

SE D A R

Southeast Data, Assessment, and Review

SEDAR 20-DW02

Reconstructing Historical Commercial Landings of Atlantic Menhaden

Prepared by
Douglas S. Vaughan and Joseph W. Smith
NOAA Fisheries
Beaufort, North Carolina
June 2009

SEDAR is a Cooperative Initiative of:
The Caribbean Fishery Management Council
The Gulf of Mexico Fishery Management Council
The South Atlantic Fishery Management Council
NOAA Fisheries Southeast Regional Office
NOAA Fisheries Southeast Fisheries Science Center
The Atlantic States Marine Fisheries Commission
The Gulf States Marine Fisheries Commission

SEDAR
The South Atlantic Fishery Management Council
4055 Faber Place #201
North Charleston, SC 29405
(843) 571-4366

Introduction

Official commercial landings of Atlantic menhaden from the reduction purse-seine fleet have been maintained by the Beaufort Laboratory of the National Marine Fisheries Service since 1955. When the menhaden program began at the Beaufort Laboratory in the early 1950s, staff visited menhaden plants along the Atlantic coast, obtaining detailed fishery landings for reduction back to 1940. Subsequently detailed pump out data from the reduction fishery have been maintained on computer files from 1955 through the present. These reduction landings are maintained by fishing year (March 1 through February 28 of the following year). During the early 1990s, the former AMAC became concerned about increasing bait landings, and began developing bait landings by state and gear back to 1985. These data continue to be maintained through the ASMFC Menhaden Technical Committee. Bait landings include all commercially landed menhaden other than purse-seine landings for reduction. These landings are considered the best available data for purposes of stock assessments.

The purpose of this report, is to investigate additional sources of menhaden landings, particularly commercial landings prior to 1940 regardless of gear, and from bait landings from 1940-1984. These data sources include:

- Commercial Catch Statistics from Historical Reports, 1879-2000.
- Menhaden Fishery, 1873-1964
- ACCSP Commercial Landings, 1950-2008

Overview of Historical Menhaden Fishery

Numerous authors have chronicled the early evolution of the menhaden fishery on the US Atlantic coast (Goode 1887; Greer 1915; Harrison 1931). Most agree that initial large-scale harvest of Atlantic menhaden began in southern New England in the early 1800s. Then, the dried fish, or scrap, was primarily used as fertilizer and catches were mostly by beach seine. Methods of extracting fish oil improved in the mid-1800s, and the industry expanded throughout Maine to New York. By about 1845 the purse seine – a gear which could be fished from a vessel - was introduced, and the fishery was no longer shore-bound by beach seines (Harrison 1931). After the Civil War the fishery expanded south to Virginia and North Carolina. Subsequently, inventions such as steam cookers and fish presses improved fish oil yields. By 1877 Harrison (1931) recounts menhaden factories operating in Maine (14), Massachusetts (5), Rhode Island (13), Connecticut (5), New York (23, with 2 additional floating ship factories), New Jersey (5), Chesapeake Bay (5), and North Carolina (3). Thus, by the 1880s in terms of landings and participation, the menhaden industry was a major US fishery, and by some accounts (USFWS 1966) with over 90 fish “plants” along the US Eastern Seaboard.

In the late 1800s the task of tabulating commercial fisheries landings was the responsibility of the US Bureau of Fisheries. Annotated data on the catch of menhaden and production of processed products were published in annual reports. By the 1950s, the Bureau’s successor, The US Bureau of Commercial Fisheries (BCF), in order to make these annual data more available, periodically published historical landings for major US fisheries in its series *Fisheries Statistics*

of the United States. Summary data published by the BCF on the menhaden fishery 1873-1964 (USFWS 1966) is a major source document for discussions on historic (pre-1940s) menhaden landings in ensuing portions of this document.

Our original intent in this section was to search the historic literature for qualitative observations on menhaden landings with which to compare against tabularized landings data (cf., USFWS 1966). Unfortunately, and except for a few seminal documents, subjective observations on the success, or failure, of individual fishing season are limited mostly to regional observations, with few comments about coast-wide landings or trends. Nevertheless, a theme that pervades much of the available literature is one of fluctuations in regional and/or coastal abundance of menhaden, and its effect on the fisheries. Indeed, one of the original research goals of the Menhaden Program established at the NOAA's Beaufort Laboratory in the 1950s was to investigate, explain, and forecast regional fluctuations in menhaden abundance (June and Reintjes 1959). Below, we highlight a few historic notes on coastal abundance of Atlantic menhaden, followed by some regional observations.

Hildebrand (1963) noted that no species has been more erratic in its appearance along the coast than the Atlantic menhaden. Greer (1915) reported that the coastal catch in 1911 "was probably one of the largest ever known". Two years later, "the fishing during the season of 1913 was practically a failure". Harrison (1931) followed with observations on the coastal catches of menhaden during the 1920s. He cited that "within the past decade [1920s] the apparent supply of [menhaden] has suffered a decline...this is no doubt due ...to the natural fluctuations that have characterized the menhaden catch since the beginning of the fishery". Harrison (1931) supported his observations with tabularized catch data for 1912 and 1921-1929. Landings were high in Massachusetts through Virginia during 1912, but generally landings declined from New England to North Carolina throughout the 1920s.

Perhaps, Bigelow and Schroeder (1953) provide the most vivid accounts of regional abundance of Atlantic menhaden in their *Fishes of the Gulf of Maine*, citing "periods of great plenty alternating with periods of scarcity or entire absence". Selected citations from their menhaden section on "Occurrence [of Atlantic menhaden] in the Gulf of Maine" follow.

"They were extremely abundant off the coasts of Massachusetts and Maine, every summer, for some years prior to 1875...few were taken during the cold summer of 1877...practically none appeared north of Cape Cod in the year of 1879; and they were so scarce along the coast of Maine for the next six years that it caused comment when an occasional one was caught...they were once more reported abundant off Maine and Massachusetts in 1886...they were as plentiful in Maine waters in 1889 as they had ever been...so numerous in 1890 that four fertilizer factories were established...this period of abundance was short-lived...menhaden were scarce again...1895-1897, but abundant again in 1898... they were scarce in 1902...rare north of Cape Cod from 1904-1921...not enough menhaden in the Gulf to be of any commercial importance from the middle 1920's to the middle 1940's...but so many visited Massachusetts Bay in 1946 and 1947 that local boards of health were forced to clean some of the bathing beaches of the [dead] fish that drifted ashore... a good many in Maine waters in 1948...more still in 1949".

Regional historical accounts on the abundance of menhaden dating back to the 1870s support the concept of the ephemeral nature of menhaden schools in the northern portion of their range, that is, in the coastal waters of Maine and Massachusetts. Periods of menhaden abundance in the Gulf of Maine tend to be followed by periods of scarcity. Furthermore, the scale of this periodicity varies from a few years to up to two decades. These observations are supported by tables of regional landings that follow in later sections of this document.

Farther south, from about New York to North Carolina, historic landings data (see subsequent sections of this document) and various coastal observations suggest that menhaden abundance varies, but not to the extent where fish are all together absent for long periods as in the Gulf of Maine. Apparently, menhaden south of about Long Island, New York, have always been abundant enough to support some level of commercial landings. Abundance in the Middle Atlantic, Chesapeake Bay, and to some extent the Carolinas seems to vary on decadal scales. The late 1880s witnessed some wide swings in coastal abundance. Early in the 1900s and through about 1912 the coastal stock built to robust levels, followed by a general decline and contraction of the stock through the 1920s and lasting until the mid-1940s. Again the stock expanded during the late 1940s, which was a precursor of 'modern' record reduction landings during the 1950s.

Commercial Catch Statistics from Historical Reports, 1879-2000

Atlantic menhaden commercial landings are available from a series of historical publications dating back to 1880. These include annual reports (*Fishery Industries of the United States*, 1920-1939, *Fishery Statistics of the United States*, 1939-1977, and *Fisheries of the United States*, 1966-2007). These data reported are available on excel spreadsheets, organized by state within region (New England, Middle Atlantic, Chesapeake Bay, and South Atlantic) for 1879-2000 (Tables 1-4). These data are summarized by calendar years 1879-1989 (Fisheries Statistics Division 1990), but they are not identified by gear, so these commercial landings are assumed to include both those for reduction and for other commercial uses (e.g., bait).

Landings are very incomplete from 1879 to 1928, followed by occasional data gaps by region through 1949. In particular, the South Atlantic region provides no landings information for 1941-1944 and 1946-1949. This has also been noted for other South Atlantic species (e.g., Spanish mackerel and snapper-grouper species in other SEDAR assessments). With detailed reduction landings available beginning in 1940, we considered using the difference to help fill in for non-reduction landings from 1940 (or 1950) through 1984. Because of the gaps in the data, particularly by region, I have used a process of linear interpolation to fill these gaps on a regional basis. These interpolated values are highlighted in Table 5.

When comparing these catch statistics from Historical Reports (as interpolated) with the historical reduction landings maintained at the NOAA Fisheries Laboratory in Beaufort, NC, they compare fairly closely. Obviously there are some exceptions, including 1940 and interpolated value for 1942. There are more recent years when the deviations become more noticeable. It would be nice to ascribe these to bait landings (purse seines for bait and other

gears), and this may be true for some years. However, there are other years when reduction landings exceed “Historical Records”. Regardless, these data do seem to provide a means of reconstructing menhaden landings back to 1880, with obviously some increased level of uncertainty, in part due to the interpolation process.

Menhaden Fishery, 1873-1964

We recently came across an undated report title *Menhaden Fishery, 1873-1964*. This report, which can be found in USFWS (1966), contains a summary of the menhaden fishery from 1873 – 1964 (a scanned pdf file is available). It was soon apparent that the landings presented represent menhaden landings from both coasts: Atlantic and Gulf of Mexico.

The landings data (“fish received”) are in thousands of pounds, and then converted to thousands of metric tons (kmt) (Table 6). First we compared the historical commercial landings from the previous section for both Atlantic and gulf menhaden to confirm our suspicions. Then we computed the average percent (2.5%) of gulf menhaden landings to Atlantic menhaden landings for the period 1918-1940. This proportion was applied to the menhaden landings from 1873-1917 to separate landings between the two coasts (Figure 6).

In the back of this report, the author(s) indicate that this report was published in Statistical Digest No. 30 and revised and updated in Statistical Digest No. 57. These Statistical Digests are described as “Fisheries Statistics of the United States” with appropriate year. These results should be identical with those landings reported in the previous section. However, this report seems to contain landings (albeit not at the state level) for many years not otherwise available, and can thus be used to extend landings back to 1873, and may provide an alternate method for filling in missing years when available only from this source. Both data sources appear to be weak for the period 1899 to 1921. Generally these historical data sets agree reasonably well where they overlap as shown in Figure 6.

ACCSP Commercial Landings, 1950-2008

Atlantic menhaden commercial landings are also available through the Atlantic Coast Cooperative Statistical Program (ACCSP). Commercial landings are available by gear (purse seine, poundnet, and other) for calendar years from 1950-2008 (Table 7). These data were provided in final download by Julie Defilippi (Data Coordinator ACCSP) on 15 June 2009.

Historical commercial landings (1950 to present) for the Atlantic coast are maintained in the Atlantic Coastal Cooperative Statistics Program (ACCSP) Warehouse. The Warehouse was queried on 12 May 2009 for all menhaden landings (annual summaries by state and gear category) from 1950 to present for Florida (east coast), Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware, New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire and Maine. (ACCSP, 2009). Data workshop gear categories were determined to be purse seine, pound net and other. The data were presented with specific ACCSP gear and gear category.

Purse-seine landings are the dominant gear (95.9%), but purse seine gears cannot be separated between that for reduction and bait. Pound nets of various types come in next with 3.3% over the 1950-2008 period. Other gears such as gill nets (0.17%), trawls (0.03%), not coded (0.12%) and combined gears (0.19%) are quite small, and in aggregate come to 0.8% of total commercial landings. We compare the purse seine landings from these data to the reduction landings (purse seine) maintained at NOAA Fisheries in Beaufort, NC (Figure 3). The higher purse seine landings in recent years reflect the increase in bait landings by purse seine (predominantly in Virginia and New Jersey) in recent years. However, it is not as easy to explain why reduction landings exceed purse seine landings in other years (as recently as early 1990s). We have no explanation.

We provide estimates of menhaden landings other than purse seine for 1950-2008 (Figure 4). These may prove useful in developing historical bait landings prior to 1985. Detailed bait landings have been developed through the ASMFC (first AMAC and now AMTC) for 1985 to the present. Bait landings by purse seine are recorded for Maine, Massachusetts, Rhode Island, New Jersey, Virginia and North Carolina since 1985 (and only in 2003 for New York). It is difficult to consistently separate out purse seine landings for bait from purse-seine reduction landings prior to 1985.

Reconstructed Historical Landings, 1873-2008

A final reconstructed times series of Atlantic menhaden landings was developed as follows:

<u>Years</u>	<u>Source</u>
1873-1879	Menhaden Fishery, 1873-1964 (Table 6)
1880-1939	Commercial Catch Statistics from Historical Reports, 1879-2000 (Table 5)
1940-2008	Reduction Landings: official landings maintained at NMFS Beaufort (S20DW05)
1940-1949	Bait Landings: Average of poundnet & other gear for 1950-1984 (next)
1950-1984	Bait Landings: Poundnet & other gear from ACCSP (Table 7)
1985-2008	Bait Landings: maintained by ASMFC Menhaden TC from state reporting (S20DW05)
1981-2008	Recreational Catches (MRFSS) (S20DW05)

These reconstructed menhaden landings for 1873-2008 are summarized in Figure 5. Reduction landings (1940-2008) and bait landings (1985-2008) are reported in a separate report (S20DW05) to describe additional analyses performed to develop catch-at-age and explore fishing effort.

References

Atlantic Coastal Cooperative Statistics Program (ACCSP). 2009. (1950-2007) Annual landings by state and custom gear category; generated by Julie Defilippi; using ACCSP Data Warehouse, Washington, D.C: accessed May 12-14, 2009.

- Bigelow, H.B., and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. U.S. Fish Wildl. Serv., Fishery Bulletin 74, Vol. 53, 577 p.
- Fisheries Statistics Division. 1990. Historical Catch Statistics, Atlantic and Gulf Coast States, 1879-1989. Current Fishery Statistics No. 9010, Historical Series Nos. 5-9 Revised. (NTIS No. PB-93-174274)
- Fisheries Statistics Division. No date? Historical Catch Statistics, Atlantic and Gulf Coast States, 1879-2000. Current Fishery Statistics No. 9010 – Historical Series #10. [Available as a series of excel spreadsheets]
- Goode, G.B. 1887. History and methods of the fisheries. In: The fisheries and fishery industries of the United States, Section V, Volume 1, Part 5, pp. 327-415.
- Greer, R.L. 1915. The menhaden industry of the Atlantic coast. U.S. Bureau of Fisheries, Document 811, 27 p.
- Harrison, R.W. 1931. The menhaden industry. U.S. Bureau of Fisheries, Investigational Report No. 1, 113 p.
- Hildebrand, S.F. 1963. Family Clupeidae, *In*: Fishes of the western North Atlantic, Sears Mem. Found. Mar. Research, Number One, pp. 257-451.
- June, F.C., and J.W. Reintjes. 1959. Age and size composition of the menhaden catch along the Atlantic coast of the United States, 1952-1955; with a brief review of the commercial fishery. U.S. Fish Wildlife Serv., Spec. Sci. Rep., Fisheries No. 317, 65 p.
- United States Fish and Wildlife Service (USFWS). 1966. Fishery statistics of the United States, 1964. Statistical Digest 58, pp. 452-454.

Table 1. New England (NE) fisheries historical catch statistics (1000 pounds) for menhaden, 1879-2000.

YEAR	MAINE	NEW HAMPSHIRE	MASSA-CHUSETTS	RHODE ISLAND	CON-NECTICUT	TOTAL
1879	(1)	(1)	26,066	(1)	(1)	(1)
1880	(1)	(1)	(1)	68,694	65,092	(1)
1887	702	-	543	34,035	42,049	77,329
1888	3,125	21	4,968	78,270	43,966	130,350
1889	10,185	501	2,546	112,580	47,991	173,803
1892	83	4	250	10,761	22,947	34,045
1897	229	20	1,106	(1)	(1)	(1)
1898	7,860	-	1,497	3,140	11,183	23,680
1902	252	-	875	471	16,877	18,475
1905	-	-	1,027	1,026	29,731	31,784
1908	-	-	258	17,942	-	18,200
1919	-	-	161	21,536	6,737	28,434
1924	1	-	522	1,743	5,270	7,536
1928	-	-	4	1,727	3,444	5,175
1929	-	-	-	133	262	395
1930	-	-	-	132	1,576	1,708
1931	-	-	-	3	2	5
1932	-	-	47	2	5	54
1933	-	-	(2)	1,004	25	1,029
1935	-	-	21	4,256	7	4,284
1937	-	-	39	129	126	294
1938	-	-	39	131	158	328
1939	-	-	55	62	5	122
1940	-	-	38	29	21	88
1942	-	-	10	41	24	75
1943	-	-	69	53	10	132
1944	-	-	23	36	11	70
1945	9	-	85	64	42	200
1946	-	-	81	25	98	204
1947	14	-	90	31	87	222
1948	24	-	1,047	35	110	1,216
1949	5,027	-	7,474	38	27	12,566
1950	490	-	8,762	8	44	9,304
1951	1,514	-	7,209	2,968	70	11,761
1952	605	-	25,980	9,404	99	36,088
1953	2,184	-	20,288	17,185	218	39,875
1954	5,876	-	35,794	17,945	70	59,685
1955	4,016	-	61,393	14,342	43	79,794
1956	1,216	-	66,407	11,122	22	78,767
1957	273	-	21,705	19,778	32	41,788
1958	-	-	3,917	9,914	22	13,853
1959	-	-	36,585	16,245	21	52,851

(CONTINUED ON NEXT PAGE)

Table 1. (cont.)

1960	.	35	-	18,032	24,549	13	42,629
1961	.	-	-	3,363	22,636	12	26,011
1962	.	-	-	16,032	7,716	5	23,753
1963	.	-	-	345	3	5	353
1964	.	-	-	2	-	4	6
1965	.	-	-	9	7	4	20
1966	.	-	-	3	9	2	14
1967	.	-	-	21	13	2	36
1968	.	-	-	8	15	(1)	(1)
1969	.	-	-	12	21	13	46
1970	.	-	-	980	9,398	128	10,506
1971	.	-	-	6,312	19,228	353	25,893
1972	.	-	-	11,920	18,403	369	30,692
1973	.	6,936	-	43,173	15,962	576	66,647
1974	.	10,149	-	47,033	20,725	535	78,442
1975	.	13,958	-	20,815	15,578	515	50,866
1976	.	17,553	-	28,594	12,713	153	59,013
1977	.	3,290	-	17,410	10,071	107	30,878
1978	.	6,960	-	99	13,182	85	20,326
1979	.	30,005	-	29,041	7,389	100	66,535
1980	.	18,806	-	43,351	46	100	62,302
1981	.	12,264	-	35,397	23	151	47,836
1982	.	47,895	-	23,080	7,008	171	78,153
1983	.	42,448	-	-	121	130	42,698
1984	.	17,806	-	-	-	187	17,993
1985	.	33,193	-	-	-	235	33,428
1986	.	22,615	-	-	-	254	22,869
1987	.	18,669	-	1,216	-	95	19,980
1988	.	19,688	5	-	-	193	19,885
1989	.	381	5	-	-	149	534
1990	.	5,745	265	1,362	-	97	7,468
1991	.	16,107	204	6,326	-	96	22,734
1992	.	14,857	26	6,607	-	91	21,581
1993	.	19,520	4	1,332	-	200	21,056
1994	.	-	-	-	-	100	100
1995	.	-	-	61	-	256	317
1996	.	-	-	9	-	83	91
1997	.	-	-	-	2,837	72	2,909
1998	.	-	(2)	-	2,019	339	2,358
1999	.	-	-	904	2	30	937
2000	.	-	-	-	320	14	334

(1) DATA NOT AVAILABLE.

(2) LESS THAN 500 LB.

Table 2. Middle Atlantic fisheries historical catch statistics (1000 pounds) for menhaden, 1880-2000.

YEAR	NEW YORK	NEW JERSEY	DELAWARE	TOTAL
1880	288,931	29,065	523	318,519
1887	71,048	14,066	220	85,334
1888	134,841	9,078	217	144,136
1889	115,452	22,241	61	137,754
1890	128,736	30,391	58	159,185
1891	104,860	20,671	67	125,598
1897	60,606	30,553	-	91,159
1901	180,410	32,911	-	213,321
1904	216,400	37,610	-	254,010
1908	12,762	12,417	59,815	84,994
1921	179,448	30,405	18,082	227,935
1926	11,225	5,379	23,251	39,855
1929	4,739	6,327	29,454	40,520
1930	4,519	5,918	41,960	52,397
1931	16,185	10,101	14,281	40,567
1932	25,493	17,701	-	43,194
1933	201	45,774	33,600	79,575
1935	46,391	49,758	83,454	179,603
1937	31,892	67,756	48,857	148,505
1938	22,633	48,101	16,207	86,941
1939	27,394	63,244	57,946	148,584
1940	36,957	107,988	100,424	245,369
1942	26,115	90,157	88,245	204,517
1943	21,138	88,822	86,299	196,259
1944	41,883	109,363	153,068	304,314
1945	62,149	139,300	166,673	368,122
1946	74,830	(1)	(1)	(1)
1947	82,162	178,071	248,494	508,727
1948	76,852	164,034	148,302	389,188
1949	89,489	143,173	159,748	392,410
1950	82,510	138,578	151,858	372,946
1951	85,433	189,903	166,489	441,825
1952	93,190	179,458	207,657	480,305
1953	100,431	396,309	360,844	857,584
1954	98,476	376,805	306,480	781,761
1955	89,616	366,735	307,476	763,827
1956	114,397	486,224	352,947	953,568
1957	116,770	418,512	286,272	821,554
1958	55,299	200,550	269,667	525,516
1959	75,783	296,100	281,141	653,024

(CONTINUED ON NEXT PAGE)

Table 2. (cont.)

1960	.	84,161	305,927	280,711	670,799
1961	.	84,068	328,208	302,773	715,049
1962	.	138,256	375,527	268,704	782,487
1963	.	91,650	178,377	102,824	372,851
1964	.	42,425	64,279	32,554	139,258
1965	.	30,140	74,373	46,498	151,011
1966	.	4,870	12,915	4,231	22,016
1967	.	642	45,896	-	46,538
1968	.	17,785	68,477	-	86,262
1969	.	9,762	33,993	-	43,755
1970	.	742	30,728	-	31,470
1971	.	999	60,563	-	61,562
1972	.	1,775	138,476	29	140,280
1973	.	1,734	154,483	33	156,250
1974	.	576	107,307	13	107,896
1975	.	1,076	65,934	20	67,030
1976	.	1,014	150,438	35	151,487
1977	.	851	97,509	25	98,385
1978	.	240	82,428	30	82,698
1979	.	713	103,281	48	104,041
1980	.	882	120,018	-	120,900
1981	.	533	103,280	-	103,814
1982	.	394	1,637	58	2,090
1983	.	216	1,582	41	1,839
1984	.	693	2,293	208	3,194
1985	.	902	2,880	176	3,958
1986	.	400	2,454	20	2,873
1987	.	207	2,563	22	2,792
1988	.	504	1,984	128	2,616
1989	.	449	2,855	91	3,394
1990	.	650	9,041	141	9,832
1991	.	650	16,597	280	17,528
1992	.	1,132	27,471	106	28,708
1993	.	1,049	28,297	164	29,510
1994	.	961	38,329	79	39,370
1995	.	1,088	36,578	101	37,768
1996	.	11	35,517	101	35,629
1997	.	554	38,119	56	38,728
1998	.	29	33,288	58	33,375
1999	.	12	31,037	79	31,127
2000	.	5	31,267	48	31,319

(1) DATA NOT AVAILABLE.

NOTE:--PENNSYLVANIA LANDINGS INCLUDED DATA FOR 1887: 2,795,000 LB; 1988: 7,611,000; AND 1926: 36,000 LB.

Table 3. Chesapeake Bay fisheries historical catch statistics (1000 pounds) for menhaden, 1880-2000.

YEAR	MARYLAND	VIRGINIA	TOTAL
1880	3,903	88,214	92,117
1887	23,630	61,603	85,233
1888	25,737	58,873	84,610
1890	27,970	107,342	135,312
1891	30,952	105,980	136,932
1897	353	178,656	179,009
1901	7,122	273,494	280,616
1904	9,849	247,919	257,768
1908	12,293	190,089	202,382
1920	8	366,379	366,387
1925	7	150,486	150,493
1929	-	99,229	99,229
1930	-	115,842	115,842
1931	-	112,920	112,920
1932	-	195,486	195,486
1933	-	115,990	115,990
1934	-	143,879	143,879
1935	7	121,081	121,088
1936	43	167,515	167,558
1937	15	121,965	121,980
1938	63	95,020	95,083
1939	16	127,665	127,681
1940	104	143,123	143,227
1941	126	182,097	182,223
1942	175	63,940	64,115
1944	183	77,787	77,970
1945	41	89,316	89,357
1946	368	148,971	149,339
1947	125	178,123	178,248
1948	565	151,367	151,932
1949	1,680	136,132	137,812
1950	1,097	169,815	170,912
1951	431	126,994	127,425
1952	1,444	90,930	92,374
1953	2,151	160,076	162,227
1954	3,883	284,933	288,816
1955	1,940	313,419	315,359
1956	1,375	189,047	190,422
1957	2,399	265,453	267,852
1958	2,274	320,512	322,786
1959	2,203	412,302	414,505

(CONTINUED ON NEXT PAGE)

Table 3. (cont.)

1960	.	2,904	246,001	248,905
1961	.	3,578	295,101	298,679
1962	.	4,316	323,594	327,910
1963	.	3,293	255,722	259,015
1964	.	5,706	330,708	336,414
1965	.	8,333	351,613	359,946
1966	.	5,504	272,391	277,895
1967	.	3,001	220,267	223,268
1968	.	4,360	269,717	274,077
1969	.	3,456	178,195	181,651
1970	.	3,837	445,960	449,797
1971	.	5,958	394,145	400,103
1972	.	7,104	549,397	556,501
1973	.	9,657	495,963	505,620
1974	.	5,523	379,252	384,775
1975	.	6,106	315,783	321,889
1976	.	5,380	440,761	446,141
1977	.	8,681	501,274	509,955
1978	.	7,116	420,813	427,929
1979	.	5,608	455,360	460,968
1980	.	8,716	537,222	545,938
1981	.	10,701	400,708	411,409
1982	.	8,946	598,631	607,577
1983	.	6,606	644,713	651,319
1984	.	5,364	485,835	491,199
1985	.	5,372	639,518	644,889
1986	.	5,449	445,674	451,124
1987	.	5,794	615,523	621,317
1988	.	6,430	550,556	556,987
1989	.	6,166	612,162	618,328
1990	.	2,634	704,565	707,199
1991	.	3,540	601,188	604,728
1992	.	2,295	574,827	577,122
1993	.	3,086	639,324	642,410
1994	.	3,512	513,270	516,782
1995	.	-	704,447	704,447
1996	.	-	584,296	584,296
1997	.	4,899	497,161	502,060
1998	.	4,464	508,728	513,192
1999	.	5,721	378,158	383,879
2000	.	4,871	367,131	372,002

Table 4. South Atlantic fisheries historical catch statistics (1000 pounds) for menhaden, 1880-2000.

YEAR	NORTH CAROLINA	SOUTH CAROLINA	GEORGIA	FLORIDA		TOTAL	TOTAL, EXCLUSIVE OF FLORIDA WEST COAST
				EAST COAST	WEST COAST		
1880	(1)	(1)	(1)	(1)	(1)	(1)	(1)
1887	14,756	-	-	(1)	(1)	(1)	(1)
1888	13,844	-	-	-	-	-	13,844
1889	8,753	-	-	-	-	-	8,753
1890	12,410	-	-	-	-	-	12,410
1897	11,310	-	-	-	-	-	11,310
1902	18,862	-	-	-	2	2	18,862
1908	57,412	-	-	-	-	-	57,412
1918	179,911	-	29,485	48,363	305	48,668	257,759
1923	63,290	-	26,973	57,918	10,956	68,874	148,181
1927	98,987	-	34,102	24,876	13,467	38,343	157,965
1928	99,302	-	30,030	21,512	5,857	27,369	150,844
1929	173,490	-	29,213	31,717	18,815	50,532	234,420
1930	134,051	-	24,701	34,242	6,172	40,414	192,994
1931	67,877	-	869	3,710	4,446	8,156	72,456
1932	54,476	-	11,520	11,180	12,170	23,350	77,176
1934	106,651	-	18,752	29,404	9,579	38,983	154,807
1936	150,088	-	14,500	65,482	3,393	68,875	230,070
1937	61,706	-	9,864	133,538	6,250	139,788	205,108
1938	146,819	-	7,034	148,916	353	149,269	302,769
1939	181,968	-	2,957	102,318	2,849	105,167	287,243
1940	129,592	-	234	95,056	-	95,056	224,882
1945	141,533	-	-	114,746	7,166	121,912	256,279
1950	124,905	961	-	21,259	1,534	22,793	147,125
1951	104,013	4,477	-	79,600	3,375	82,975	188,090
1952	191,341	3,218	-	120,282	10,737	131,019	314,841
1953	132,105	1,696	-	65,544	4,031	69,575	199,345
1954	160,301	3,952	-	42,009	2	42,011	206,262
1955	184,919	6,638	-	36,254	1,935	38,189	227,811
1956	246,648	-	-	67,998	32	68,030	314,646
1957	172,522	7,027	-	16,852	7	16,859	196,401
1958	235,385	861	-	7,871	9,108	16,979	244,117
1959	279,888	3,991	-	46,637	17,590	64,227	330,516

(CONTINUED ON NEXT PAGE)

Table 4. (cont.)

1960	.	190,431	-	-	24,592	6,580	31,172	221,603
1961	.	221,555	-	-	32,950	3,375	36,325	257,880
1962	.	122,898	-	-	34,271	20	34,291	157,189
1963	.	190,214	-	-	25,672	44	25,716	215,930
1964	.	172,992	-	-	17,154	84	17,238	190,230
1965	.	160,595	10	-	31,670	432	32,102	192,707
1966	.	182,289	235	-	32,590	7,302	39,892	222,416
1967	.	150,481	-	-	43,297	127	43,424	193,905
1968	.	167,189	253	-	23,940	457	24,397	191,839
1969	.	145,235	245	-	19,394	382	19,776	165,256
1970	.	108,235	10	-	28,008	617	28,625	136,870
1971	.	79,488	12	-	19,789	807	20,596	100,096
1972	.	84,692	2	-	21,257	644	21,901	106,595
1973	.	66,943	-	-	18,280	983	19,263	86,206
1974	.	121,198	2	-	12,637	702	13,339	134,539
1975	.	153,805	340	-	12,750	466	13,216	167,361
1976	.	134,902	-	-	10,131	722	10,853	145,033
1977	.	158,119	-	-	537	656	1,193	158,656
1978	.	192,324	(2)	-	13,034	890	13,924	205,359
1979	.	254,330	1	-	5,035	3,807	8,842	259,366
1980	.	196,920	-	-	21,305	2,202	23,507	218,226
1981	.	309,415	8	-	15,448	2,369	17,816	324,871
1982	.	187,015	-	(2)	10,358	3,476	13,834	197,373
1983	.	177,973	34	-	8,251	3,834	12,085	186,259
1984	.	157,667	-	-	8,479	5,103	13,582	166,146
1985	.	97,738	8	-	5,771	5,866	11,637	103,517
1986	.	66,378	10	-	7,580	18,505	26,085	73,968
1987	.	55,499	4	-	2,776	18,988	21,764	58,278
1988	.	73,716	1	-	1,034	16,606	17,641	74,750
1989	.	66,756	-	-	1,371	15,674	17,045	68,128
1990	.	72,232	-	-	2,635	9,470	12,105	74,867
1991	.	110,529	-	-	2,496	9,022	11,518	113,025
1992	.	57,516	1	-	2,746	8,390	11,136	60,263
1993	.	64,711	-	-	2,585	6,597	9,182	67,296
1994	.	75,595	-	-	1,387	7,108	8,495	76,982
1995	.	60,797	-	-	660	848	1,509	61,458
1996	.	53,863	-	-	272	137	410	54,135
1997	.	97,727	(2)	-	408	224	633	98,136
1998	.	62,376	-	-	302	49	350	62,677
1999	.	42,356	-	-	282	244	526	42,639
2000	.	52,768	-	-	264	91	355	53,031

(1) DATA NOT AVAILABLE.

(2) LESS THAN 500 LB.

Table 5. Historical catch statistics (in 1000 pounds) for menhaden with interpolated values by region, 1880-2000. Linearly interpolated values by region are highlighted in red.

Year	NE Total	MA Total	CB Total	SA Total	Total
1880	133,786	318,519	92,117	0	544,422
1881	125,721	285,207	91,134	0	502,061
1882	117,655	251,895	90,150	0	459,700
1883	109,590	218,583	89,167	0	417,339
1884	101,525	185,270	88,183	0	374,979
1885	93,460	151,958	87,200	0	332,618
1886	85,394	118,646	86,216	0	290,257
1887	77,329	85,334	85,233	14,756	262,652
1888	130,350	144,136	84,610	13,844	372,940
1889	173,803	137,754	109,961	8,753	430,271
1890	127,217	159,185	135,312	12,410	434,124
1891	80,631	125,598	136,932	12,253	355,414
1892	34,045	119,858	143,945	12,096	309,944
1893	27,507	114,118	150,958	11,939	304,522
1894	20,969	108,379	157,971	11,781	299,099
1895	14,431	102,639	164,983	11,624	293,677
1896	7,893	96,899	171,996	11,467	288,255
1897	1,355	91,159	179,009	11,310	282,833
1898	23,680	91,159	179,009	11,310	305,158
1899	22,379	121,700	204,411	13,198	361,687
1900	21,078	152,240	229,813	15,086	418,216
1901	19,776	213,321	280,616	18,862	532,575
1902	18,475	226,884	273,000	24,369	542,728
1903	22,911	240,447	265,384	29,876	558,619
1904	27,348	254,010	257,768	35,383	574,509
1905	31,784	211,756	243,922	40,891	528,352
1906	27,256	169,502	230,075	46,398	473,231
1907	22,728	127,248	216,229	51,905	418,109
1908	18,200	84,994	202,382	57,412	362,988
1909	19,130	95,989	216,049	77,447	408,616
1910	20,061	106,985	229,716	97,481	454,243
1911	20,991	117,980	243,383	117,516	499,871
1912	21,921	128,976	257,050	137,551	545,498
1913	22,852	139,971	270,717	157,586	591,126
1914	23,782	150,967	284,385	177,620	636,754
1915	24,713	161,962	298,052	197,655	682,381
1916	25,643	172,958	311,719	217,690	728,009
1917	26,573	183,953	325,386	237,724	773,636
1918	27,504	194,949	339,053	257,759	819,264
1919	28,434	205,944	352,720	235,843	822,941
1920	24,254	216,940	366,387	213,928	821,509

Table 5. (cont.)

1921	20,075	227,935	323,208	192,012	763,230
1922	15,895	190,319	280,029	170,097	656,340
1923	11,716	152,703	236,851	148,181	549,450
1924	7,536	115,087	193,672	150,627	466,922
1925	6,946	77,471	150,493	153,073	387,983
1926	6,356	39,855	137,677	155,519	339,407
1927	5,765	40,077	124,861	157,965	328,668
1928	5,175	40,298	112,045	150,844	308,362
1929	395	40,520	99,229	234,420	374,564
1930	1,708	52,397	115,842	192,994	362,941
1931	5	40,567	112,920	72,456	225,948
1932	54	43,194	195,486	77,176	315,910
1933	1,030	79,575	115,990	115,992	312,586
1934	0	0	143,879	154,807	298,686
1935	4,284	179,603	121,088	192,439	497,414
1936	0	0	167,558	230,070	397,628
1937	294	148,505	121,980	205,108	475,887
1938	328	86,941	95,083	302,769	485,121
1939	122	148,584	127,681	287,243	563,630
1940	88	245,369	143,227	224,882	613,566
1941	82	224,943	182,223	231,161	638,409
1942	75	204,517	64,115	237,441	506,148
1943	132	196,259	71,043	243,720	511,154
1944	70	304,314	77,970	250,000	632,354
1945	200	368,122	89,357	256,279	713,958
1946	204	74,830	149,339	234,448	458,821
1947	222	508,727	178,248	212,617	899,814
1948	1,216	389,188	151,932	190,787	733,123
1949	12,566	392,410	137,812	168,956	711,744
1950	9,304	372,946	170,912	147,125	700,287
1951	11,761	441,825	127,425	188,090	769,101
1952	36,088	480,305	92,374	314,841	923,608
1953	39,875	857,584	162,227	199,345	1,259,031
1954	59,685	781,761	288,816	206,262	1,336,524
1955	79,794	763,827	315,359	227,811	1,386,791
1956	78,767	953,568	190,422	314,646	1,537,403
1957	41,788	821,554	267,852	196,401	1,327,595
1958	13,853	525,516	322,786	244,117	1,106,272
1959	52,851	653,024	414,505	330,516	1,450,896
1960	42,629	670,799	248,905	215,023	1,177,356
1961	26,011	715,049	298,679	254,505	1,294,244
1962	23,753	782,487	327,910	157,169	1,291,319
1963	353	372,851	259,015	215,886	848,105
1964	6	139,258	336,414	190,146	665,824
1965	20	151,011	359,946	192,275	703,252

Table 5. (cont.)

1966	14	22,016	277,895	215,114	515,039
1967	36	46,538	223,268	193,778	463,620
1968	23	86,262	274,077	191,382	551,744
1969	46	43,755	181,651	164,874	390,326
1970	10,506	31,470	449,797	136,253	628,026
1971	25,893	61,562	400,103	99,289	586,847
1972	30,692	140,280	556,501	105,951	833,424
1973	66,647	156,250	505,620	85,223	813,740
1974	78,442	107,896	384,775	133,837	704,950
1975	50,866	67,030	321,889	166,895	606,680
1976	59,013	151,487	446,141	145,033	801,674
1977	30,878	98,385	509,955	158,656	797,874
1978	20,326	82,698	427,929	205,359	736,312
1979	66,535	104,041	460,968	259,366	890,910
1980	62,302	120,900	545,938	218,226	947,366
1981	47,836	103,814	411,409	324,871	887,929
1982	78,153	2,090	607,577	197,374	885,194
1983	42,698	1,839	651,319	186,259	882,115
1984	17,993	3,194	491,199	166,146	678,531
1985	33,428	3,958	644,889	103,517	785,792
1986	22,869	2,873	451,124	73,968	550,834
1987	19,980	2,792	621,317	58,278	702,367
1988	19,885	2,616	556,987	74,750	654,238
1989	534	3,394	618,328	68,128	690,384
1990	7,468	9,832	707,199	74,867	799,366
1991	22,734	17,528	604,728	113,025	758,014
1992	21,581	28,708	577,122	60,263	687,674
1993	21,056	29,510	642,410	67,296	760,272
1994	100	39,370	516,782	76,982	633,233
1995	317	37,768	704,447	61,458	803,990
1996	91	35,629	584,296	54,135	674,151
1997	2,909	38,728	502,060	98,136	641,833
1998	2,358	33,375	513,192	62,677	611,602
1999	937	31,127	383,879	42,639	458,582
2000	334	31,319	372,002	53,031	456,687

Regional definitions are: New England (ME, NH, MA, RI, CT), Middle Atlantic (NY, NJ, DE), Chesapeake Bay (MD, VA), and South Atlantic (NC, SC, GA, east coast of FL).

Table 6. Historical menhaden plants and landings (Atlantic and gulf menhaden) from the report *Menhaden Fishery, 1873-1964*. Fish received is in thousands of pounds, and 'Landings' is converted to 1000 metric tons (kmt).

Year	Plants	Fish Received	Landings
1873	62	266459	120.9
1874	64	330228	149.8
1875	60	377429	171.2
1876	64	343342	155.7
1877	56	393720	178.6
1878	56	514412	233.3
1879	60	426833	193.6
1880	79	520506	236.1
1881	97	304309	138.0
1882	97	232248	105.3
1883	78	411019	186.4
1884	52	575257	260.9
1885	50	321074	145.6
1886	26	189681	86.0
1887	28	223488	101.4
1888	24	294391	133.5
1889	29	372064	168.8
1890	28	357570	162.2
1891	27	237943	107.9
1892	29	149828	68.0
1893	33	245492	111.4
1894	44	357352	162.1
1895	42	309370	140.3
1896	35	268955	122.0
1897	41	391483	177.6
1898	40	363475	164.9
1899	*		
1900	*		
1901	36	609744	276.6
1902	*		
1903	*		
1904	*		
1905	*		
1906	*		
1907	*		
1908	*		
1909	*		
1910	*		
1911	*		
1912	48	711435	322.7
1913	*		
1914	*		
1915	*		
1916	*		
1917	*	306146	138.9
1918	*	259292	117.6
1919	*	438520	198.9
1920	*		

Table 6. (cont.)

1921	40	691132	313.5
1922	45	812342	368.5
1923	50	743895	337.4
1924	45	344284	156.2
1925	43	532118	241.4
1926	41	382781	173.6
1927	39	392763	178.2
1928	34	362213	164.3
1929	37	442443	200.7
1930	33	409513	185.8
1931	27	236432	107.2
1932	24	375479	170.3
1933	30	357726	162.3
1934	27	517403	234.7
1935	27	434386	197.0
1936	29	516104	234.1
1937	32	529202	240.0
1938	32	517530	234.7
1939	33	574825	260.7
1940	30	634589	287.8
1941	29	775087	351.6
1942	30	482644	218.9
1943	25	615554	279.2
1944	27	685980	311.2
1945	24	759074	344.3
1946	28	916013	415.5
1947	31	948156	430.1
1948	31	1007889	457.2
1949	31	1072630	486.5
1950	35	1000498	453.8
1951	35	1103915	500.7
1952	40	1386281	628.8
1953	36	1683406	763.6
1954	34	1740600	789.5
1955	35	1848299	838.4
1956	38	2076588	941.9
1957	41	1681580	762.8
1958	38	1544683	700.7
1959	40	2193864	995.1
1960	38	1999036	906.7
1961	35	2290936	1039.2
1962	33	2227316	1010.3
1963	32	1787638	810.9
1964	31	1530631	694.3

Table 7. Historical landings (1000 metric tons) by gear available from ACCSP, 1950-2008.

Year	Purse Seine	Pound Net	Other	Total
1950	306.4	8.7	2.6	317.6
1951	328.4	18.0	2.4	348.9
1952	404.8	11.7	2.4	418.9
1953	545.3	25.0	0.8	571.1
1954	587.0	18.2	1.1	606.2
1955	614.4	13.8	0.8	629.0
1956	674.1	22.2	1.1	697.4
1957	577.5	22.9	1.8	602.2
1958	487.1	12.9	1.8	501.8
1959	637.5	18.4	2.2	658.1
1960	514.6	16.8	2.7	534.0
1961	562.0	18.0	7.0	587.1
1962	559.2	24.2	2.4	585.7
1963	360.3	20.5	3.9	384.7
1964	281.8	18.9	1.3	302.0
1965	295.4	19.0	4.7	319.0
1966	219.9	10.6	3.2	233.6
1967	198.7	10.5	1.1	210.3
1968	240.8	8.6	0.9	250.3
1969	166.4	9.8	0.8	177.0
1970	263.2	20.3	1.3	284.9
1971	252.7	12.5	0.9	266.2
1972	367.7	8.8	1.5	378.0
1973	354.3	13.5	1.3	369.1
1974	305.2	13.2	1.4	319.8
1975	253.5	20.4	1.3	275.2
1976	344.0	18.5	1.1	363.6
1977	344.2	21.7	1.4	367.3
1978	330.3	19.2	6.7	356.2
1979	391.1	10.4	2.6	404.1
1980	403.6	16.0	10.1	429.7
1981	380.3	14.9	7.5	402.8
1982	381.7	14.6	5.3	401.5
1983	401.9	14.3	4.7	421.0
1984	322.2	9.6	4.7	336.6
1985	346.8	11.3	3.5	361.6
1986	244.4	7.7	4.3	256.3
1987	314.3	9.9	2.1	326.3
1988	296.5	9.3	1.7	307.5
1989	311.7	9.4	1.3	322.4

Table 7. (cont.)

Year	Purse Seine	Pound Net	Other	Total
1990	363.3	4.6	2.5	370.3
1991	339.2	4.7	2.0	345.9
1992	306.3	4.7	2.2	313.2
1993	340.6	5.3	1.9	347.8
1994	280.2	4.5	1.7	286.5
1995	361.4	4.0	3.4	368.9
1996	303.0	2.6	3.1	308.7
1997	285.1	3.3	2.7	291.1
1998	270.5	2.7	2.2	275.4
1999	202.3	4.9	1.0	208.2
2000	203.0	5.0	0.9	208.9
2001	255.6	4.0	1.5	261.1
2002	206.5	4.0	1.0	211.5
2003	198.9	3.1	1.2	203.3
2004	207.3	4.1	2.7	214.1
2005	176.7	9.1	8.4	194.2
2006	173.7	4.3	6.0	183.9
2007	200.8	9.5	6.7	217.0
2008	172.2	6.3	9.2	187.7

Figure 1. A comparison of commercial catch statistics from *Historical Reports* (linearly interpolated by region) with reduction landings statistics maintained at NOAA Fisheries at Beaufort, NC.

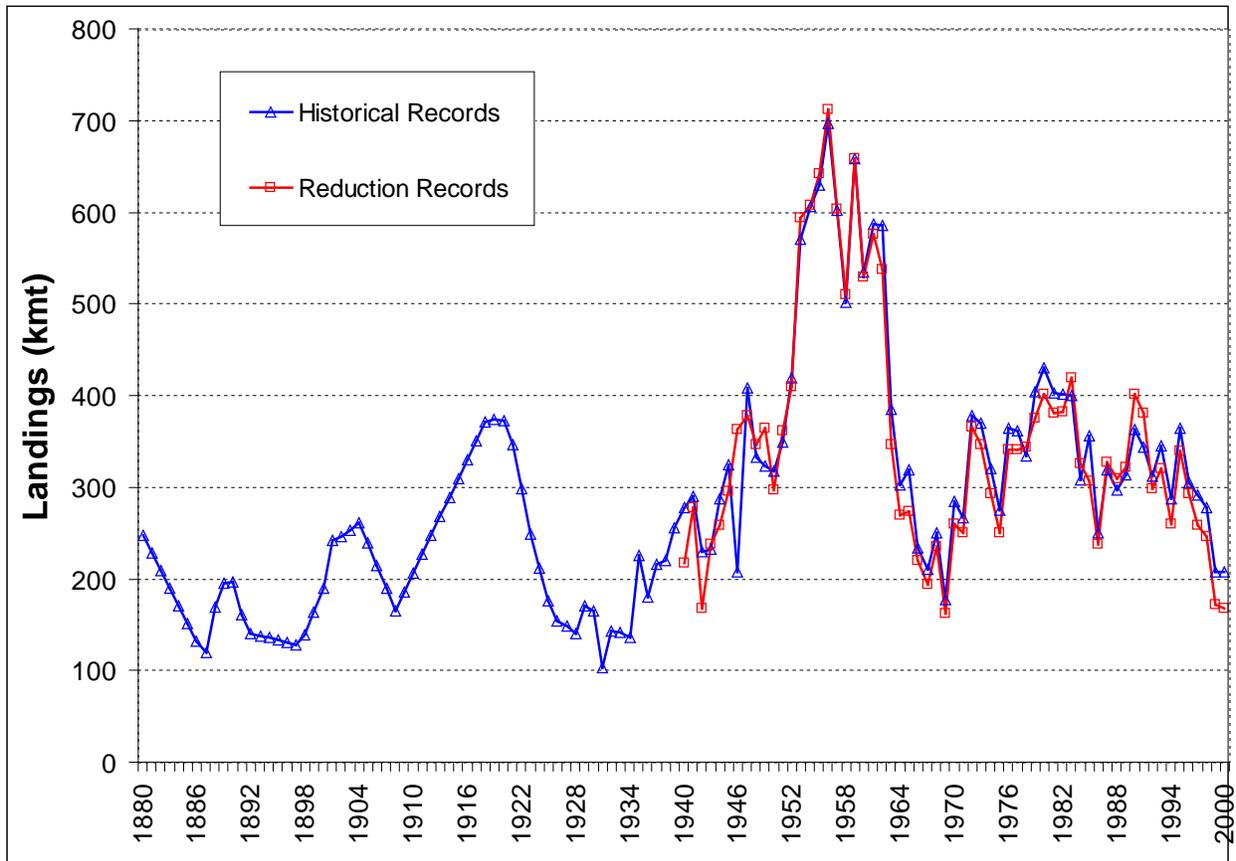


Figure 2. Comparison of menhaden landings (Atlantic and gulf menhaden combined) between two sources of historical data, 1873-1964. Reconstructed landings refer to the historical landings available on excel spreadsheets from annual historical reports, and Menhaden landings refers to those taken from the report *Menhaden Landings, 1873-1964*.

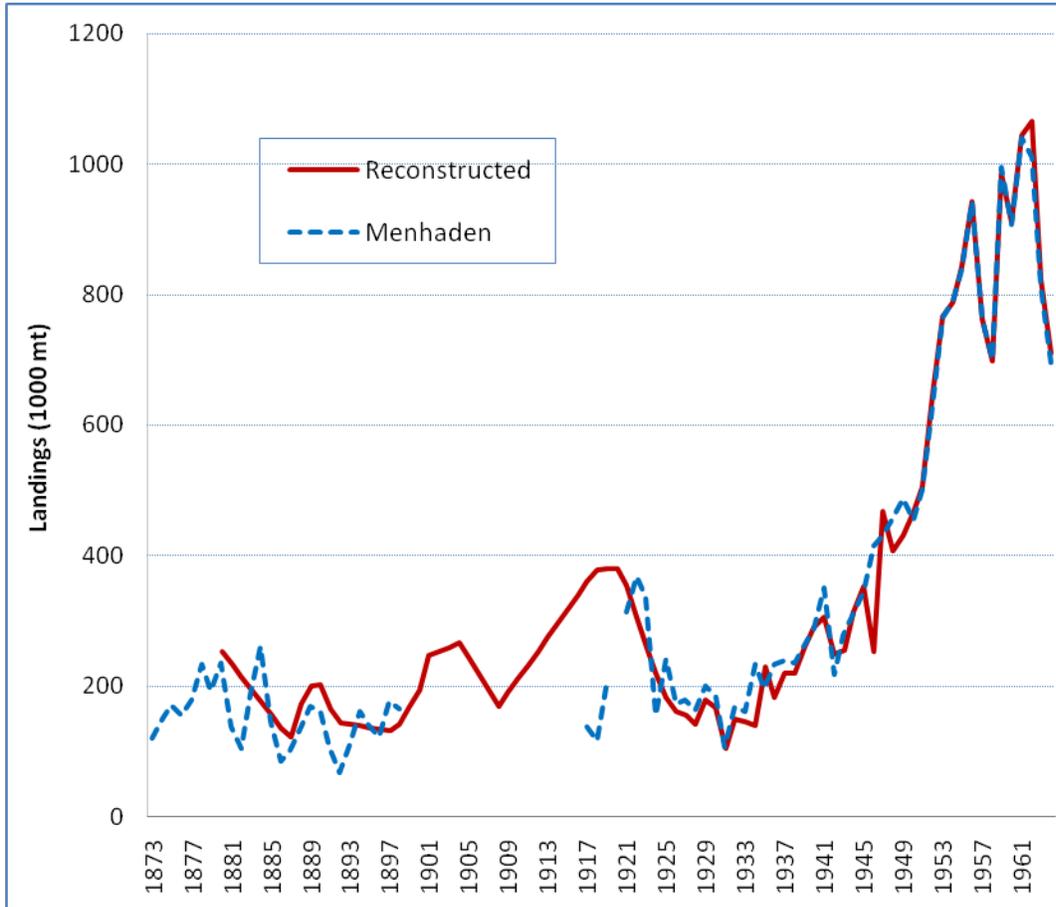


Figure 3. A comparison of purse seine landings obtained from the ACCSP Commercial Landings (Purse Seine) to purse-seine reduction landings (Reduction) maintained by NOAA Fisheries at Beaufort, NC.

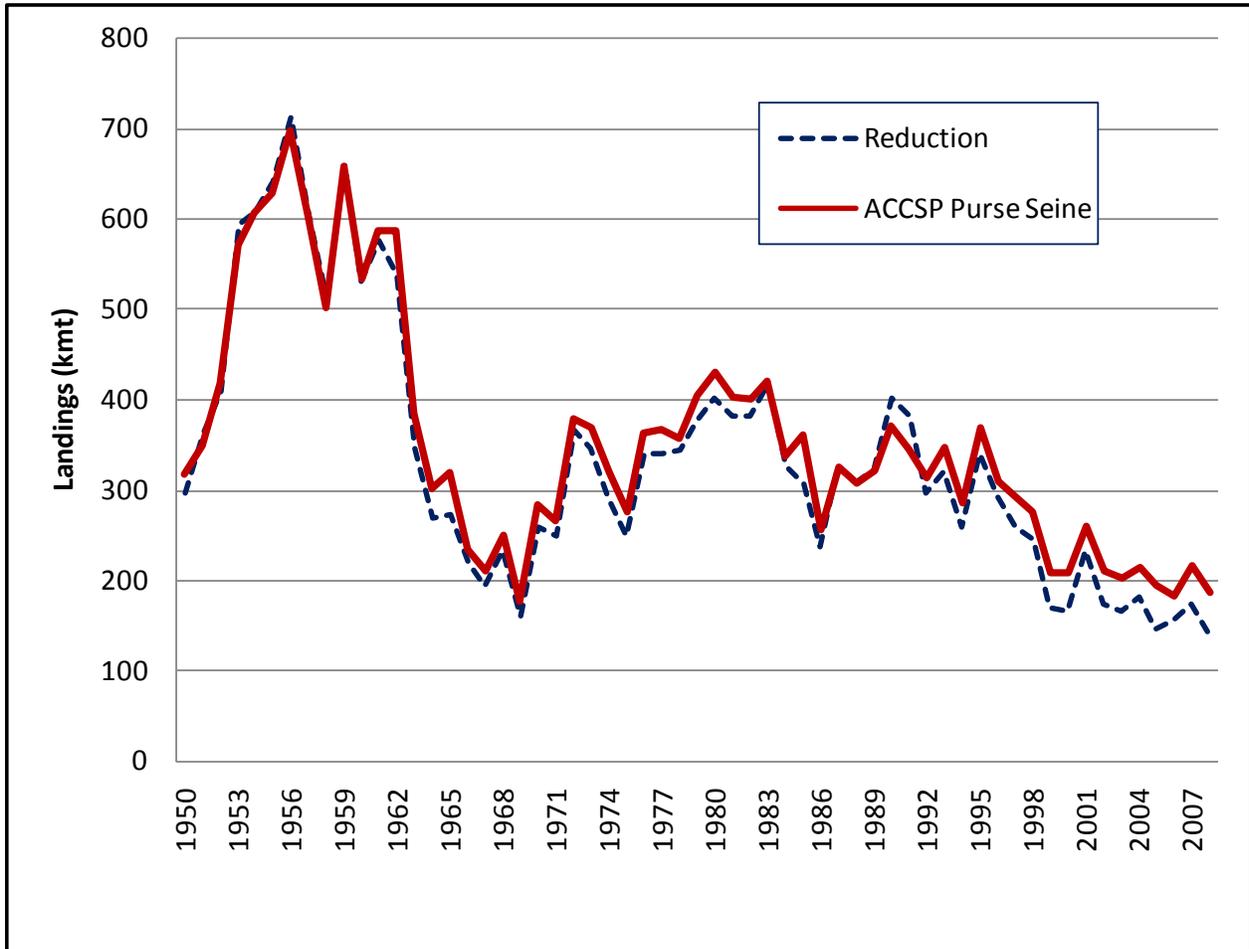


Figure 4. Non-purse seine landings obtained from the ACCSP Commercial Landings, 1950-2008; primarily pound net and a mix of other gears (gill nets, haul seines, fyke and hoop nets, otter trawl, cast nets, etc.).

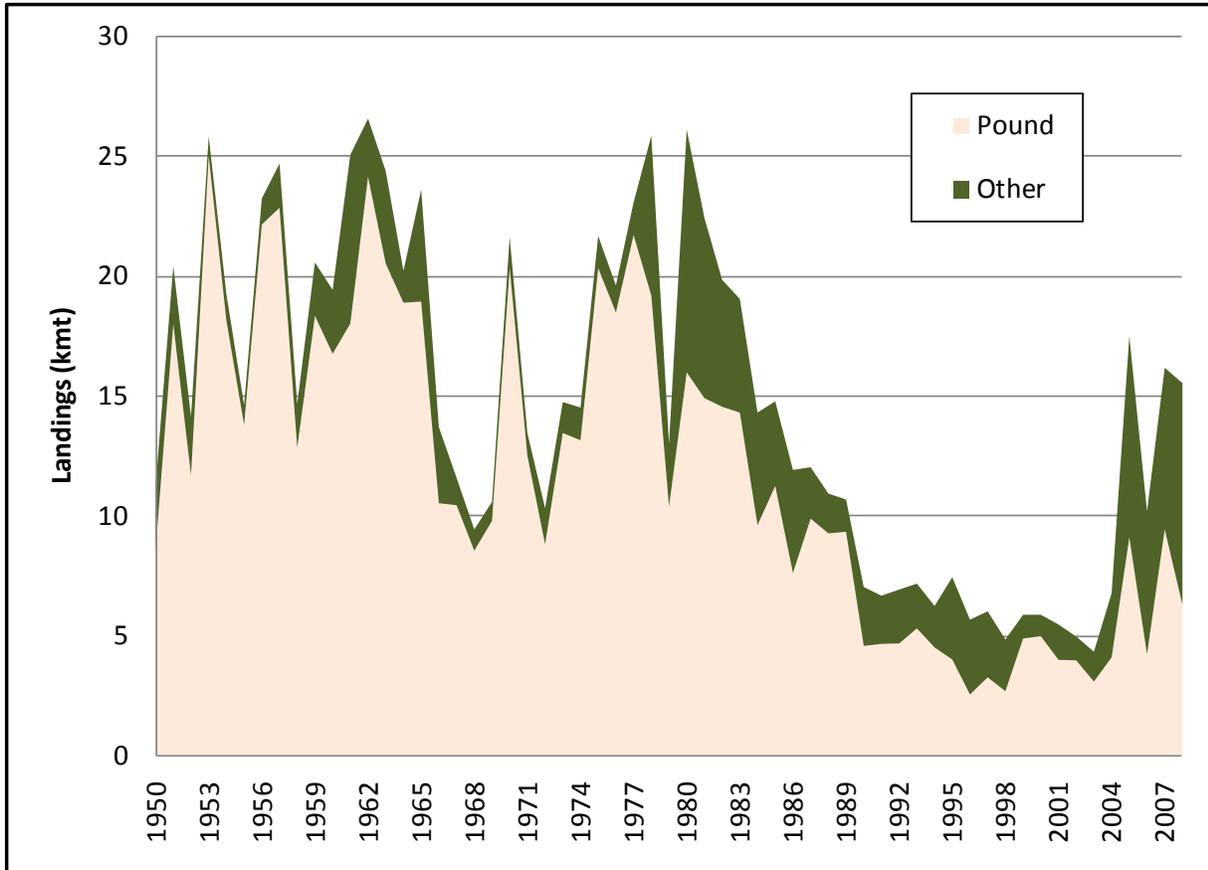


Figure 5. Reconstructed Atlantic menhaden landings along the coast of the U.S., 1873-2008.

