Output	Earnings	Employment	Value Added
1	681835	183384	15	600325
2	1363670	366768	30	1200649
3	2045504	550151	45	1800974
4	2727339	733535	60	2401299
5	3409174	916919	75	3001623
6	4091009	1100303	89	3601948
7	4772843	1283686	104	4202273
8	5454678	1467070	119	4802597
9	6136513	1650454	134	5402922
10	6818348	1833838	149	6003247
11	7500182	2017222	164	6603571
12	8182017	2200605	179	7203896
13	8863852	2383989	194	7804221
14	9545687	2567373	209	8404545
15	10227522	2750757	224	9004870
16	10909356	2934140	239	9605195
17	11591191	3117524	253	10205519
18	12273026	3300908	268	10805844
19	12954861	3484292	283	11406169
20	13636695	3667676	298	12006493
21	14318530	3851059	313	12606818
22	15000365	4034443	328	13207143
23	15682200	4217827	343	13807467
24	16364035	4401211	358	14407792
25	17045869	4584594	373	15008117
26	17727704	4767978	388	15608441
27	18409539	4951362	403	16208766
28	19091374	5134746	417	16809091
29	19773208	5318130	432	17409415
30	20455043	5501513	447	18009740

Rest of Virginia Type I Impacts				
%ΔTAC	Output	Earnings	Employment	Value Added
1	116,374	52,349	2	78,743
2	232749	104698	5	157487
3	349123	157047	7	236230
4	465498	209396	9	314974
5	581872	261745	11	393717
6	698247	314094	14	472461
7	814621	366443	16	551204
8	930995	418792	18	629948
9	1047370	471141	21	708691
10	1163744	523490	23	787435
11	1280119	575839	25	866178
12	1396493	628188	27	944921
13	1512868	680537	30	1023665
14	1629242	732886	32	1102408
15	1745616	785235	34	1181152
16	1861991	837584	37	1259895
17	1978365	889934	39	1338639
18	2094740	942283	41	1417382
19	2211114	994632	43	1496126
20	2327489	1046981	46	1574869
21	2443863	1099330	48	1653612
22	2560237	1151679	50	1732356
23	2676612	1204028	53	1811099
24	2792986	1256377	55	1889843
25	2909361	1308726	57	1968586
26	3025735	1361075	60	2047330
27	3142109	1413424	62	2126073
28	3258484	1465773	64	2204817
29	3374858	1518122	66	2283560
30	3491233	1570471	69	2362304

9.11 Appendix L. NOAA County Level Data Summary

County-level Economic and Landings Data Summary

2005					
Variable	Counties	Mean	Std Dev	Min	Max
Employment	47	88226	144882	999	604188
Income	47	10197	19106	66	80495
Landings	47	731	3561	0	24037

2006					
Variable	Counties	Mean	Std Dev	Min	Max
Employment	47	79826	125065	1079	599794
Income	47	9511	17642	77	84660
Landings	47	577	2165	0	11846

2007					
Variable	Counties	Mean	Std Dev	Min	Max
Employment	52	93463	145410	1092	622605
Income	52	11000	19400	73	88486
Landings	52	691	2847	0	15849

2008					
Variable	Counties	Mean	Std Dev	Min	Max
Employment	53	138387	347336	1130	2376385
Income	53	20707	74965	77	537822
Landings	53	857	3232	0	17852

2009					
Variable	Counties	Mean	Std Dev	Min	Max
Employment	48	149301	351308	1103	2275090
Income	48	23570	75265	80	509944
Landings	48	465	2326	0	16018

2010					
Variable	Counties	Mean	Std Dev	Min	Max
Employment	50	147895	345411	1096	2280092
Income	50	23953	77716	80	538352
Landings	50	445	2029	0	13893

2011					
Variable	Counties	Mean	Std Dev	Min	Max
Employment	48	147635	359683	1168	2329322

Income	48	24437	81460	82	553246
Landings	48	116	387	0	2125

		2012			
Variable	Counties	Mean	Std Dev	Min	Max
Employment	54	124866	345519	1226	2383607
Income	54	19985	77999	84	563220
Landings	54	840	3731	0	21644

		2013			
Variable	Counties	Mean	Std Dev	Min	Max
Employment	53	134439	357898	1211	2432252
Income	53	22135	80960	86	576655
Landings	53	311	1855	0	13504

9.12 Appendix M. Public Survey Questionnaire

1. In what Atlantic state do you live?

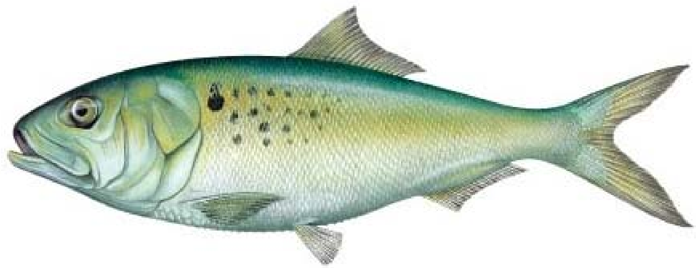
- Florida
- Maine
- Maryland
- New Jersey
- New York
- North Carolina
- Rhode Island
- Virginia

The Atlantic States Marine Fisheries Commission (ASMFC) is an interstate compact formed under an agreement by the 15 Atlantic coast states. The mission of the ASMFC is "and promote the better utilization of the fisheries, marine, shell and anadromous, of the Atlantic seaboard by the development of a joint program for the promotion and protection of such fisheries, and by the prevention of physical waste of the fisheries from any cause."

2. How much did you know about the ASMFC before this survey?

- A lot
- Some
- A little
- Nothing

A difficult issue facing the ASMFC concerns the harvesting of Atlantic menhaden. Menhaden is a species of fish in the herring family. They are found in the coastal and estuarine waters from northern Florida and Canada. They swim in large schools. Younger and smaller fish are found in the Chesapeake Bay and southern coastline while older and larger fish are found along the northern coastline. 1-year old menhaden are about 6 inches long, 3-year old menhaden are about 12 inches long and weigh about 0.5 pounds and 6-year old menhaden can be up and 14 inches long and weigh about 1 pound.

50% 

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3. How much did you know about Atlantic menhaden before this survey?

- A lot
- Some
- A little
- Nothing

The commercial menhaden fishery has the largest landings along the Atlantic Coast of any other fish species. "Landings" are the number or pounds of fish caught and sold by commercial fishermen. In 2015 410 million pounds of menhaden were caught and sold for about $38.13 million.

4. How important do you think that the Atlantic menhaden commercial fishery is and the economy?

- Very important
- Somewhat important
- Somewhat not important
- Not important

The ASMFC manages menhaden and prevent overfishing. Overfishing occurs when ando many fish are being taken from the population of a fish stock. The most recent scientific assessment of the population in 2012 indicates that overfishing is not occurring for menhaden.

5. How concerned are you about overfishing of menhaden?

- Very concerned
- Somewhat concerned
- Not ando concerned
- Not at all concerned

Menhaden has a number of "direct" or "consumptive" uses:

- Menhaden is processed into fish meal and used as feed for livesstock, poultry and farm-raised fish.
- Menhaden is processed into fish oil and used as a human health supplement containing omega-3 fatty acids.
- Menhaden is used as bait by recreational fishermen.
- Menhaden is used as bait by commercial fishermen for American lobster, blue crabs, and crawfish.

6. How important do you think menhaden are for the following uses?

	Very important	Somewhat important	Not too important	Not at all important	I don't know / no opinion
Fish meal	☐	☐	☐	☐	☐
Fish oil	☐	☐	☐	☐	☐
Bait for commercial fishing	☐	☐	☐	☐	☐
Bait for recreational fishing	☐	☐	☐	☐	☐

Menhaden has a number of "indirect" or "nonconsumptive" uses:

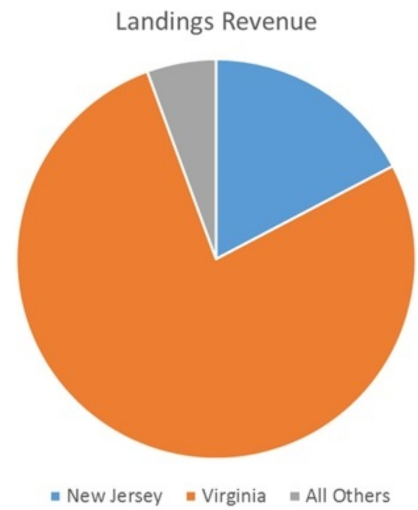
- Menhaden is a significant part of the diet of many important commercial and recreational fish like striped bass, weakfish and bluefish.
- Menhaden is a significant part of the diet of water birds like osprey, pelicans and loons.
- Menhaden filter pollution from the water through their gills and there is some scientific evidence that this may improve water quality.

7. How important do you think menhaden are for the following uses?

	Very important	Somewhat important	Not too important	Not at all important	I don't know / no opinion
Food for other fish species	☐	☐	☐	☐	☐
Food for water birds	☐	☐	☐	☐	☐
Water Quality	☐	☐	☐	☐	☐

The 2016 menhaden landings quota (in pounds) for each Atlantic state, predicted landings revenue and predicted price per pound earned by commercial fishermen is in the table below. The quota is the limit on how much fish can be caught and still avoid overfishing.

Atlantic Menhaden Landings with a 410 million pound quota			
State	**Landings Quota**	**Landings Revenue**	**Price per pound**
Connecticut	71,537	$14,373	$0.201
Delaware	54,153	$5,827	$0.108
Florida	73,695	$24,307	$0.330
New Hampshire	123	$10	$0.081
Maine	161,466	$13,049	$0.081
Maryland	5,628,568	$975,765	$0.173
Massachusetts	3,438,630	$277,905	$0.081
New Jersey	45,893,335	$6,610,043	$0.144
New York	227,365	$39,628	$0.174
North Carolina	2,020,645	$338,889	$0.168
PRFC*	2,545,595	$441,303	$0.173
Rhode Island	73,457	$9,728	$0.132
Virginia	349,873,884	$29,459,601	$0.084



Note:

- Virginia receives 85% of the Atlantic quota. New Jersey receives 11% of the Atlantic quota.
- Most of the menhaden landings in Virginia are used for fish oil and fish meal and the rest for bait.
- All of the menhaden landings in the other Atlantic states are used for bait.
- The Potomac River Fisheries Commission (PRFC) has their own quota separate from the Atlantic quota.

8. How important do you think that the Atlantic menhaden commercial fishery is and the {{ Q1 }} economy?

- Very important
- Somewhat important
- Somewhat not important
- Not important

The current process of fisheries management typically involves decision-making on an individual species basis with a focus on overfishing.

The ASMFC is in the process of studying an "ecosystem-based management plan" for menhaden that accounts for the interactions between menhaden and other fish species, water bird species and water quality.

9. How important do you think it is and manage menhaden at the ecosystem level instead of the individual species level?

- Very important
- Somewhat important
- Somewhat unimportant
- Not important

PLEASE READ THESE INSTRUCTIONS

Please consider the following ecosystem-based management situations for menhaden. These situations are designed and give the ASMFC information about public preferences over a wide range of potential outcomes.

You will be presented with a status quo situation. The status quo is the current quota for menhaden. You will also be presented with alternative quotas that either increase or decrease menhaden landings. The ASMFC does not believe that overfishing will occur if the menhaden quota is increased by up and 40%.

Changes in the menhaden quota menhaden will lead and changes in the landing revenues that commercial fishermen receive when they sell their catch. Revenues are equal and pounds landed multiplied by the price per pound.

The price per pound is uncertain at this time. We have estimated a range of prices. Each scenario presents a number in this range.

Changes in the landings of menhaden will lead and changes in the number of jobs in the commercial fishing industry. The size of the change is uncertain at this time. We have estimated a range of job changes. Each scenario presents a number in this range.

There is the possibility that changes in menhaden landings will lead and changes in other parts of the ecosystem such as water quality, predator fish species like striped bass, weakfish and bluefish and water birds like osprey, pelicans and loons. There is currently scientific uncertainty about these relationships. So, we describe the potential effects in very simple terms:

Quota	Water quality, predator fish species and water birds
Increase	No change or a decrease
Decrease	No change or a decrease

You will be presented with several of these situations. Please consider each one independently from the others. After each situation is presented you will be asked about which alternative you would vote for if an election were held today. For this question imagine that you have the opportunity and vote on the menhaden quota change in an advisory referendum and the

ASMFC. If more than 50% of the households in {{ Q1 }} vote for the quota change then the ASMFC would consider {{ Q1 }} and be in favor.

Your responses will be used and develop a decision-making tool and help the ASMFC consider what people think for a wide range of potential situations and incorporate new scientific findings over the next several years.

10. How well do you understand these instructions?

- Very well
- Somewhat well
- Not very well
- I did not read the instructions
- Other (please specify)

Current Quota

Menhaden landings throughout the Atlantic States are expected and be 410 million pounds and landings revenue is expected and be $38.13 million at an average price of $0.093 per pound.

Increased Quota

33%	The ASMFC is considering a 10% increase and each state's individual menhaden quota. Throughout the Atlantic States: Landings increase by 41 million pounds and revenues increase by $3.81 million.
33%	The ASMFC is considering a 20% increase and each state's individual menhaden quota. Throughout the Atlantic States: Landings increase by 82 million pounds and revenues increase by $7.63 million.
33%	The ASMFC is considering a 30% increase and each state's individual menhaden quota. Throughout the Atlantic States: Landings increase by 123 million pounds and revenues increase by $11.44 million.
33%	The number of jobs in the menhaden industry increase by 250.
33%	The number of jobs in the menhaden industry increase by 500.
33%	The number of jobs in the menhaden industry increase by 750.
50%	There is no change in striped bass, weakfish and bluefish populations.
50%	There is a decrease in striped bass, weakfish and bluefish populations.
50%	There is no change in osprey, pelican and loon populations.
50%	There is a decrease in osprey, pelican and loon populations.
50%	There is no change in water quality.
50%	There is a decrease in water quality.

11. Would you vote for or against the increased quota?

I would vote for the increased quota

I would vote against the increased quota

I don't know how I would vote

Current Quota

Menhaden landings throughout the Atlantic States are expected and be 410 million pounds and landings revenue is expected and be $31.57 million at an average price of $0.077 per pound.

Increased Quota

33%	The ASMFC is considering a 10% increase and each state's individual menhaden quota. Throughout the Atlantic States: Landings increase by 41 million pounds and revenues increase by $3.16 million.
33%	The ASMFC is considering a 20% increase and each state's individual menhaden quota. Throughout the Atlantic States: Landings increase by 82 million pounds and revenues increase by $6.31 million.
33%	The ASMFC is considering a 30% increase and each state's individual menhaden quota. Throughout the Atlantic States: Landings increase by 123 million pounds and revenues increase by $9.47 million.
33%	The number of jobs in the menhaden industry increase by 250.
33%	The number of jobs in the menhaden industry increase by 500.
33%	The number of jobs in the menhaden industry increase by 750.
50%	There is no change in striped bass, weakfish and bluefish populations.
50%	There is a decrease in striped bass, weakfish and bluefish populations.
50%	There is no change in osprey, pelican and loon populations.
50%	There is a decrease in osprey, pelican and loon populations.
50%	There is no change in water quality.
50%	There is a decrease in water quality.

12. Would you vote for or against the increased quota?

I would vote for the increased quota

I would vote against the increased quota

I don't know how I would vote

Current Quota

Menhaden landings throughout the Atlantic States are expected and be 410 million pounds and landings revenue is expected and be $43.87 million at an average price of $0.107 per pound.

Increased Quota

33%	The ASMFC is considering a 10% increase and each state's individual menhaden quota. Throughout the Atlantic States: Landings increase by 41 million pounds and revenues increase by $4.39 million.
33%	The ASMFC is considering a 20% increase and each state's individual menhaden quota. Throughout the Atlantic States: Landings increase by 82 million pounds and revenues increase by $8.77 million.
33%	The ASMFC is considering a 30% increase and each state's individual menhaden quota. Throughout the Atlantic States: Landings increase by 123 million pounds and revenues increase by $13.16 million.
33%	The number of jobs in the menhaden industry increase by 250.
33%	The number of jobs in the menhaden industry increase by 500.
33%	The number of jobs in the menhaden industry increase by 750.
50%	There is no change in striped bass, weakfish and bluefish populations.
50%	There is a decrease in striped bass, weakfish and bluefish populations.
50%	There is no change in osprey, pelican and loon populations.
50%	There is a decrease in osprey, pelican and loon populations.
50%	There is no change in water quality.
50%	There is a decrease in water quality.

13. Would you vote for or against the increased quota?

I would vote for the increased quota

I would vote against the increased quota

I don't know how I would vote

Current Quota

Menhaden landings throughout the Atlantic States are expected and be 410 million pounds and landings revenue is expected and be $38 million at an average price of $0.093 per pound.

Decreased Quota

33%	The ASMFC is considering a 10% decrease and each state's individual menhaden quota. Throughout the Atlantic States: Landings increase by 41 million pounds and revenues increase by $3.81 million.
33%	The ASMFC is considering a 20% decrease and each state's individual menhaden quota. Throughout the Atlantic States: Landings increase by 82 million pounds and revenues increase by $7.63 million.
33%	The ASMFC is considering a 30% decrease and each state's individual menhaden quota. Throughout the Atlantic States: Landings increase by 123 million pounds and revenues increase by $11.44 million.
33%	The number of jobs in the menhaden industry decrease by 250.
33%	The number of jobs in the menhaden industry decrease by 500.
33%	The number of jobs in the menhaden industry decrease by 750.
50%	There is no change in striped bass, weakfish and bluefish populations.
50%	There is an increase in striped bass, weakfish and bluefish populations.
50%	There is no change in osprey, pelican and loon populations.
50%	There is an increase in osprey, pelican and loon populations.
50%	There is no change in water quality.
50%	There is an increase in water quality.

14. Would you vote for or against the decreased quota?

I would vote for the increased quota

I would vote against the increased quota

I don't know how I would vote

Current Quota

Menhaden landings throughout the Atlantic States are expected and be 410 million pounds and landings revenue is expected and be $31.57 million at an average price of $0.077 per pound.

Decreased Quota

33%	The ASMFC is considering a 10% decrease and each state's individual menhaden quota. Throughout the Atlantic States: Landings increase by 41 million pounds and revenues increase by $3.16 million.
33%	The ASMFC is considering a 20% decrease and each state's individual menhaden quota. Throughout the Atlantic States: • Landings increase by 82 million pounds and revenues increase by $6.31 million.
33%	The ASMFC is considering a 30% decrease and each state's individual menhaden quota. Throughout the Atlantic States: • Landings increase by 123 million pounds and revenues increase by $9.47 million.
33%	• The number of jobs in the menhaden industry decrease by 250.
33%	• The number of jobs in the menhaden industry decrease by 500.
33%	• The number of jobs in the menhaden industry decrease by 750.
50%	• There is no change in striped bass, weakfish and bluefish populations.
50%	• There is an increase in striped bass, weakfish and bluefish populations.
50%	• There is no change in osprey, pelican and loon populations.
50%	• There is an increase in osprey, pelican and loon populations.
50%	• There is no change in water quality.
50%	• There is an increase in water quality.

15. Would you vote for or against the decreased quota?

- ☐ I would vote for the increased quota
- ☐ I would vote against the increased quota
- ☐ I don't know how I would vote

Current Quota

Menhaden landings throughout the Atlantic States are expected and be 410 million pounds and landings revenue is expected and be $43.87 million at an average price of $0.107 per pound.

Decreased Quota

33%	The ASMFC is considering a 10% decrease and each state's individual menhaden quota. Throughout the Atlantic States: • Landings increase by 41 million pounds and revenues increase by $4.39 million.
33%	The ASMFC is considering a 20% decrease and each state's individual menhaden quota. Throughout the Atlantic States: • Landings increase by 82 million pounds and revenues increase by $8.77 million.
33%	The ASMFC is considering a 30% decrease and each state's individual menhaden quota. Throughout the Atlantic States: • Landings increase by 123 million pounds and revenues increase by $13.16 million.
33%	• The number of jobs in the menhaden industry decrease by 250.
33%	• The number of jobs in the menhaden industry decrease by 500.
33%	• The number of jobs in the menhaden industry decrease by 750.
50%	• There is no change in striped bass, weakfish and bluefish populations.
50%	• There is an increase in striped bass, weakfish and bluefish populations.
50%	• There is no change in osprey, pelican and loon populations.
50%	• There is an increase in osprey, pelican and loon populations.
50%	• There is no change in water quality.
50%	• There is an increase in water quality.

16. Would you vote for or against the decreased quota?

- ☐ I would vote for the increased quota
- ☐ I would vote against the increased quota
- ☐ I don't know how I would vote

17. How much did you consider each of the factors when you were making your decisions about how and vote?

	None	Some	A lot
Size of the quota	☐	☐	☐
Price per pound	☐	☐	☐
Number of jobs	☐	☐	☐
Water quality	☐	☐	☐
Striped bass, weakfish and bluefish populations	☐	☐	☐
Osprey, pelican and loon populations	☐	☐	☐
Overfishing	☐	☐	☐

18. Do you agree or disagree with the following statements?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
The results of this survey will be shared with the ASMFC.	☐	☐	☐	☐	☐
The results of this survey could affect ASMFC decisions about menhaden.	☐	☐	☐	☐	☐
I understand all of the information presented and me on the proposed alternative menhaden quotas.	☐	☐	☐	☐	☐
Public opinion surveys are a good way for citizens and express their preferences about fisheries policy	☐	☐	☐	☐	☐

Finally, we would like and ask some questions about you and your household. These questions will help us analyze the results of this study. Your answers will be kept strictly anonymous.

19. Are you currently a member of any recreational, environmental or conservation organization or association?

- ☐ Yes
- ☐ No

20. Are you currently employed in the commercial fishing or a related industry?

- ☐ Yes
- ☐ No

Recreational saltwater fishing refers and fishing for pleasure, amusement, relaxation, or home consumption in oceans, bays, inlets, intra-coastal waterways, and brackish portions of water bodies affected by the tides such as rivers, sounds, passes, estuaries, bayous, and canals.

21. During the past 12 months have you participated in recreational saltwater fishing?

- ☐ Yes
- ☐ No

22. [If Yes to Q21] During the past 12 months have you participated in recreational saltwater fishing in {{ Q1 }}?

- ☐ Yes
- ☐ No

23. [If Yes to Q22] About how many days would you say you fished in {{ Q1 }} during the past 12 months?

Days _______

24. How many people, including yourself, normally live in your household?

People _____

25. How many of these people are under the age of 18?

People _____

26. In what year were you born? (enter 4-digit birth year; for example, 1976)

— — — —

27. What is your gender?

- ☐ Female
- ☐ Male

- ☐ Other (please specify)

28. Which race/ethnicity best describes you? (Please choose only one.)

- ☐ American Indian or Alaskan Native
- ☐ Asian / Pacific Islander
- ☐ Black or African American
- ☐ Hispanic
- ☐ White / Caucasian
- ☐ Multiple ethnicity / Other (please specify)

29. What is your current 5-digit zip code?

— — — — —

30. What is the highest degree or level of school that you have completed?

- ☐ Less than 9th grade
- ☐ 9th and 12th grade, no diploma
- ☐ High school graduate (includes equivalency)
- ☐ Some college, no degree
- ☐ Associate degree
- ☐ Bachelor's degree
- ☐ Graduate or professional degree

31. What is your household's total annual income before taxes?

- ☐ Less than $10,000
- ☐ $10,000 and $14,999
- ☐ $15,000 and $24,999
- ☐ $25,000 and $34,999
- ☐ $35,000 and $49,999
- ☐ $50,000 and $74,999
- ☐ $75,000 and $99,999
- ☐ $100,000 and $149,999
- ☐ $150,000 and $199,999
- ☐ $200,000 or more

Thanks for completing the survey!

32. Is there anything else you would like and tell us about your interest in menhaden?

9.13 Appendix N. An example of a stated preference choice question

Current Quota

Menhaden landings throughout the Atlantic States are expected to be **410 million pounds** and landings revenue is expected to be **$31.57 million** at an average price of **$0.077 per pound**.

Decreased Quota

The ASMFC is considering a **30% decrease** to each state's individual menhaden quota.

Throughout the Atlantic States:

- Landings decrease by **123 million pounds** and revenues decrease by **$9.47 million**.
- The number of jobs in the menhaden industry decrease by **250**.
- There is **no change** in striped bass, weakfish and bluefish populations.
- There is **no change** in osprey, pelican and loon populations.
- There is an **increase** in water quality.

Would you vote for or against the decreased quota?

- ◯ I would vote for the decreased quota
- ◯ I would vote against the decreased quota
- ◯ I don't know how I would vote

9.14 Appendix O. Public Survey Responses

Q1. In what Atlantic state do you live?

Answer Options	Response Percent	Response Count
Florida	10.1 %	227
Maine	9.6 %	217
Maryland	9.6 %	216
New Jersey	22.0 %	495
New York	10.5 %	236
North Carolina	10.2 %	229
Rhode Island	7.0 %	158
Virginia	21.1 %	475
		2253

Q2. How much did you know about the ASMFC before this survey?

	Response Percent	Response Count
A lot	10.0 %	225
Some	15.3 %	345
A little	15.7 %	353
Nothing	58.9 %	1325
		2248

	Viewed Percent	Viewed Count
Image = 1	50.9 %	1138
Image = 0	49.1 %	1099
	5otal views	2237

Q3. How much did you know about Atlantic menhaden before this survey?

	Response Percent	Response Count
A lot	9.1 %	203
Some	14.7 %	329
A little	14.8 %	330
Nothing	61.5 %	1375
	answered question	2237

Q4. How important do you think that the Atlantic menhaden commercial fishery is to the economy?

	Response Percent	Response Count
Very important	47.1 %	1050
Somewhat important	44.8 %	999
Somewhat not important	5.3 %	118
Not important	2.8 %	62
		2229

Q5. How concerned are you about overfishing of menhaden?

	Response Percent	Response Count
Very concerned	26.7 %	593
Somewhat concerned	37.7 %	839
Not too concerned	27.4 %	609
Not at all concerned	8.2 %	183
		2224

Q6. How important do you think menhaden are for the following uses?

	Very important	Somewhat important	Not too important	Not at all important	I don't know / no opinion	Response Count
Fish meal	43.9%	38.4%	9.4%	2.8%	5.4%	2205
Fish oil	42.2%	40.9%	9.8%	2.3%	4.8%	2208
Bait for recreational fishing	27.4%	36.8%	22.6%	7.6%	5.6%	2201
Bait for commercial fishing	34.5%	42.6%	12.5%	4.5%	5.9%	2195
						2212

Q7. How important do you think menhaden are for the following uses?

	Very important	Somewhat important	Not too important	Not at all important	I don't know / no opinion	Response Count
Food for other fish species	59.2%	30.8%	4.3%	1.3%	4.4%	2211
Food for water birds	52.5%	36.7%	5.4%	1.0%	4.3%	2211
Water quality	61.9%	27.4%	5.0%	1.3%	4.4%	2211

2211

Q8. How important do you think that the Atlantic menhaden commercial fishery is and the [Q1] economy?

	Response Percent	Response Count
Very important	41.5 %	912
Somewhat important	40.0 %	880
Somewhat not important	13.5 %	296
Not important	5.0 %	111
		2199

Q9. How important do you think it is and manage menhaden at the ecosystem level instead of the individual species level?

	Response Percent	Response Count
Very important	52.5 %	1152
Somewhat important	41.7 %	915
Somewhat unimportant	3.6 %	80
Not important	2.1 %	46
		2193

Q10. How well do you understand these instructions?

	Response Percent	Response Count
Very well	44.7 %	962
Somewhat well	45.4 %	977
Not very well	8.2 %	176
I did not read the instructions	1.7 %	36
		2151

The ASMFC is considering a ___ increase and each state's individual menhaden quota.
Throughout the Atlantic States:
Landings increase by __ million pounds and revenues increase by ____ million."

	Viewed Percent	Viewed Count
10%, 41, $3.81	33.9 %	724
20% 82, $7.63	34.0 %	726
30%, 123, $11.44	32.1 %	684
		2134

The number of jobs in the menhaden industry increase by ___.

	Viewed Percent	Viewed Count
250	31.3 %	668
500	35.1 %	750
750	33.6 %	716
		2134

There is _____ in striped bass, weakfish and bluefish populations.

	Viewed Percent	Viewed Count
no change	51.4 %	1096
a decrease	48.6 %	1038
		2134

There is _____ in osprey, pelican and loon populations.

	Viewed Percent	Viewed Count
no change	50.3 %	1074
a decrease	49.7 %	1060
		2134

There is _____ in water quality.

	Viewed Percent	Viewed Count
no change	48.4 %	1033
a decrease	51.6 %	1101
		2134

Q11. Would you vote for or against the increased quota?

	Response Percent	Response Count
I would vote for the increased quota	43.8 %	935
I would vote against the increased quota	41.0 %	876
I don't know how I would vote	15.1 %	323
		2134

The ASMFC is considering a ___increase and each state's individual menhaden quota.
Throughout the Atlantic States:
Landings increase by __ million pounds and revenues increase by ____ million."

	Viewed Percent	Viewed Count
10%, 41, $3.16	32.9 %	703
20% 82, $6.31	32.5 %	694
30%, 123, $9.47	34.5 %	737
		2134

The number of jobs in the menhaden industry increase by ___.

	Viewed Percent	Viewed Count
250	33.9 %	723
500	32.8 %	699
750	33.4 %	712
		2134

There is _____ in striped bass, weakfish and bluefish populations.

	Viewed Percent	Viewed Count
no change	48.3 %	1031
a decrease	51.7 %	1103
		2134

There is _____ in osprey, pelican and loon populations.

	Viewed Percent	Viewed Count
no change	48.1 %	1027
a decrease	51.9 %	1107
		2134

There is _____ in water quality.

	Viewed Percent	Viewed Count
no change	49.1 %	1047
a decrease	50.9 %	1087
		2134

Q12. Would you vote for or against the increased quota?

	Response Percent	Response Count
I would vote for the increased quota	43.3 %	923
I would vote against the increased quota	40.7 %	868
I don't know how I would vote	16.1 %	343
		2134

The ASMFC is considering a ___increase and each state's individual menhaden quota.
Throughout the Atlantic States:
Landings increase by __ million pounds and revenues increase by ____ million."

	Viewed Percent	Viewed Count
10%, 41, $4.39	34.2 %	730
20% 82, $8.77	33.2 %	708
30%, 123, $13.16	32.6 %	696
		2134

The number of jobs in the menhaden industry increase by ___.

	Viewed Percent	Viewed Count
250	33.0 %	705
500	34.3 %	732
750	32.7 %	697
		2134

There is _____ in striped bass, weakfish and bluefish populations.

	Viewed Percent	Viewed Count
no change	51.5 %	1099
a decrease	48.5 %	1035
		2134

There is _____ in osprey, pelican and loon populations.

	Viewed Percent	Viewed Count
no change	50.7 %	1083
a decrease	49.3 %	1051
		2134

There is _____ in water quality.

	Viewed Percent	Viewed Count
no change	49.9 %	1065
a decrease	50.1 %	1069
		2134

Q13. Would you vote for or against the increased quota?

	Response Percent	Response Count
I would vote for the increased quota	44.9 %	959
I would vote against the increased quota	39.5 %	842
I don't know how I would vote	15.6 %	333
		2134

The ASMFC is considering a ___ decrease and each state's individual menhaden quota.
Throughout the Atlantic States:
Landings decrease by __ million pounds and revenues decrease by _____ million."

	Viewed Percent	Viewed Count
10%, 41, $3.81	33.3 %	711
20%, 82, $7.63	33.1 %	705
30%, 123, $11.44	33.6 %	716
		2132

The number of jobs in the menhaden industry decrease by ___.

	Viewed Percent	Viewed Count
250	32.4 %	691
500	32.6 %	694
750	35.0 %	747
		2132

There is _____ in striped bass, weakfish and bluefish populations.

	Viewed Percent	Viewed Count
no change	50.6 %	1079
an increase	49.4 %	1053
		2132

There is _____ in osprey, pelican and loon populations.

	Viewed Percent	Viewed Count
no change	50.4 %	1074
an increase	49.6 %	1058
		2132

There is _____ in water quality.

	Viewed Percent	Viewed Count
no change	49.2 %	1049
an increase	50.8 %	1083
		2132

Q14. Would you vote for or against the decreased quota?

	Response Percent	Response Count
I would vote for the decreased quota	40.4 %	861
I would vote against the decreased quota	42.1 %	898
I don't know how I would vote	17.5 %	373
		2132

The ASMFC is considering a ___ decrease and each state's individual menhaden quota.
Throughout the Atlantic States:
Landings decrease by __ million pounds and revenues decrease by _____ million."

	Viewed Percent	Viewed Count
10%, 41, $3.81	33.3 %	711
20%, 82, $7.63	33.1 %	705
30%, 123, $11.44	33.6 %	716
		2132

The number of jobs in the menhaden industry decrease by ___.

	Viewed Percent	Viewed Count
250	32.4 %	691
500	32.6 %	694
750	35.0 %	747
		2132

There is _____ in striped bass, weakfish and bluefish populations.

	Viewed Percent	Viewed Count
no change	50.6 %	1079
an increase	49.4 %	1053
		2132

There is _____ in osprey, pelican and loon populations.

	Viewed Percent	Viewed Count
no change	50.4 %	1074
an increase	49.6 %	1058
		2132

There is _____ in water quality.

	Viewed Percent	Viewed Count
no change	49.2 %	1049
an increase	50.8 %	1083
		2132

Q14. Would you vote for or against the decreased quota?

	Response Percent	Response Count
I would vote for the decreased quota	40.4 %	861
I would vote against the decreased quota	42.1 %	898
I don't know how I would vote	17.5 %	373
		2132

The ASMFC is considering a ___ decrease and each state's individual menhaden quota. Throughout the Atlantic States:
Landings decrease by __ million pounds and revenues decrease by _____ million."

	Viewed Percent	Viewed Count
10%, 41, $3.16	34.7 %	740
20%, 82, $6.13	32.9 %	701
30%, 123, $9.47	32.3 %	689
		2130

The number of jobs in the menhaden industry decrease by ___.

	Viewed Percent	Viewed Count
250	35.7 %	760
500	33.1 %	705
750	31.2 %	665
		2130

There is _____ in striped bass, weakfish and bluefish populations.

	Viewed Percent	Viewed Count
no change	50.0 %	1066
an increase	50.0 %	1064
		2130

There is _____ in osprey, pelican and loon populations.

	Viewed Percent	Viewed Count
	51.8 %	1104
	48.2 %	1026
		2130

There is _____ in water quality.

	Viewed Percent	Viewed Count
no change	50.0 %	1066
an increase	50.0 %	1064
		2130

Q15. Would you vote for or against the decreased quota?

	Response Percent	Response Count
I would vote for the decreased quota	41.5 %	885
I would vote against the decreased quota	40.1 %	855
I don't know how I would vote	18.3 %	390
		2130

The ASMFC is considering a ___ decrease and each state's individual menhaden quota.
Throughout the Atlantic States:
Landings decrease by __ million pounds and revenues decrease by _____ million."

	Viewed Percent	Viewed Count
10%, 41, $4.39	32.4 %	691
20%, 82, $8.77	32.5 %	694
30%, 123, $13.16	35.1 %	748
		2133

The number of jobs in the menhaden industry decrease by ___.

	Viewed Percent	Viewed Count
250	32.4 %	691
500	33.4 %	713
750	34.2 %	729
		2133

There is _____ in striped bass, weakfish and bluefish populations.

	Viewed Percent	Viewed Count
no change	50.8 %	1084
an increase	49.2 %	1049
		2133

There is _____ in osprey, pelican and loon populations.

	Viewed Percent	Viewed Count
no change	52.7 %	1125
an increase	47.3 %	1008
		2133

There is _____ in water quality.

	Viewed Percent	Viewed Count
no change	51.3 %	1094
an increase	48.7 %	1039
		2133

Q16. Would you vote for or against the decreased quota?

Answer Options	Response Percent	Response Count
I would vote for the decreased quota	40.4 %	861
I would vote against the decreased quota	39.8 %	850
I don't know how I would vote	19.8 %	422
		2133

Q17. How much did you consider each of the factors when you were making your decisions about how and vote?

	None	Some	A lot	Response Count
Size of the quota	17.5%	56.5%	26.1%	2120
Price per pound	29.3%	49.6%	21.1%	2119
Number of jobs	8.6%	41.2%	50.1%	2119
Water quality	6.0%	31.5%	62.5%	2120
Striped bass, weakfish and blue fish populations	8.7%	54.3%	37.0%	2119
Osprey, pelican and loon populations	10.3%	57.1%	32.6%	2120
Overfishing	10.8%	48.5%	40.8%	2119
				2120

Q18. Do you agree or disagree with the following statements?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Response Count
The results of this survey will be shared with the ASMFC.	51.2%	28.1%	17.3%	2.3%	1.1%	2115
The results of this survey could affect ASMFC decisions about menhaden.	37.4%	37.1%	19.3%	4.4%	1.7%	2116
I understand all of the information presented and me on the proposed alternative menhaden quotas.	43.7%	35.1%	15.0%	4.3%	2.0%	2116
Public opinion surveys are a good way for citizens and express their preferences about fisheries policy.	49.3%	33.3%	12.9%	2.8%	1.7%	2115
						2116

Q19. Are you currently a member of any recreational, environmental or conservation organization or association?

	Response Percent	Response Count
Yes	19.9 %	421
No	80.1 %	1693
		2114

Q20. Are you currently employed in the commercial fishing or a related industry?

	Response Percent	Response Count
Yes	10.6 %	223
No	89.4 %	1889
		2112

Q21. During the past 12 months have you participated in recreational saltwater fishing?

	Response Percent	Response Count
Yes	24.4 %	516
No	75.6 %	1596
		2112

Q22. During the past 12 months have you participated in recreational saltwater fishing in [Q1]?

	Response Percent	Response Count
Yes	83.9 %	433
No	16.1 %	83
		516

Q23. About how many days would you say you fished in [Q1] during the past 12 months?

	Response Average	Response Count
Days	21.55	428

Q24. How many people, including yourself, normally live in your household?

	Response Average	Response Count
People	4.22	2111

Q25. How many of these people are under the age of 18?

	Response Average	Response Count
People	1.03	2110

Q26. In what year were you born? (enter 4-digit birth year; for example, 1976)

	Response Count
	2107

Q27. What is your gender?

	Response Percent	Response Count
Female	52.0 %	1097
Male	47.6 %	1004
Other (please specify)	0.3 %	7
		2108

Q28. Which race/ethnicity best describes you? (Please choose only one.)

	Response Percent	Response Count
American Indian or Alaskan Native	0.9 %	19
Asian / Pacific Islander	5.7 %	120
Black or African American	13.1 %	275
Hispanic	10.9 %	229
White / Caucasian	67.9 %	1431
Multiple ethnicity / Other (please specify)	1.6 %	33
		2107

Q29. What is your current 5-digit zip code?

	Response Count
	2105

Q30. What is the highest degree or level of school that you have completed?

	Response Percent	Response Count
Less than 9th grade	0.5 %	10
9th and 12th grade, no diploma	1.9 %	40
High school graduate (includes equivalency)	17.9 %	378
Some college, no degree	21.5 %	453
Associate degree	10.9 %	229
Bachelor's degree	28.2 %	593
Graduate or professional degree	19.1 %	403
		2106

Q31. What is your household's total annual income before taxes?

	Response Percent	Response Count
Less than $10,000	4.1 %	87
$10,000 and $14,999	3.4 %	71
$15,000 and $24,999	7.0 %	147
$25,000 and $34,999	8.4 %	176
$35,000 and $49,999	14.3 %	299
$50,000 and $74,999	17.1 %	358
$75,000 and $99,999	20.3 %	426
$100,000 and $149,999	17.3 %	362
$150,000 and $199,999	4.8 %	100
$200,000 or more	3.4 %	72
		2098

Q32. Is there anything else you would like and tell us about your interest in menhaden?

Response Count
929

9.15 Appendix P. Random Utility Models[6]

Survey respondents will tend to choose ecosystem-based management plans that provide the most utility. For simplicity, let jobs and revenue be represented by m and ecosystem services (game fish, water birds, water quality) by q. The individual utility from the choice is decreasing in TAC cost and increasing in TAC quality: $u_i = v_i(m, q) + \varepsilon_i$, where u is the individual indirect utility function, v is the nonstochastic portion of utility, ε is the error term, and $i = 1, 2$ alternatives. The random utility model assumes that the individual chooses the alternative that gives the highest utility, $\pi_i = \Pr(v_i + \varepsilon_i > v_s + \varepsilon_s \ \forall s \neq i)$, where π is the probability that alternative i is chosen. If the error terms are independent and identically distributed extreme value variates then the multinomial (conditional) logit model results:

(1) $$\pi_i = \frac{e^{v_i}}{\sum_{s=1}^{2} e^{v_s}}$$

The conditional logit model restricts the choices according to the assumption of the independence of irrelevant alternatives (IIA). Intuitively, imposing IIA on the choice patterns means that the researcher thinks that the relative probability of survey respondent choosing alternative A over alternative B is independent of the attributes of all other alternatives. This is not a concern when there are only two alternatives in the choice set.

The conditional and nested logit models assume that respondent preferences are homogeneous. That is, the marginal utility of a change in any of the alternative attributes is the same for all individuals sampled. A well-specified model will allow for preference heterogeneity across respondents.

The random parameters logit is one model that allows for preference heterogeneity across individuals. For the conditional logit model, the parameter vector β is assumed to be constant across individuals. Imposing preference homogeneity may result in a mis-specified utility function and inaccurate estimates of the value of changes in the independent variables. To allow for preference heterogeneity, we will assume that individual preferences randomly vary according to a pre-specified population distribution such that $\beta_{ih} = \tilde{\beta} + \eta_{ih}$, where $\tilde{\beta}$ is an unknown, but constant locational parameter for preferences, and η is an individual and alternative specific random error component for preferences that is independently and (not necessarily identically) distributed across alternatives and identically (but not necessarily independently) distributed across individuals.

[6] This appendix is adapted from Timothy, Haab, Robert Hicks, Kurt Schnier, and John C. Whitehead. "Angler heterogeneity and the species-specific demand for marine recreational fishing." Marine Resource Economics 27, no. 3 (2012): 229-251

With preference heterogeneity a new conditional expression for the choice probability for a specific individual is:

(2) $$\pi_{ih} | \eta_{ik} = \frac{e^{\tilde{\beta} + \eta_{ih}}}{\sum_{s=1}^{J} e^{\tilde{\beta} + \eta_{jh}}}$$

The choice probability in (2) is conditional on a specific value or realization of the preference error term, η_{ik}. However, to the researcher the most we can know, or assume, is the form of the distribution for η_{ik} up to an unknown parameter vector γ. Assuming that the density function is $f(\eta|\gamma)$, the probability in (2) must be integrated over all possible values of η_{ik} to eliminate the conditioning:

(3) $$\pi_{ih} = \int_{\eta_{ih}} \pi_{ih} | \eta_{ih} \partial f(\eta_{ih}|\gamma) = \int_{\eta_{ih}} \frac{e^{\tilde{\beta} + \eta_{ih}}}{\sum_{s=1}^{J} e^{\tilde{\beta} + \eta_{jh}}} \partial f(\eta_{ih}|\gamma)$$

Ideally, the integration problem in (3) would be such that the probability has a closed form expression as a function of the unknown parameters β and γ. Unfortunately this is not the case. Closed form expressions for equation (3) do not exist for common distributions (normal, uniform, log normal) and estimation of the parameters in (3) requires simulation of the integral.

The most common way to simulate the probability is to repeatedly draw from the multivariate distribution of η_{ik}, calculating the integrand in (3) at each draw and then averaging over the draws to find an estimate of π_{ih} conditional on β and γ (Train 2003).[7] Using maximum likelihood algorithms to search over the possible space of β and γ (and simulating the probability vector for each possible value of β and γ) will yield simulated maximum likelihood estimates of the utility function and the preference heterogeneity parameters.

Welfare analysis is conducted by specifying a functional form for the utilities of the alternatives. It is typical to specify the utility function as linear, $v(m,q) = \alpha m + \beta q$, where α is the marginal

[7] See Kenneth E. Train, Discrete Choice Methods with Simulation, Cambridge University Press, 2003.

utility of income. The willingness-to-pay (or willingness-to-accept) for a change in ecosystem services can be measured as $WTP(\Delta q) = -\frac{\beta \Delta q}{\alpha}$.[8]

The 95% confidence intervals for willingness-to-pay are calculated using the asymptotic procedure adapted from Krinsky and Robb (see footnote 4 for a detailed explanation). The confidence intervals are calculated by taking 1000 independent draws from a multivariate normal distribution with mean equal to the estimated parameter vector for each model and variance covariance matrix equal to the corresponding estimated variance covariance matrix. At each draw, willingness-to-pay is calculated to give 1000 draws from the empirical distribution of willingness-to-pay. Sorting the resulting empirical draws in ascending order and choosing the 2.5^{th} and 97.5^{th} percentile observations yields a consistent estimate of the desired confidence interval.

[8] See Timothy C. Haab, and Kenneth E. McConnell. Valuing environmental and natural resources: the econometrics of non-market valuation. Edward Elgar Publishing, 2002.

9.16 Appendix Q. Predicted Probabilities

Predicted Probabilities of a Vote in Favor of Increased Quotas

Revenue	Jobs	Water quality	Game fish	Shore birds	Pr(For)
3.16	250	1	1	1	38.19
7.55	250	1	1	1	42.50
13.16	250	1	1	1	48.17
3.16	500	1	1	1	42.14
7.55	500	1	1	1	46.57
13.16	500	1	1	1	52.29
3.16	750	1	1	1	46.20
7.55	750	1	1	1	50.67
13.16	750	1	1	1	56.37
3.16	250	1	0	1	42.20
7.55	250	1	0	1	46.62
13.16	250	1	0	1	52.34
3.16	500	1	0	1	46.25
7.55	500	1	0	1	50.73
13.16	500	1	0	1	56.42
3.16	750	1	0	1	50.36
7.55	750	1	0	1	54.83
13.16	750	1	0	1	60.42
3.16	250	1	1	0	42.62
7.55	250	1	1	0	47.05
13.16	250	1	1	0	52.77
3.16	500	1	1	0	46.68
7.55	500	1	1	0	51.16
13.16	500	1	1	0	56.84
3.16	750	1	1	0	50.79
7.55	750	1	1	0	55.25
13.16	750	1	1	0	60.83
3.16	250	1	0	0	46.73
7.55	250	1	0	0	51.21
13.16	250	1	0	0	56.89
3.16	500	1	0	0	50.84
7.55	500	1	0	0	55.31
13.16	500	1	0	0	60.88
3.16	750	1	0	0	54.94
7.55	750	1	0	0	59.33
13.16	750	1	0	0	64.72
3.16	250	0	1	1	48.58
7.55	250	0	1	1	53.05
13.16	250	0	1	1	58.70

3.16	500	0	1	1	52.69
7.55	500	0	1	1	57.12
13.16	500	0	1	1	62.62
3.16	750	0	1	1	56.76
7.55	750	0	1	1	61.10
13.16	750	0	1	1	66.39
3.16	250	0	0	1	52.74
7.55	250	0	0	1	57.18
13.16	250	0	0	1	62.67
3.16	500	0	0	1	56.82
7.55	500	0	0	1	61.15
13.16	500	0	0	1	66.43
3.16	750	0	0	1	60.80
7.55	750	0	0	1	64.98
13.16	750	0	0	1	70.00
3.16	250	0	1	0	53.17
7.55	250	0	1	0	57.60
13.16	250	0	1	0	63.07
3.16	500	0	1	0	57.24
7.55	500	0	1	0	61.56
13.16	500	0	1	0	66.82
3.16	750	0	1	0	61.21
7.55	750	0	1	0	65.37
13.16	750	0	1	0	70.36
3.16	250	0	0	0	57.29
7.55	250	0	0	0	61.61
13.16	250	0	0	0	66.86
3.16	500	0	0	0	61.26
7.55	500	0	0	0	65.42
13.16	500	0	0	0	70.40
3.16	750	0	0	0	65.09
7.55	750	0	0	0	69.04
13.16	750	0	0	0	73.71