

## Forecast for the 2016 Gulf and Atlantic Menhaden Purse-Seine Fisheries and Review of the 2015 Fishing Season

*March 2016*

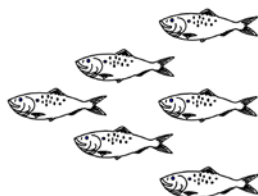
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### INTRODUCTION

The 2016 fishing year marks the forty-fourth year that the National Marine Fisheries Service has made quantitative forecasts of purse-seine landings of menhaden. The forecasts are based on a multiple regression equation that relates landings and fishing effort over a series of years. Landings forecasts are conditioned on estimates of expected fishing effort for the upcoming fishing year. Fishing effort estimates are vessel-specific and are derived from 1) industry input regarding the number of vessels that companies expect to be active during the upcoming fishing year, and 2) historical performance (catch and effort) of the vessels expected to participate in the fishery. In the Atlantic Menhaden fishery, actual purse-seine landings have differed an average of 13% from those forecasted for the forty year period, 1973-2012 (pre-TAC years; see page 4). Landings in the Gulf Menhaden fishery have differed from those forecasted by an average of 14% for the forty-three year period, 1973-2015. In this forecast report, we review the 2015 Gulf and Atlantic Menhaden fishing seasons in terms of:

- landings and fleet size
- age composition of the catch
- status of the most recent forecast

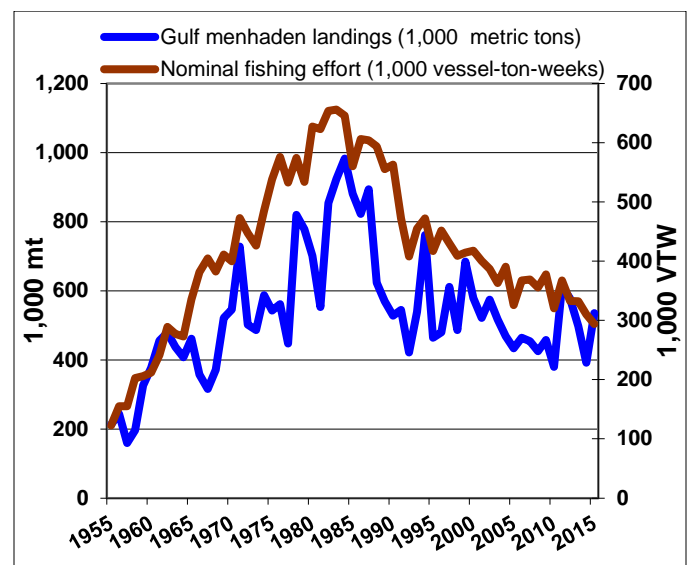
Finally, we will forecast estimated landings for the 2016 menhaden fishing season.



### GULF MENHADEN FISHERY

#### Gulf Menhaden Landings, Fishing Conditions, and Vessel Participation in 2015

Final purse-seine landings of Gulf Menhaden for reduction in 2015 totaled 535,688 metric tons (mt; 1,762 million standard fish). This is an increase of 37% from total landings in 2014 (391,854 mt), and 9% more than the previous 5-year mean (492,141 mt; Figure 1).



**Figure 1. Gulf Menhaden landings in 1,000s of metric tons (mt) and nominal fishing effort in 1,000s of vessel-ton-weeks (VTW), 1955–2015.**

Winter 2014-2015 across much of the Mississippi Basin was much colder than average with above-average precipitation. The Gulf Coast experienced colder-than-average temperatures. Precipitation in this region did not differ much from average. Beginning in March, the Gulf Coast began to experience warmer-than-usual temperatures and the Gulf States had greater-than-average

precipitation that would continue until the fishing season began.

The 2015 Gulf Menhaden fishing season opened on April 20<sup>th</sup>. Landings in April (21,368 mt) were higher than 2014, but slightly below the previous 5-year average. Landings in May (59,668 mt) were also lower than the 5-year average.

During June, the Gulf States were in a worsening drought and experienced higher-than-average temperatures. Tropical Storm Bill moved north and affected fishing, primarily in the western portion of the Gulf, for the week of June 15<sup>th</sup>. Landings then began to increase, approaching the 5-year average for June (91,331 mt).

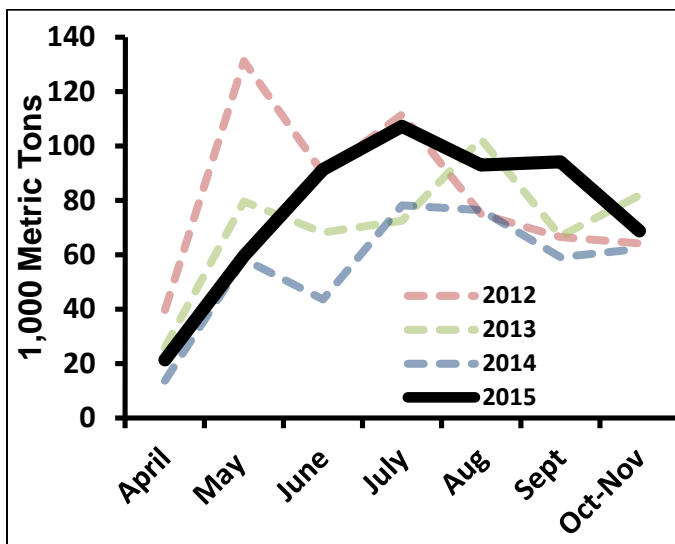


Figure 2. Gulf Menhaden landings by month, 2012-2015.

In July, reports began to come in of large schools of menhaden clogging the cooling systems of some vessels in the shipping channels around Houston, TX. After the July 4<sup>th</sup> holiday, fishing was pretty steady and active through the rest of the month and landings increased over the 5-year average for the first time during the year (107,314 mt).

In August, nutrient runoff contributed to the growth of the Gulf of Mexico's hypoxic zone. Its growth exceeded the estimation models, in part due to the heavy rainfall experienced over parts of the Mississippi River Basin in June. Landings declined after peaking in July, but remained above the five-year average for August (93,028 mt). The conditions remained favorable throughout September, with the exception of bad weather for the week of the 28<sup>th</sup>. September concluded well

above the 5-year average (94,237 mt), the highest for September since 1999.

Heavy rains and the remnants of hurricane Patricia impacted fishing in October. Menhaden landings amounted to 68,742 mt, slightly below the 5-year average of 73,835 mt. All fish plants "cut-out" for the fishing season by October 30<sup>th</sup>. Similar to summer 2014, tropical cyclone activity was below-average and, with the exception of Tropical Storm Bill, most storms remained outside the Gulf of Mexico.

In 2015, 33 vessels unloaded Gulf Menhaden for reduction: 31 regular steamers, one run boat, and one bait vessel.

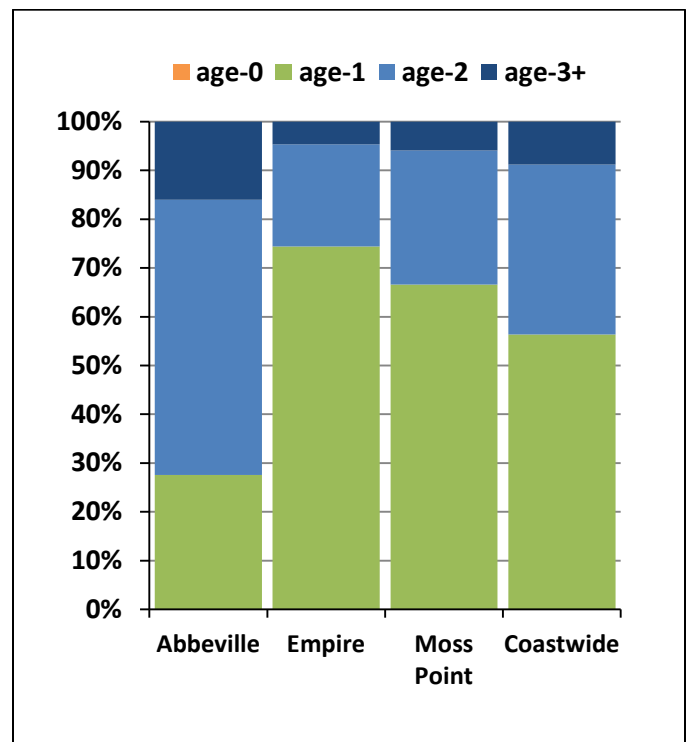


Figure 3. Percent estimated numbers-at-age of Gulf menhaden by port in 2015.

### Age Composition of Gulf Menhaden in 2015

Approximately 8,100 Gulf Menhaden have been aged from the 2015 port samples to date (Fig. 3). From the preliminary catch-at-age matrix, coastwide age-1 fish (56%) outnumbered age-2 fish (35%) by a wide margin (Table 1). On closer examination, this pattern was exhibited mostly east of the Mississippi River with age-1 fish making up 74% of Empire's catch and 67% of Moss Point's catch (Figure 3). The pattern was inverted west of the Mississippi River, with age-2 fish making up 56% of the catch in Abbeville (Figure 3).

**Table 1. Percent age composition, estimated total numbers of fish caught, and total landings for the Gulf Menhaden fishery, 2011-2015; 2015 data are preliminary.**

Year	Age-0	Age-1	Age-2	Estimated total number of fish caught in billions	Landings in thousands of metric tons
2015	-	56%	35%	6.20	535.7
2014	1%	26%	60%	3.51	391.9
2013	<1%	25%	73%	4.54	497.5
2012	<1%	31%	66%	6.78	578.4
2011	1%	63%	32%	7.21	613.3

### Fishing Effort in 2015 and Review of the 2015 Forecast for Gulf Menhaden

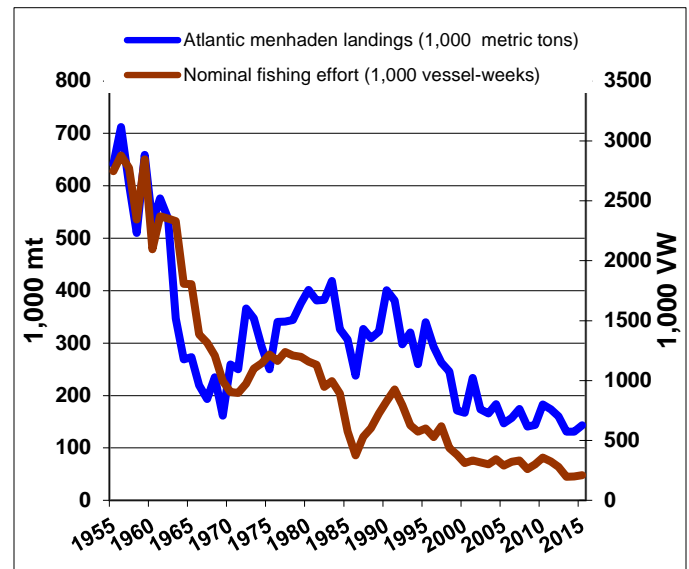
Nominal fishing effort for the Gulf Menhaden fishery during 2015 was estimated at 294,200 vessel ton weeks; this is 3% less than nominal fishing effort in 2014 (312,900 vessel ton weeks).

In March 2015, we anticipated that nominal fishing effort during 2015 could amount to 310,000 vessel ton weeks with 33 vessels participating in the fishery. With this level of anticipated fishing effort, we forecasted 2015 Gulf Menhaden landings of 401,000 mt with 80% confidence levels of 282,000 and 519,000 mt. A “hindcast” using our forecast model and actual nominal fishing effort in 2015 produced a post-season forecast of 452,000 mt with 80% confidence levels of 336,000 and 586,000 mt. Actual landings of 535,688 mt were 18% more than our post-season estimate.

### Forecast for the 2016 Gulf Menhaden Fishing Season

As in 2015, we expect that only three menhaden factories (Moss Point, MS, and Empire and Abbeville, LA) will process Gulf Menhaden in 2016. Our best estimate of vessel participation is for 33 vessels: 31 regular steamers, one run boat, and one bait boat. Based on average nominal fishing effort for recent years by the vessels expected to be active in 2016, we estimate that nominal fishing

effort in 2016 may be about 320,000 vessel ton weeks; with this level of nominal fishing effort, we forecast 2015 Gulf Menhaden landings of 467,000 mt, with 80% confidence levels of 346,000 and 586,000 mt.



**Figure 4. Atlantic Menhaden landings in 1,000s of metric tons (mt) and nominal fishing effort in 1,000s of vessel-weeks (VW), 1955–2015.**

## ATLANTIC MENHADEN FISHERY

### Atlantic Menhaden Landings, Fishing Conditions, and Vessel Participation in 2015

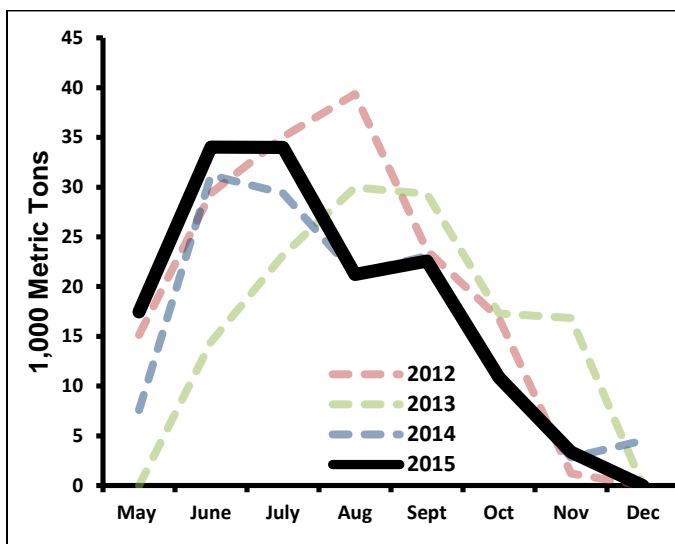
Final catch information indicated that 2015 landings of Atlantic Menhaden for reduction amounted to 143,479 mt (472 million standard fish; Fig. 4). This is 12% less than purse-seine landings for the 2012 season (160,627 mt), the last season before implementation of the coastwide total allowable catch (TAC). It is also 12% less than average landings for the years 2008-12 (160,524 mt). As has been the case since 2005, only one menhaden factory, the Omega Protein plant at Reedville, VA, operated on the Atlantic coast in 2015.

In December 2012, the Atlantic States Marine Fisheries Commission (ASMFC) approved Amendment 2 to the Fishery Management Plan for Atlantic Menhaden which established a TAC for the reduction and bait fisheries combined of 170,800 mt beginning in 2013, and in 2015, this TAC was raised to 187,880 mt.

The TAC now represents an approximate 12% decrease from average landings (bait and reduction

fisheries combined) during 2009-11. The menhaden reduction fishery was allocated about 142,900 mt of the TAC for 2015. In early November 2015, the ASMFC redistributed an unused portion of the coastwide TAC that had been reserved for any unanticipated abundance of menhaden in New England waters during summer (“episodic event”). Virginia was allocated about 1,600 mt of this unused reserve, hence total landings of Atlantic Menhaden for reduction in 2015 were 143,479 mt.

Due to the TAC and an abundance of menhaden in Virginia waters throughout summer 2015, Omega Protein chose to limit catches via company-imposed weekly catch quotas, and thus extend their fishing season into fall 2015.



**Figure 5. Atlantic Menhaden landings by month, 2012–2015.**

Atlantic Menhaden landings for reduction during May 2015 were slightly above average at 17,447 mt (Fig. 5). Landings remained slightly above average in June at 34,023 mt, the month for peak landings in 2015. Landings remained high in July (33,999 mt). In August, landings declined to 21,225 mt, but increased slightly in September to 22,558 mt. In October, landings dropped sharply to 10,867 mt. The season ended in mid-November with 3,361 mt in landings.

Despite a late-arriving, cold period in winter, May turned out to be somewhat calm. Omega Protein vessels began fishing on May 12<sup>th</sup> and spotter pilots reported good signs of menhaden schools throughout Chesapeake Bay.

2015 was the second consecutive year to feature below-average tropical storm activity, with only

eleven named storms. In early May, Tropical Storm Ana made landfall in South Carolina, causing minor damage but only disrupting fishing for a short time.

In June, Omega Protein restricted weekly catches by their vessels in an effort to extend the TAC-limited fishing season; company restrictions lasted through most of the summer.

By mid-September Omega Protein removed company-imposed vessel quotas. In October, the Virginia fleet lost a week of fishing to bad weather from Hurricane Joaquin that affected almost the entire fishing area. Fishing, mostly in ocean waters, was fair in late October and throughout November. The Virginia fleet remained active until November 11.

The coastwide TAC for Atlantic Menhaden also included the bait fisheries. Bait allocations by state were assigned based on landings histories during 2009-11. The snapper rig purse-seine fishery for bait in Virginia started the week of May 11<sup>th</sup>. Catches were good most of the summer.

Purse-seine landings of menhaden in New Jersey began in mid-May with most catches coming from Delaware Bay; catches later switched to ocean waters. New Jersey's purse-seine TAC was reached in early July and the fishery closed. The TAC for gears other than purse seine remained open until September 13 when those fisheries were closed.

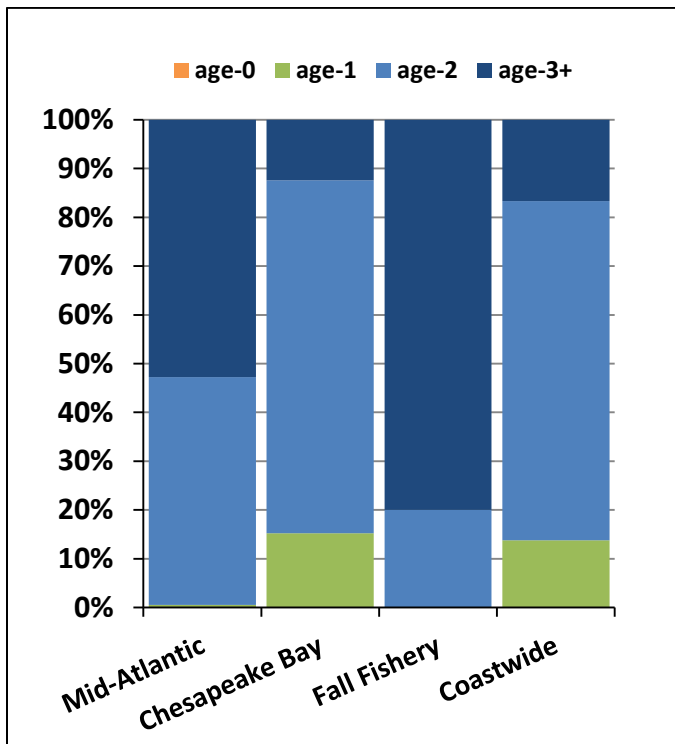
Maryland's pound net fishery reached its TAC on August 20 and was limited to a 6,000-lb daily bycatch allowance thereafter. Menhaden bait prices remained high due to limited supply.

### Age Composition of Atlantic Menhaden in 2015

Approximately 2,200 Atlantic Menhaden were sampled for size and age from the 2015 reduction fishery. From the catch-at-age matrix, coastwide age-2 fish (70%) outnumbered age-1 fish (14%) and age-3 fish (16%) by a large margin (Fig. 6 and Table 2). Age-4 fish made slightly more than 1%; age-0s, or “peanuts”, accounted for much less than 1% of the catch for 2015.

Catches for reduction off New Jersey and the Delmarva Peninsula during 2015 consisted mostly of age-3+ fish (53%), followed by age-2 fish (47%). Catches from Chesapeake Bay and ocean areas near the mouth of the Bay during summer favored age-2 (72%) Atlantic Menhaden over age-1

and age-3 fish (15% each). During the fall fishery off the Virginia coast, age-3+ fish (80%) were caught more frequently than age-2s (20%).



**Figure 6. Percent estimated numbers at age of Atlantic Menhaden by area in 2015.**

About 400 samples of Atlantic Menhaden have been aged from the bait fisheries on the East coast at this time. Bait samples from snapper boats in Chesapeake Bay consisted mostly of age-2 fish (67%), followed by age-1 fish (19%) and age-3 fish (13%). Preliminary bait samples from off the New Jersey coast were mostly age-2 (51%) and age-3 (40%), followed by age-4 fish.

The relatively strong 2012 and 2013 year classes are still making their presence felt in the age composition; however, there were relatively few age-1 fish to be seen in 2015.

Signs are that 2016's El Niño/Southern Oscillation (ENSO) are the highest ever recorded. El Niño events (the buildup of warm water in the Pacific Ocean) affect areas around the globe and are generally favorable for Atlantic Menhaden abundance. The sum of these effects is unpredictable in even the more moderate years and estimating the effects of an El Niño event of the magnitude this one is shaping up to be is even more unpredictable.

**Table 2. Percent age composition of the reduction catch in the Atlantic Menhaden fishery, 2011–2015.**

Year	Age-0	Age-1	Age-2	Age-3+
2015	0%	14%	70%	16%
2014	1%	40%	41%	18%
2013	3%	38%	45%	14%
2012	1%	16%	79%	4%
2011	-	42%	50%	8%

### Fishing Effort in 2015

Nominal fishing effort in 2015 was estimated at 182 vessel weeks, decreasing from 201 vessel weeks expended in 2014. The decline in observed effort in the past three years (for example, from 279 vessel weeks in 2012) is due to the TAC and the decrease in number of steamers at the Reedville factory to seven.

### Forecast for the 2016 Atlantic Menhaden Fishing Season

Amendment 2 to the Fishery Management Plan for Atlantic Menhaden specifies an annual coastwide TAC of about 129,900 mt for the purse-seine reduction fishery. This TAC is to be in place “until completion of, and [Atlantic Menhaden Management] Board action on, the next benchmark assessment [completed in December 2014]”. The 2014 Benchmark Assessment found that “the Atlantic Menhaden stock status is not overfished and overfishing is not occurring”. In May, 2015, the Board met and approved an increase to the TAC for 2015. If there are no changes to the existing TAC, 2016 landings for reduction will be about 142,900 mt. If changes are made to the TAC, then landings will adjust accordingly.

### Combined 2015 Gulf and Atlantic Menhaden Landings

Combined landings by the Gulf and Atlantic Menhaden purse-seine fisheries for reduction during 2015 year amounted to 1.5 billion pounds, an increase from landings during the 2014 calendar year which amounted to 1.15 billion pounds.

**Fishing effort and landings in the Gulf Menhaden purse-seine fishery,1955-2015**

<b>Year</b>	<b>Fishing effort 1,000 vessel- ton-weeks</b>	<b>Landings 1,000 metric tons</b>	<b>Year</b>	<b>Fishing effort 1000 vessel- ton-weeks</b>	<b>Landings 1,000 metric tons</b>
<b>1955</b>	122.9	213.3	<b>1986</b>	606.5	822.1
<b>1956</b>	155.1	244.0	<b>1987</b>	604.2	894.2
<b>1957</b>	155.2	159.3	<b>1988</b>	594.1	623.7
<b>1958</b>	202.8	196.2	<b>1989</b>	555.3	569.6
<b>1959</b>	205.8	325.9	<b>1990</b>	563.1	528.3
<b>1960</b>	211.7	376.8	<b>1991</b>	472.3	544.3
<b>1961</b>	241.6	455.9	<b>1992</b>	408.0	421.4
<b>1962</b>	289.0	479.0	<b>1993</b>	455.2	539.2
<b>1963</b>	277.3	437.5	<b>1994</b>	472.0	761.6
<b>1964</b>	272.9	407.8	<b>1995</b>	417.0	463.9
<b>1965</b>	335.6	461.2	<b>1996</b>	451.7	479.4
<b>1966</b>	381.3	357.6	<b>1997</b>	430.2	611.2
<b>1967</b>	404.7	316.1	<b>1998</b>	409.3	486.2
<b>1968</b>	382.8	371.9	<b>1999</b>	414.5	684.3
<b>1969</b>	411.0	521.5	<b>2000</b>	417.6	579.3
<b>1970</b>	400.0	545.9	<b>2001</b>	400.6	521.3
<b>1971</b>	472.9	728.5	<b>2002</b>	386.7	574.5
<b>1972</b>	447.5	501.9	<b>2003</b>	363.2	517.1
<b>1973</b>	426.2	486.4	<b>2004</b>	390.5	468.7
<b>1974</b>	485.5	587.4	<b>2005</b>	326.0	433.8
<b>1975</b>	538.0	542.6	<b>2006</b>	367.2	464.4
<b>1976</b>	575.8	561.2	<b>2007</b>	369.2	453.8
<b>1977</b>	532.7	447.1	<b>2008</b>	355.8	425.4
<b>1978</b>	574.3	820.0	<b>2009</b>	377.8	457.5
<b>1979</b>	533.9	777.9	<b>2010</b>	320.3	379.7
<b>1980</b>	627.6	701.3	<b>2011</b>	367.2	613.3
<b>1981</b>	623.0	552.6	<b>2012</b>	332.7	578.4
<b>1982</b>	653.8	853.9	<b>2013</b>	332.5	497.5
<b>1983</b>	655.8	923.5	<b>2014</b>	312.9	391.9
<b>1984</b>	645.9	982.8	<b>2015</b>	294.2	535.7
<b>1985</b>	560.6	881.1			

**Fishing effort and landings in the Atlantic Menhaden purse-seine fishery, 1955-2015**

<b>Year</b>	<b>Fishing effort vessel-weeks</b>	<b>Landings 1,000 metric tons</b>	<b>Year</b>	<b>Fishing effort vessel-weeks</b>	<b>Landings 1,000 metric tons</b>
<b>1955</b>	2748	641.4	<b>1986</b>	377	238.0
<b>1956</b>	2878	712.1	<b>1987</b>	531	327.0
<b>1957</b>	2775	602.8	<b>1988</b>	604	309.3
<b>1958</b>	2343	510.0	<b>1989</b>	725	322.0
<b>1959</b>	2847	659.1	<b>1990</b>	826	401.2
<b>1960</b>	2097	529.8	<b>1991</b>	926	381.4
<b>1961</b>	2371	575.9	<b>1992</b>	794	297.6
<b>1962</b>	2351	537.7	<b>1993</b>	626	320.6
<b>1963</b>	2331	346.9	<b>1994</b>	573	260.0
<b>1964</b>	1807	269.2	<b>1995</b>	600	339.9
<b>1965</b>	1805	273.4	<b>1996</b>	528	292.9
<b>1966</b>	1386	219.6	<b>1997</b>	616	259.1
<b>1967</b>	1316	193.5	<b>1998</b>	437	245.9
<b>1968</b>	1209	234.8	<b>1999</b>	382	171.2
<b>1969</b>	995	161.6	<b>2000</b>	311	167.2
<b>1970</b>	906	259.4	<b>2001</b>	334	233.7
<b>1971</b>	897	250.3	<b>2002</b>	318	174.0
<b>1972</b>	973	365.9	<b>2003</b>	302	166.1
<b>1973</b>	1099	346.9	<b>2004</b>	345	183.4
<b>1974</b>	1145	292.2	<b>2005</b>	291	146.9
<b>1975</b>	1218	250.2	<b>2006</b>	322	157.4
<b>1976</b>	1163	340.5	<b>2007</b>	333	174.5
<b>1977</b>	1239	341.1	<b>2008</b>	262	141.1
<b>1978</b>	1210	344.1	<b>2009</b>	300	143.8
<b>1979</b>	1198	375.7	<b>2010</b>	356	183.1
<b>1980</b>	1158	401.5	<b>2011</b>	324	174.0
<b>1981</b>	1133	381.3	<b>2012</b>	279	160.6
<b>1982</b>	948	382.4	<b>2013</b>	196	131.0
<b>1983</b>	995	418.6	<b>2014</b>	201	131.1
<b>1984</b>	892	326.3	<b>2015</b>	182	143.5
<b>1985</b>	577	306.7			