S E D A R

Southeast Data, Assessment, and Review

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History of the Gulf Menhaden Fishery and Reconstruction of Historical Commercial Landings

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Introduction

Official commercial landings of gulf menhaden from the reduction purse-seine fleet have been maintained by the Beaufort Laboratory of the National Marine Fisheries Service (NMFS). When the Menhaden Program began at the Beaufort Laboratory in the early 1950s, staff visited menhaden plants along the Gulf of Mexico coast, obtaining detailed fishery landings for the reduction fishery consistently back to 1946. Subsequently, detailed dockside landings from the reduction fishery have been maintained on computer files by calendar year (January 1 through December 31 of the same year). These landings are considered the best available data for purposes of stock assessments.

The purpose of this report is to investigate historical sources of menhaden landings, particularly commercial landings prior to 1950 regardless of gear, and bait and recreational landings subsequent to 1950. These data sources include:

- Menhaden Fishery, 1873-1964
- Commercial Catch Statistics from Historical Reports, 1880-2000.
- Commercial Landings from NMFS Accumulated Landings System (ALS, 1950-2009)
- Recreational Landings from Marine Recreational Fisheries Statistical Survey (MRFSS), 1981-2009

Overview of Historical Gulf Menhaden Fishery

For those interested in the history and evolution of the gulf menhaden fishery, unfortunately, a volume equivalent to that which G.B. Goode (1887) compiled for the Atlantic menhaden fishery is unavailable. Goode (1887) surveyed fishermen, fish factory owners, and various seaside observers for insights about the seasonality, movements, and habits of Atlantic menhaden, as well as information on fishing operations and disposition of the catch along the U.S. Eastern Seaboard. Goode (1887) was able to cobble together a history of the Atlantic menhaden fishery back to the mid-1800s. No such author or tome has chronicled the history of the early days of the menhaden fishery in the northern Gulf of Mexico. Several sources however provide us with glimpses of the gulf menhaden fishery beginning in the mid-twentieth century.

Frye (1978) delved into the genealogy of menhaden factory ownership for the gulf fishery. He recounts that numerous corporate families active in the Atlantic menhaden fishery moved some or all of their operations to the northern Gulf of Mexico just before and after World War II. Simmons and Breuer (1964) make brief reference to the establishment of menhaden fishing operations in Texas in 1951. Kutkuhn[1] was among the first to recognize that the surging landings in the gulf menhaden fishery during 1958-61 were primarily due to the "vastly improved efficiency of the fishing fleet rather than to greater abundance or availability of the resource." Fishing fleet innovations which he cited included spotter aircraft, nylon seines, fish pumps, power blocks, refrigerated fish holds, and larger carrier vessels. Henry (1969) noted that

[1] Kutkuhn, J.H.1965. Unpublished ms by the NMFS Beaufort Laboratory. The gulf menhaden fishery, a paper presented to the National Menhaden Association in Washington, DC, December 16, 1965.

the gulf menhaden fishery "started much later than that for the Atlantic species." He reported that the annual catch of gulf menhaden in the early 1940s was less than about 40,000 mt, but that the fishery had grown steadily and in 1963, for the first time in history, the gulf menhaden catch of about 445,000 mt exceeded that of the Atlantic fishery. Henry (1969) also pointed out that although the Atlantic menhaden fleet tended to make one-day trips to the fishing grounds, the gulf menhaden fleet generally made multiple-day trips, thus the need for refrigerated fish holds. Additionally, he categorized gulf menhaden landings by state, noting that in 1966 "70% of the menhaden catch from the Gulf of Mexico was landed in Louisiana, 24% in Mississippi, 5% in Texas, and 1% in Florida".

Perhaps, Nicholson (1978) best summarized the evolution of the gulf menhaden fishery. He canvassed confidential company records and statistical digests for landings in the gulf menhaden fishery from the first half of the 1900s. Nicholson (1978) reported that although a menhaden fishery had existed along the U.S. Gulf coast since the late 1800s, records of catches, the location and years of operation of plants, and the numbers of vessels prior to 1946 were fragmentary at best. Historically, up to 13 menhaden processing plants existed in the northern Gulf of Mexico, ranging from Apalachicola, Florida, to Sabine Pass, Texas. One plant was known to have operated in Texas from around the turn of the century until at least 1923; another near Port St. Joe and Apalachicola, Florida, from about 1918 to 1961; and another near Pascagoula, Mississippi, from the 1930s until 1959.

Nicholson (1978) claimed that the modern gulf menhaden fishery began after World War II as the worldwide demand for fish meal and fish oil increased. The first plant in Louisiana opened in 1946; shortly thereafter, additional plants opened in Mississippi, Louisiana, and Texas. As older plants were closed, larger and more efficient plants replaced them. During the 1950s to the early 1970s, the number of menhaden plants fluctuated between 9 and 13 (Nicholson 1978). Between the mid-1970s to the early 1980s, the number of processing plants in the Gulf was stable at eleven (Smith 1991). Two periods of corporate consolidation followed. In 1985 the number of plants fell to seven, then increased during 1989-90 to nine. The number of plants declined to seven in 1991, to six in 1992, then to five between 1996 and 1999. After the 1997, fishing season, the menhaden company at Morgan City was acquired by one of its competitors, who closed this facility after 1999. That left only four factories (owned by two companies, i.e., Omega Protein, Inc. [OPI] and Daybrook Fisheries, Inc. [DFI]) operational throughout 2000 to 2010, one each at Moss Point, Mississippi [OPI], and Empire [DFI], Abbeville [OPI], and Cameron [OPI], Louisiana.

In 1945, only about ten menhaden vessels were reported operating in the Gulf of Mexico (Nicholson 1978). After World War II, the fleet grew rapidly and reached 81 vessels by 1956. During the 1960s and 1970s, fleet size fluctuated and ranged from 65 vessels in 1973 to 92 vessels in 1966 (Nicholson 1978, Smith 1991). Fleet size peaked at 82 vessels in 1982, followed by two major downsizings. The first occurred in 1985 when the fleet was reduced from 81 to 73 vessels (Smith 1991); the second occurred in 1991 when the fleet was reduced from 75 to 58 vessels (Vaughan et al. 1996). Between 1995 and 1999, fleet size was about 50-55 vessels. Through the past decade, number of gulf menhaden vessels declined slightly from 47 in 2000 to 41 in 2006. Since 2006, the fleet has been reasonably stable at about 41 vessels.

Sources for Gulf Menhaden Landings

The NMFS Beaufort Laboratory has maintained detailed gulf menhaden reduction landings since 1946. However, NMFS Office of Science and Technology (S&T) maintains commercial fishery landings including gulf menhaden by gear for 1950 to present at their website

http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html.

Commercial landings from the U.S. South Atlantic and Gulf of Mexico are available from the NMFS Southeast Fisheries Information Network (SEFIN) Accumulated Landings (ALS) for 1962 to the present. The NMFS S&T and ALS are our source for commercial bait landings.

Recreational landings from 1981 to present are downloaded from the MRFSS website:

http://www.st.nmfs.noaa.gov/st1/recreational/queries/index.html

using the Custom Query option.

Historical Commercial Landings

Landings of gulf menhaden prior to 1950 in general, and prior to 1946 for the reduction fishery are limited. These earlier commercial landings of gulf menhaden can be found intermittently from a series of historical publications to be described in the next two subsections.

Commercial Catch Statistics from Historical Reports, 1880-2000

Data from various 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) have been summarized for 1880-2000 (**Table 1**). However, other than 2000 pounds reported in 1902, positive landings began in 1918. They are not identified by gear, so these commercial landings are assumed to include both those for reduction and for other commercial gears/uses (e.g., bait). Intermittent landings from Florida (west coast) are reported from 1918 to 1948, after which consistent annual landings are shown through 2000. Alabama only reports consistent values starting in the 1980s. Landings from the other Gulf states do not appear consistently until 1948. This generally agrees with our understanding of the historical development of the fishery in the Gulf of Mexico. Because of the gaps in these data, we used a process of linear interpolation to fill these gaps between 1918 and 1948. These interpolated values are highlighted in **Table 2**. Reduction landings are available from NMFS Beaufort Laboratory beginning in 1946, but not earlier.

When comparing these interpolated catch statistics from historical reports (1918-2000) with the historical reduction landings maintained at the NMFS Beaufort Laboratory, they compare fairly closely for years of overlap (**Figure 1**). Greatest differences are noted for 1946-1948. Nicholson (1978) noted that the records retained at Beaufort were incomplete for 1946-1947. On this basis, we favor using the separate reduction landings based on the Beaufort data base for 1948 to present as augmented with separate estimates for bait and recreational landings as described later.

Menhaden Fishery, 1873-1964

During the recent Atlantic menhaden assessment (ASMFC 2010), we discovered an undated report titled *Menhaden Fishery, 1873-1964.* This report, which can be found in USFWS (1966), contains summary statistics for the menhaden fishery from 1873 – 1964 (a scanned pdf file is available). It became 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 3**). We compared the historical commercial landings from other sources (previous section) for both Atlantic and gulf menhaden to confirm our suspicions (**Figure 2**). Most plants were located on the U.S. Atlantic coast. This report seems to contain landings (albeit not at the state level) for many years not otherwise available and was used to extend Atlantic menhaden landings back to 1873 (ASMFC 2010). However, both data sources are still weak for the period 1899 to 1916. These historical data sets agree reasonably well where they overlap (1918-1947) as shown in **Figure 2**. We used these data to extend gulf menhaden landings back as well. The average proportion of gulf to total menhaden for 1918-1940 was calculated at 2.46% when data was more robust. This proportion was applied to the total menhaden landings from 1873-1917 to separate landings between the two coasts (SEDAR20). Reconstructed gulf menhaden landings for 1873-1947 are summarized in **Table 3** and plotted in **Figure 3**. The important point taken from these reconstructed data is that overall commercial gulf menhaden landings were generally small prior to World War II.

Commercial Bait Landings

Gulf menhaden commercial bait landings are available by gear through the NMFS S&T Commercial Landings website (1950-2009), particularly for 1950-1961 prior to availability of data from the NMFS ALS for 1962-2009. The ALS data were provided by NOAA Fisheries SEFSC staff in Miami on 14 February 2011. Two gears (codes 100 and 125) are associated with reduction landings, while the remaining gear codes are associated with bait landings (**Table 4**). First, we compared the reduction purse-seine landings obtained from the ALS with those maintained at the Beaufort Laboratory (**Figure 3**). Only small differences were noted, with the largest differences found in 1973-1974 and in 2001 (**Figure 4**). Purse-seine landings were the dominant gear for bait landings (64.0%). Gill nets and haul seines also were important gears for landing gulf menhaden for bait (24.5% for various gill net codes and 4.8% for haul seines). The remaining 6.7% of bait landings were caught with a variety of gears. We provided estimates of gulf menhaden bait landings by major gears for 1950-2010 (**Table 5**). An annual plot of these landings by gear demonstrates a period between 1986 and 2000 when purse seines dominated the

bait landings (**Figure 5**). Peaks in the other gears also occurred during the 1980s and 1990s. Bait landings were very small prior to 1980 and more recently. We suggest using average bait landings for 1950-1959 (9 mt) for 1948-1949 and average bait landings for 2005-2009 (192 mt) for 2010. Note that the reduction landings averaged 91,000 mt during 1948-1949 and were 379,700 mt in 2010. For the recent period 2000-2009, bait landings average 388.3 mt or 0.08% of the average of 489,622 mt for the reduction fishery. However, bait landings did range between 1% and 2% of the coastwide landings between 1987 and 1999.

Recreational Landings (MRFSS)

A small amount of gulf menhaden harvest can be attributed to the recreational fishery, predominantly by cast net. Comparable data for Atlantic menhaden were considered in the recent assessment on that species (ASMFC 2010 – SEDAR 20).

Estimated recreational catches are reported as number of fish harvested (Types A and B1), released alive (Type B2), and total caught (Types A+B1+B2; **Table 6)**. The fundamental cell structure for estimating recreational catches is by state [Florida - Texas], mode of fishing [beach/bank, man-made, shore, private/rental, charter], fishing area [inland, ocean (<=3mi), ocean (>3mi)], and wave [six 2-month periods]. To determine total removals, an estimate of release mortality to apply to the B2-caught fish was required. Under the assumption that many of these recreationally-caught fish were taken by castnet, the SEDAR 27 Data Workshop participants will need to decide what might be a reasonable value. A value of 50% was used in ASMFC (2010) for Atlantic menhaden (Sect 4.3.5 in ASMFC 2010). Based on this value, the total number of fish dying due recreational fishing would then be given by A+B1+0.5*B2.

There are complications for estimating total biomass of fish dying due to recreational fishing. Because observed fish weights at this basic cell level are not always available for converting landings in numbers to landings in weight, or small sample sizes can give spurious estimates, reporting harvest (A+B1) in weight typically underestimates the actual harvest weight. Also, catches of released-alive (B2) fish are only available in numbers. To provide estimates of harvest (Type A+B1) in weight, the catch records were retained at the basic cell level for which both harvest in numbers and harvest in weights were available. These landings were then pooled and the ratio was used to obtain an average weight. For lack of data, we make the assumption that the size (mean weight) of the B2-caught fish is similar to that of the A+B1 fish and combine them in calculating our harvest in weight. Thus, the average weight (120 g) was applied by region to total harvest (A+B1+B2) in numbers to obtain harvest in weight (**Figure 6**).

To put these removals into perspective, for 2000-2009, reduction landings have averaged 489,622 mt, bait landings have average about 388.3 mt, and recreational landings have averaged about 76.6 mt. In general, the recreational landings represent about 0.02% of the reduction landings and about 20% of the bait landings.

Data Workshop participants will need to make several decisions:

1. How to convert numbers to weight? One example would be to apply a simple average of all retained gulf menhaden (Type A) to convert numbers to weight. This value would be 120 g.

2. What survival value should be applied to Type B2 fish to represent those that have been killed? Atlantic menhaden applied a survival value of 50% to the Type B2-released fish to represent those killed.

3. Should the recreational landings data be combined with the larger reduction landings for use in the stock assessment for 1964-2010? Should the average value for years lacking in the MRFSS data (e.g., prior to 1981 and 2010) be used? We could apply average values in a manner similar to what is suggested for bait landings above.

Reconstructed Historical Landings, 1873-2010

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

Years Used	Source
1873-1917	Menhaden Fishery, 1873-1964 (**Table 3**)
1918-1947	Commercial Catch Statistics from Historical Reports, 1880-2000 (**Table 2**)
1948-2010	Reduction Landings: official landings maintained at NMFS Beaufort (S27DW05).
1950-2009	Bait Landings: Purse seine, gill nets & other gear from NMFS S&T ALS (**Table 5**). Extended for 1948-1949 and 2010.
1981-2009	Recreational Landings: MRFSS website (**Table 6**). Extended for 1948-1980 and 2010.

These reconstructed menhaden landings for 1873-2010 are summarized in **Figure 7**. Reduction landings (1948-2010) are reported in greater detail as a separate report (S27DW05) to describe additional analyses performed to develop catch-at-age and explore fishing effort.

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Table 1. Gulf fisheries historical catch statistics (1000 pounds) for menhaden, 1880-2000.

YEAR	FLORIDA WEST COAST	ALABAMA	MISSISSIPPI	LOUISIANA	TEXAS	TOTAL
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
1880	(1)	-	-	-	-	(1)
1887	(1)	-	-	-	-	(1)
1902	2	10	-	-	-	12
1918	305	-	-	-	14,118	14,423
1923	10,956	-	-	-	8,517	19,473
1927	13,467	-	-	-	-	13,467
1928	5,857	-	-	-	-	5,857
1929	18,815	-	-	-	-	18,815
1930	6,172	-	-	-	-	6,172
1931	4,446	4	-	-	-	4,450
1932	12,170	-	-	-	-	12,170
1934	9,579	-	-	-	-	9,579
1936	3,393	-	-	-	-	3,393
1937	6,250	-	-	-	-	6,250
1938	353	-	-	-	-	353
1939	2,849	-	9,000	-	-	11,849
1940	-	-	25,195	-	-	25,195
1945	7,166	-	57,340	-	-	64,506
1946						
1947						
1948	(1)	-	68,636	88,110	28,185	(1)
1949	24,879	-	44,579	165,914	41,135	276,507
1950	1,534	-	69,550	207,755	47,191	326,030
1951	3,375	-	114,895	209,574	30,121	357,965
1952	10,737	-	112,890	283,373	52,984	459,984
1953	4,031	-	58,933	307,492	66,589	437,045
1954	2	-	79,445	270,094	51,702	401,243
1955	1,935	-	128,123	298,309	52,625	480,992
1956	32	-	172,592	320,521	66,691	559,836
1957	7	-	142,124	162,817	57,585	362,533
1958	9,108	-	123,346	241,813	68,559	442,826
1959	17,590	-	174,082	442,740	117,424	751,836

(CONTINUED ON NEXT PAGE)

Table 1 (cont.)

YEAR	FLORIDA WEST COAST	ALABAMA	MISSISSIPPI	LOUISIANA	TEXAS	TOTAL
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
1960	6,580	-	218,644	470,108	145,575	840,907
1961	3,375	-	301,271	581,682	134,105	1,020,433
1962	20	-	263,574	689,157	103,874	1,056,625
1963	44	-	250,429	633,484	83,736	967,693
1964	84	-	237,833	599,538	66,686	904,141
1965	432	-	278,104	682,435	61,866	1,022,837
1966	7,302	-	190,654	555,852	38,863	792,671
1967	127	-	166,527	510,414	23,020	700,088
1968	457	-	149,535	622,291	51,073	823,356
1969	382	-	225,377	856,251	73,193	1,155,203
1970	617	-	205,980	959,810	43,060	1,209,467
1971	807	-	308,351	1,237,093	62,931	1,609,182
1972	644	-	178,273	928,252	-	1,107,169
1973	983	-	177,856	894,931	-	1,073,770
1974	702	-	215,674	1,079,304	-	1,295,680
1975	466	-	212,071	984,106	-	1,196,643
1976	722	-	180,152	1,057,077	-	1,237,951
1977	656		228,962	756,753	-	986,371
1978	890	-	298,992	1,508,744	-	1,808,626
1979	3,807	-	318,249	1,396,707	-	1,718,763
1980	2,202	-	262,166	1,283,419	-	1,547,786
1981	2,369	-	193,553	1,024,612	-	1,220,533
1982	3,476	-	315,093	1,580,151	-	1,898,720
1983	3,834	-	365,084	1,753,807	-	2,122,726
1984	5,103	2	410,576	1,756,284	-	2,171,965
1985	5,866	15	415,109	1,528,134	-	1,949,124
1986	18,505	2	353,592	1,459,153	-	1,831,252
1987	18,988	4	380,799	1,609,728	-	2,009,518
1988	16,606	1	277,103	1,116,648	-	1,410,358
1989	15,674	3	250,756	1,019,168	-	1,285,600
1990	9,470	-	270,052	909,587	-	1,189,108
1991	9,022	-	200,204	1,009,695	-	1,218,920
1992	8,390	2,275	156,411	786,899	-	953,975
1993	6,597	1,805	148,819	1,058,399	-	1,215,621
1994	7,108	1,329	195,517	1,504,046	-	1,707,999
1995	848	2,614	116,002	921,120	-	1,040,585
1996	137	3,307	134,648	945,724	-	1,083,816
1997	224	4,166	150,373	1,216,373	-	1,371,137
1998	49	3,530	181,021	908,070	-	1,092,670
1999	244	2,387	239,297	1,288,558	-	1,530,487
2000	107	1,642	190,168	1,111,979	-	1,303,895

(1) DATA NOT AVAILABLE.

Table 2. Historical catch statistics (in 1000 pounds) for menhaden with interpolated values by region, 1880-1950. Linearly interpolated values by region are highlighted in red, and boxes highlighted in yellow are missing values.

YEAR	FLORIDA WEST COAST	ALABAMA	MISSISSIPPI	LOUISIANA	TEXAS	TOTAL	TOTAL	Reconstructed
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	Metric Tons	Metric Tons
1902	2	10	-	-	-	12		
1918	305	-	-	-	14,118	14,423	6.5	6.5
1919								7.0
1920								7.5
1921								7.9
1922								8.4
1923	10,956	-	-	-	8,517	19,473	8.8	8.8
1924								8.2
1925								7.5
1926								6.8
1927	13,467	-	-	-	-	13,467	6.1	6.1
1928	5,857	-	-	-	-	5,857	2.7	2.7
1929	18,815	-	-	-	-	18,815	8.5	8.5
1930	6,172	-	-	-	-	6,172	2.8	2.8
1931	4,446	4	-	-	-	4,450	2.0	2.0
1932	12,170	-	-	-	-	12,170	5.5	5.5
1933								3.2
1934	9,579	-	-	-	-	9,579	4.3	4.3
1935								2.9
1936	3,393	-	-	-	-	3,393	1.5	1.5
1937	6,250	-	-	-	-	6,250	2.8	2.8
1938	353	-	-	-	-	353	0.2	0.2
1939	2,849	-	9,000	-	-	11,849	5.4	5.4
1940	-	-	25,195	-	-	25,195	11.4	11.4
1941								15.0
1942								18.6
1943								22.1
1944								25.7
1945	7,166	-	57,340	-	-	64,506	29.3	29.3
1946								44.4
1947								59.5
1948	(1)	-	68,636	88,110	28,185	184,931	184.9	74.6
1949	24,879	-	44,579	165,914	41,135	276,507	125.4	107.4
1950	1,534	-	69,550	207,755	47,191	326,030	147.9	147.2

Table 3. Historical plants and menhaden landings (Atlantic and gulf menhaden) for the period 1873-1947 obtained from the report '*Menhaden Fishery, 1873-1964'* along with reconstructed gulf menhaden landings. Landings prior to 1918 based on 2.46% of Atlantic menhaden landings. Data not available represented by blanks.

Year	Plants	Fish Received (1000 lbs)	Landings (1000 mt)	Gulf (1000 mt)
1873	62	266459	120.9	2.9
1874	64	330228	149.8	3.6
1875	60	377429	171.2	4.1
1876	64	343342	155.7	3.7
1877	56	393720	178.6	4.3
1878	56	514412	233.3	5.6
1879	60	426833	193.6	4.6
1880	79	520506	236.1	6.1
1881	97	304309	138.0	5.6
1882	97	232248	105.3	5.1
1883	78	411019	186.4	4.7
1884	52	575257	260.9	4.2
1885	50	321074	145.6	3.7
1886	26	189681	86.0	3.2
1887	28	223488	101.4	2.9
1888	24	294391	133.5	4.2
1889	29	372064	168.8	4.8
1890	28	357570	162.2	4.8
1891	27	237943	107.9	4.0
1892	29	149828	68.0	3.5
1893	33	245492	111.4	3.4
1894	44	357352	162.1	3.3
1895	42	309370	140.3	3.3
1896	35	268955	122.0	3.2
1897	41	391483	177.6	3.2
1898	40	363475	164.9	3.4
1899				4.0
1900				4.7
1901	36	609744	276.6	5.9
1902				6.1
1903				6.2
1904				6.4
1905				5.9
1906				5.3
1907				4.7
1908				4.1
1909				4.6
1910				5.1
1911				5.6
1912	48	711435	322.7	6.1
1913				6.6
1914				7.1
1915				7.6
1916				8.1
1917		306146	138.9	8.6

Table 3. (cont.)

Year	Plants	Fish Received (1000 lbs)	Landings (1000 mt)	Gulf (1000 mt)
1918		259292	117.6	6.5
1919		438520	198.9	7.0
1920				7.5
1921	40	691132	313.5	7.9
1922	45	812342	368.5	8.4
1923	50	743895	337.4	8.8
1924	45	344284	156.2	8.2
1925	43	532118	241.4	7.5
1926	41	382781	173.6	6.8
1927	39	392763	178.2	6.1
1928	34	362213	164.3	2.7
1929	37	442443	200.7	8.5
1930	33	409513	185.8	2.8
1931	27	236432	107.2	2.0
1932	24	375479	170.3	5.5
1933	30	357726	162.3	3.2
1934	27	517403	234.7	4.3
1935	27	434386	197.0	2.9
1936	29	516104	234.1	1.5
1937	32	529202	240.0	2.8
1938	32	517530	234.7	0.2
1939	33	574825	260.7	5.4
1940	30	634589	287.8	11.4
1941	29	775087	351.6	15.0
1942	30	482644	218.9	18.6
1943	25	615554	279.2	22.1
1944	27	685980	311.2	25.7
1945	24	759074	344.3	29.3
1946	28	916013	415.5	44.4
1947	31	948156	430.1	59.5

Table 4. Historical landings (metric tons) of gulf menhaden by gear available from NMFS Commercial Landings database, 1962-2010. Percentages are for bait landings relative to total bait landings.

GEAR_NAME	NMFSGEAR	Metric Tons	Fishery	Percentage
PURSE SEINES, MENHADEN	125	22696446.294	Reduction	
ENCIRCLINLING NETS (PURSE)	100	4959664.360	Reduction	
PURSE SEINES, OTHER	145	108117.018	Bait	63.96%
GILL NETS, DRIFT, RUNAROUND	475	39157.710	Bait	23.17%
HAUL SEINES, BEACH	020	7738.883	Bait	4.58%
PURSE SEINES, MACKEREL	120	4821.288	Bait	2.85%
COMBINED GEARS	999	2968.801	Bait	1.76%
ENTANGLING NETS (GILL) UNSPC	400	2224.156	Bait	1.32%
NOT CODED	000	1983.235	Bait	1.17%
CAST NETS	735	1300.160	Bait	0.77%
HAUL SEINES, LONG	030	363.378	Bait	0.21%
LINES HAND, OTHER	610	140.456	Bait	0.08%
TRAMMEL NETS	530	98.378	Bait	0.06%
TRAWL MIDWATER, PAIRED	233	32.355	Bait	0.02%
OTTER TRAWL BOTTOM, FISH	210	23.728	Bait	0.01%
UNKNOWN	015	23.451	Bait	0.01%
OTTER TRAWL BOTTOM, SHRIMP	215	17.376	Bait	0.01%
PURSE SEINES, HERRING	110	4.581	Bait	0.00%
POTS AND TRAPS, FISH	345	2.555	Bait	0.00%
ROD AND REEL	611	2.380	Bait	0.00%
UNKNOWN	445	2.359	Bait	0.00%
LINES LONG SET WITH HOOKS	675	1.576	Bait	0.00%
LINES TROLL, OTHER	660	1.007	Bait	0.00%
GILL NETS, OTHER	425	0.776	Bait	0.00%
LAMPARA & RING NETS, OTHER	175	0.319	Bait	0.00%
UNKNOWN	187	0.187	Bait	0.00%
BY HAND, OTHER	955	0.088	Bait	0.00%
SPEARS	760	0.079	Bait	0.00%
GILL NETS, SINK/ANCHOR, OTHER	430	0.070	Bait	0.00%
POTS AND TRAPS, OTHER	379	0.064	Bait	0.00%
POTS AND TRAPS, CRAB, BLUE	330	0.049	Bait	0.00%
LINES LONG, REEF FISH	676	0.020	Bait	0.00%
REEL, ELECTRIC OR HYDRAULIC	613	0.008	Bait	0.00%

Table 5. Gulf menhaden bait landings (mt) by gear from NOAA Fisheries S&T and ALS data bases, 1950-2009.

	Gear				Total
Year	Purse	Gill	Haul	Other	Bait
1950	0.0	0.0	0.0	0.0	0.0
1951	0.0	0.0	2.9	0.0	2.9
1952	0.0	0.0	3.7	0.0	3.7
1953	0.0	0.0	1.2	0.0	1.2
1954	0.0	0.0	1.1	0.0	1.1
1955	0.0	1.5	9.3	0.0	10.8
1956	0.0	11.2	2.0	1.1	14.4
1957	0.0	2.9	0.5	0.0	3.4
1958	0.0	31.0	9.0	0.0	40.1
1959	0.0	3.7	5.5	0.0	9.2
1960	0.0	2.9	2.4	0.0	5.4
1961	0.0	4.3	5.7	1.5	11.4
1962	0.0	8.9	0.0	0.0	8.9
1963	0.0	0.5	0.0	19.6	20.2
1964	0.0	33.8	0.5	3.9	38.1
1965	0.0	140.3	44.8	10.8	195.9
1966	0.0	190.0	51.4	12.8	254.1
1967	2.3	38.6	13.5	3.4	57.7
1968	41.8	129.3	34.4	1.7	207.2
1969	0.0	83.1	52.4	1.8	137.3
1970	0.5	231.5	42.2	5.6	279.8
1971	2.3	255.6	92.8	15.2	365.9
1972	39.2	97.2	153.4	2.3	292.2
1973	125.4	66.3	253.0	1.1	445.9
1974	54.5	124.6	138.4	1.1	318.6
1975	45.9	48.9	113.0	3.6	211.5
1976	102.2	52.1	173.1	0.1	327.5
1977	98.0	30.1	169.1	0.4	297.6
1978	134.2	32.0	236.9	0.5	403.6
1979	838.7	37.0	849.4	1.7	1726.8

Table 5. (cont.)

	Gear				Total
Year	Purse	Gill	Haul	Other	Bait
1980	502.9	22.9	472.8	0.1	998.7
1981	544.6	21.4	507.0	0.0	1073.0
1982	797.6	40.0	739.1	0.0	1576.7
1983	883.4	36.3	819.5	0.0	1739.2
1984	1167.3	72.7	1077.3	0.0	2317.4
1985	1447.5	359.3	1063.0	0.2	2870.0
1986	251.3	1353.5	70.5	0.1	1675.4
1987	8567.7	2931.3	155.9	5.6	11660.5
1988	8485.8	1594.9	205.5	1.0	10287.2
1989	11226.7	894.3	79.6	0.2	12200.8
1990	9996.4	178.7	2.0	32.5	10209.6
1991	4958.6	91.6	272.4	2.4	5325.0
1992	6503.1	1295.0	57.0	47.3	7902.4
1993	6470.1	836.8	46.6	1954.4	9308.0
1994	7320.8	670.3	0.1	1995.8	9987.1
1995	5828.3	1276.1	0.0	963.7	8068.0
1996	10758.4	1500.2	0.0	11.5	12270.1
1997	10349.4	1559.0	9.6	8.7	11926.8
1998	6505.3	892.0	0.0	5.4	7402.8
1999	7210.4	914.7	0.1	11.5	8136.5
2000	0.0	744.8	0.3	48.0	793.1
2001	1.2	698.9	0.1	59.9	760.1
2002	0.0	439.3	0.2	27.7	467.2
2003	0.0	460.6	0.5	25.6	486.6
2004	0.0	370.8	0.9	45.8	417.5
2005	12.8	214.8	2.9	30.4	260.9
2006	4.7	158.3	0.6	10.1	173.7
2007	1.4	210.8	5.2	33.7	251.0
2008	0.0	119.7	0.1	19.6	139.3
2009	1.0	85.3	2.2	45.5	134.1

Table 6. Recreational harvest (Type A+B1), released alive (Type B2), and total removals (Type A+B1+B2) of gulf menhaden are given in numbers and weights (based on overall mean weight) from the recreational fishery, 1981-2008. Also provided are estimated proportional standard errors (PSE) as a measure of uncertainty for the estimates in numbers.

	Numbers			PSE in Number			Weight (MT)		
Year	A+B1	B2	A+B1+B2	A+B1	B2	A+B1+B2	A+B1	B2	A+B1+B2
1981	107625	222013	329638	46.9	83.8	58.5	12.5	25.7	38.2
1982	427194	38285	465479	45.1	42.4	41.5	49.5	4.4	54.0
1983	0	206558	206558	0.0	71.8	71.8	0.0	24.0	24.0
1984	0	42423	42423	0.0	95.1	95.1	0.0	4.9	4.9
1985	3836666	34189	3870855	99.5	67.3	98.6	445.0	4.0	448.9
1986	1613975	612558	2226533	30.8	34.3	24.2	187.2	71.0	258.2
1987	401893	1398320	1800213	48.8	80.7	63.6	46.6	162.2	208.8
1988	1449709	2760716	4210425	74.8	40.2	36.8	168.1	320.2	488.3
1989	3235928	561651	3797579	73.2	49.0	62.8	375.3	65.1	440.4
1990	890584	275957	1166541	38.5	89.1	36.2	103.3	32.0	135.3
1991	416206	25129	441335	37.4	73.0	35.5	48.3	2.9	51.2
1992	922505	266255	1188760	31.9	73.1	29.7	107.0	30.9	137.9
1993	1218051	247341	1465392	25.4	51.4	22.8	141.3	28.7	170.0
1994	1497193	132517	1629710	37.1	36.0	34.2	173.6	15.4	189.0
1995	456781	29693	486474	30.5	57.2	28.8	53.0	3.4	56.4
1996	643854	59884	703738	38.5	59.3	35.6	74.7	6.9	81.6
1997	144758	26087	170845	41.1	58.1	35.9	16.8	3.0	19.8
1998	245698	163578	409276	40.2	73.6	38.1	28.5	19.0	47.5
1999	144600	299187	443787	39.2	72.7	50.6	16.8	34.7	51.5
2000	758747	1025699	1784446	34.0	35.1	24.8	88.0	119.0	207.0
2001	334856	76810	411666	35.6	56.0	30.8	38.8	8.9	47.7
2002	701425	229464	930889	25.5	41.7	21.8	81.3	26.6	108.0
2003	903383	114501	1017884	33.7	44.7	30.4	104.8	13.3	118.1
2004	393152	158803	551955	27.1	43.9	23.0	45.6	18.4	64.0
2005	370303	43751	414054	40.3	60.6	36.6	42.9	5.1	48.0
2006	363561	110500	474061	39.0	97.4	37.5	42.2	12.8	55.0
2007	176681	77941	254622	43.1	54.0	34.2	20.5	9.0	29.5
2008	217092	22872	239964	31.9	47.5	29.2	25.2	2.7	27.8
2009	347352	178213	525565	52.1	86.2	45.1	40.3	20.7	61.0

Figure 1. Comparison of interpolated commercial catch statistics representing (Atlantic and gulf menhaden combined) from *Historical Reports* (**Table 2**; 1918-2000) with reduction landings statistics maintained at NOAA Fisheries at Beaufort, NC (1946-2000).

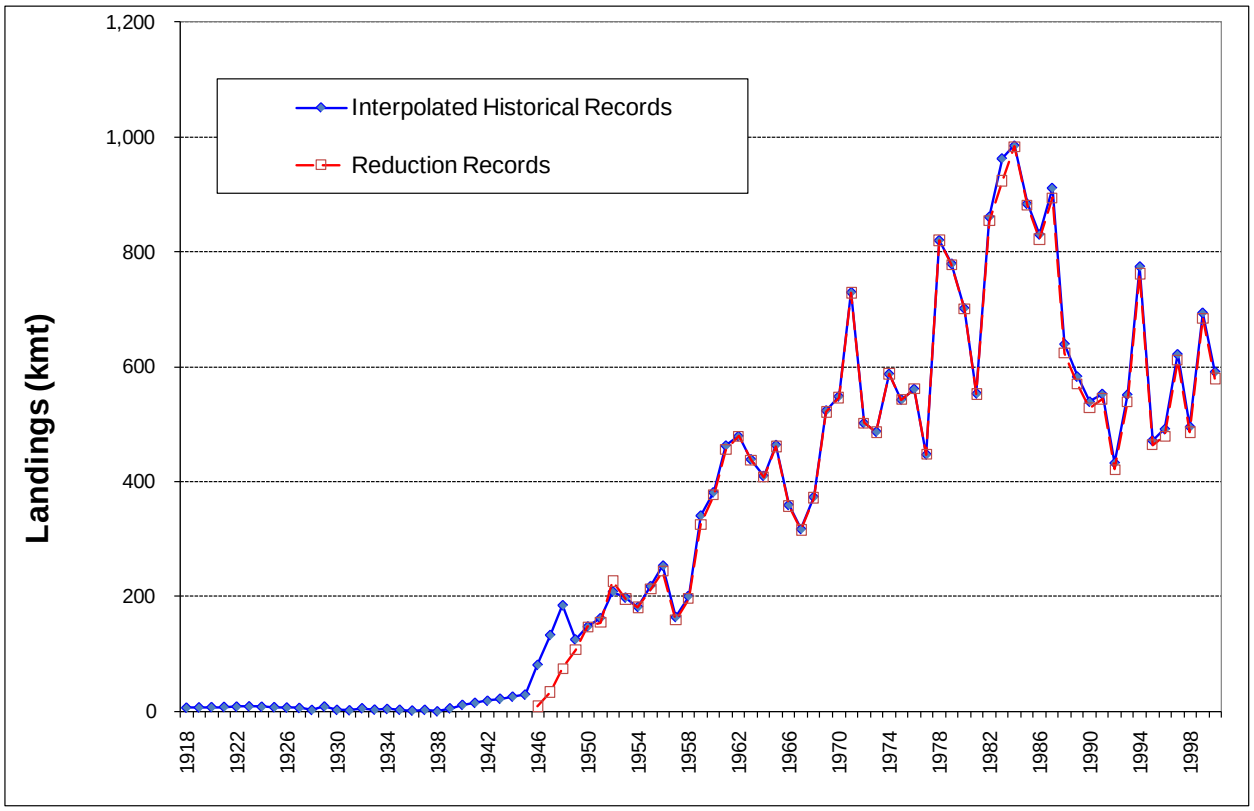

Figure 2. Comparison of reported menhaden landings (Atlantic and gulf menhaden combined) between two sources of historical data, 1873-1947. Reconstructed landings refer to the historical landings available on excel spreadsheets from annual historical reports, and Landings refers to those taken from the report *Menhaden Landings, 1873-1964*. (From ASMFC 2010)

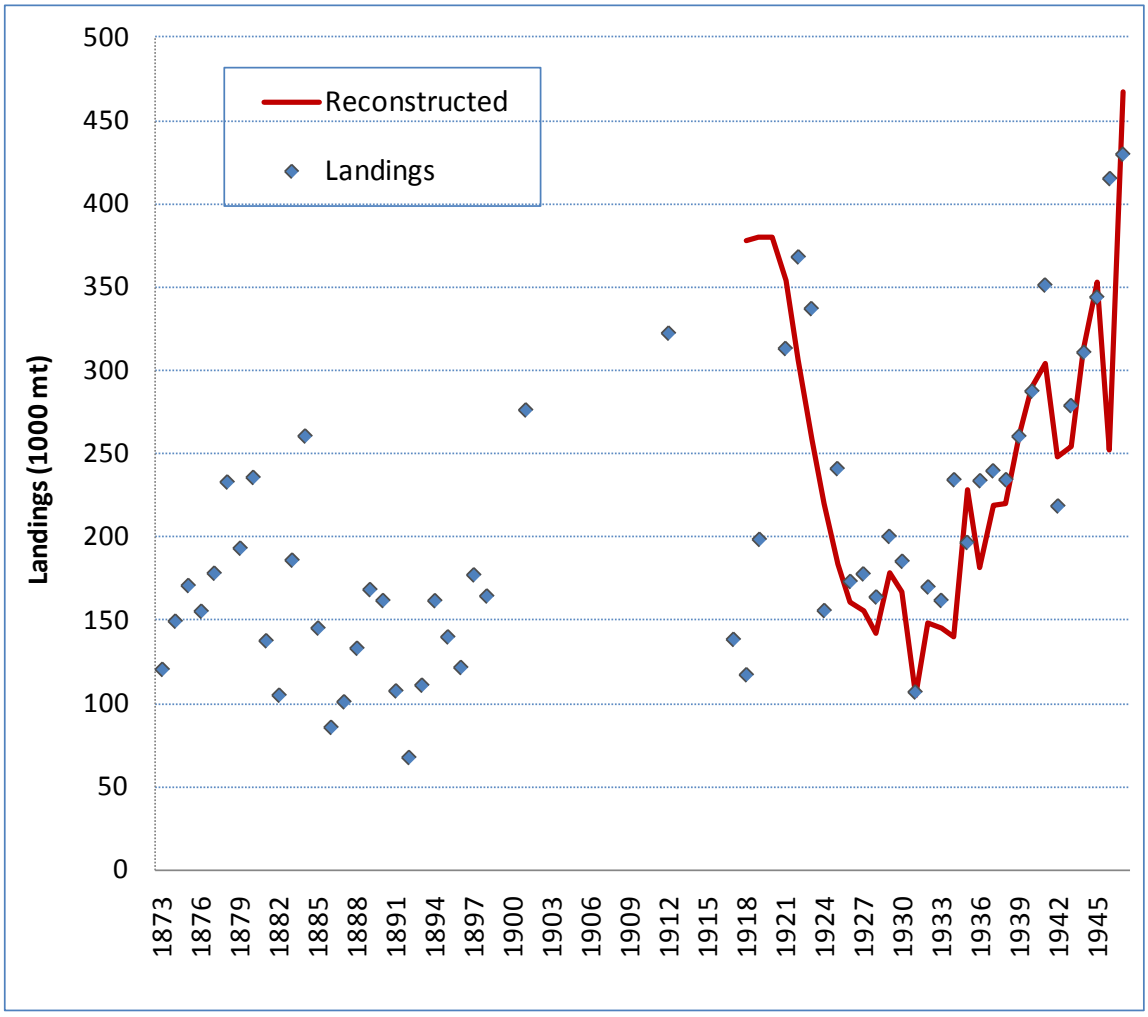

Figure 3. Gulf menhaden landings as reconstructed for 1873-1947, prior to the NMFS Beaufort reduction landings data (complete beginning in 1948).

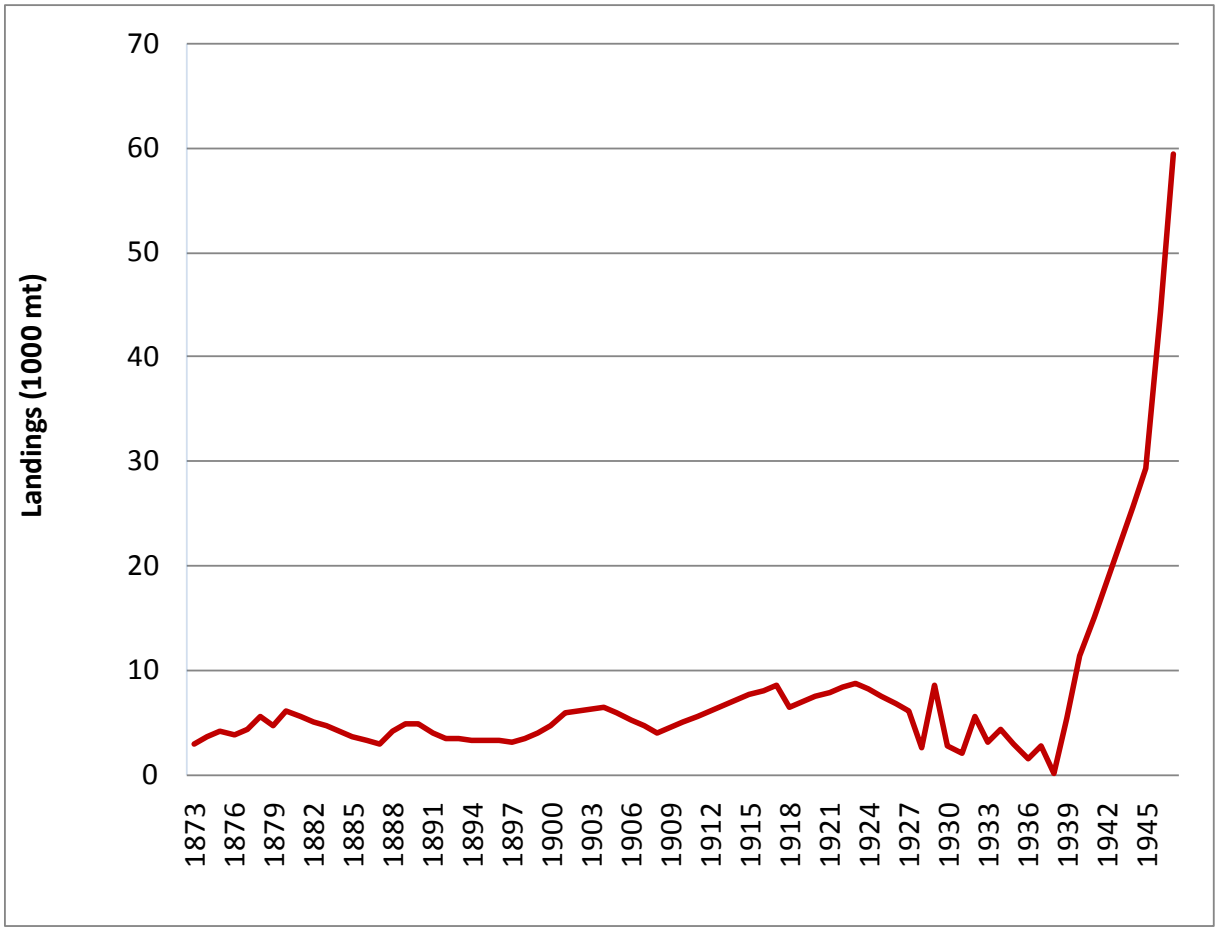

Figure 4. A comparison of gulf menhaden reduction purse-seine landings obtained from the NOAA Fisheries Commercial Landings database (ALS) to purse-seine reduction landings (reduction) maintained by NOAA Fisheries at Beaufort, NC, for 1962-2009. Bait landings obtained from the ALS are scaled on the right axis for 1962-2009.

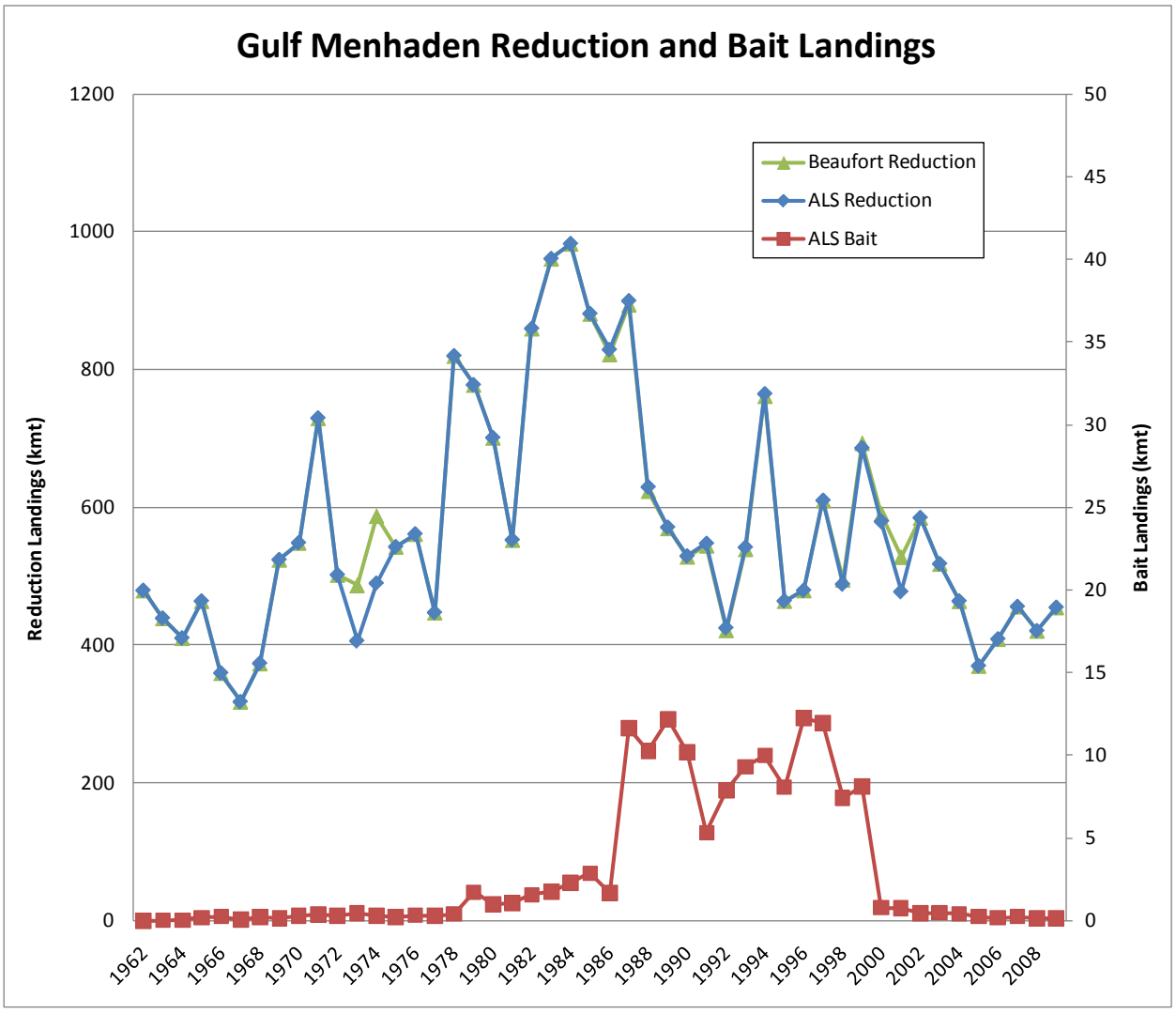

Figure 5. Gulf menhaden bait landings obtained from the NOAA Fisheries Commercial Landings database (ALS), 1950-2010; primarily purse seine, gill nets, haul seines and other gears.

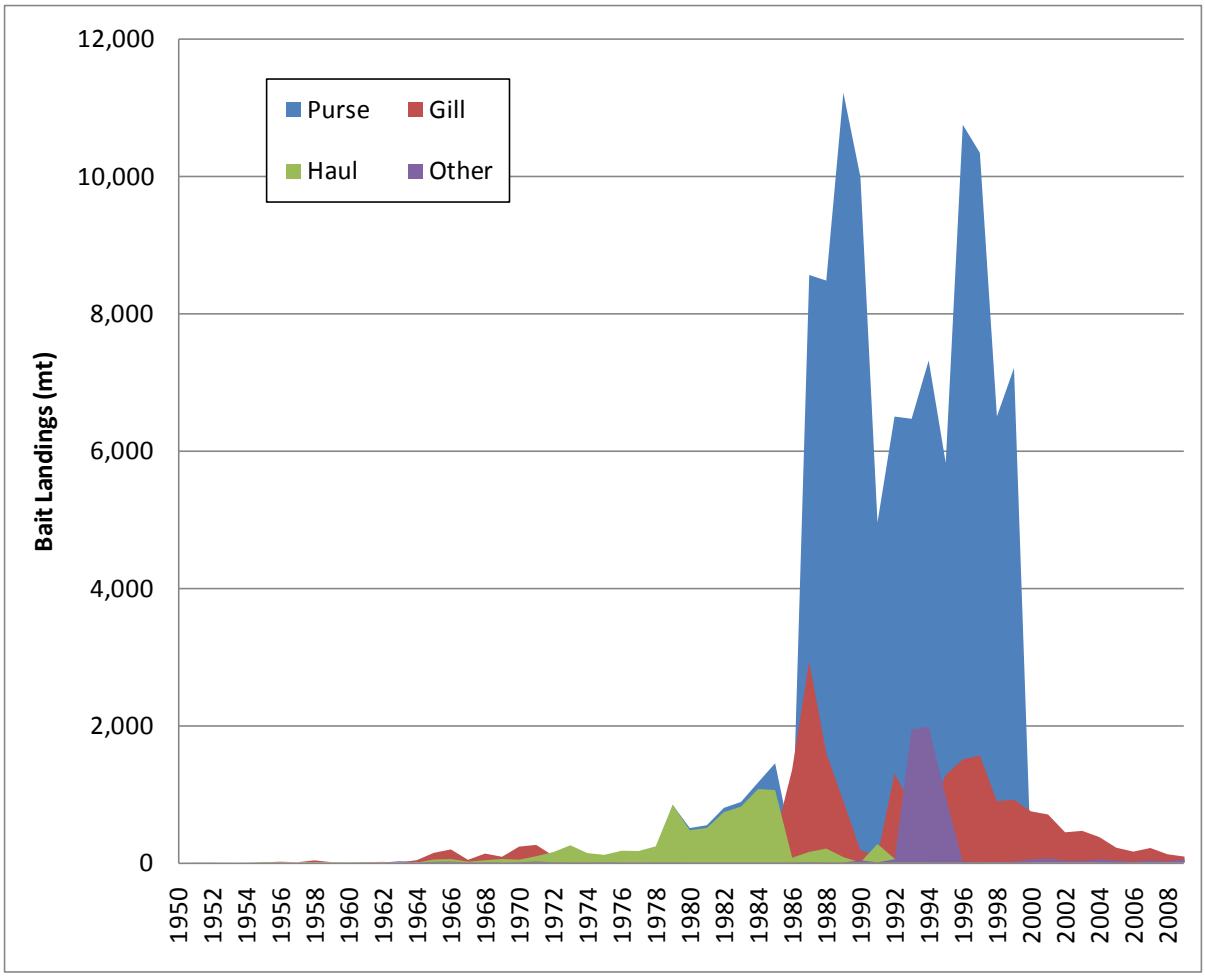

Figure 6. Recreational catch (mt) of gulf menhaden reported from the recreational fishery.

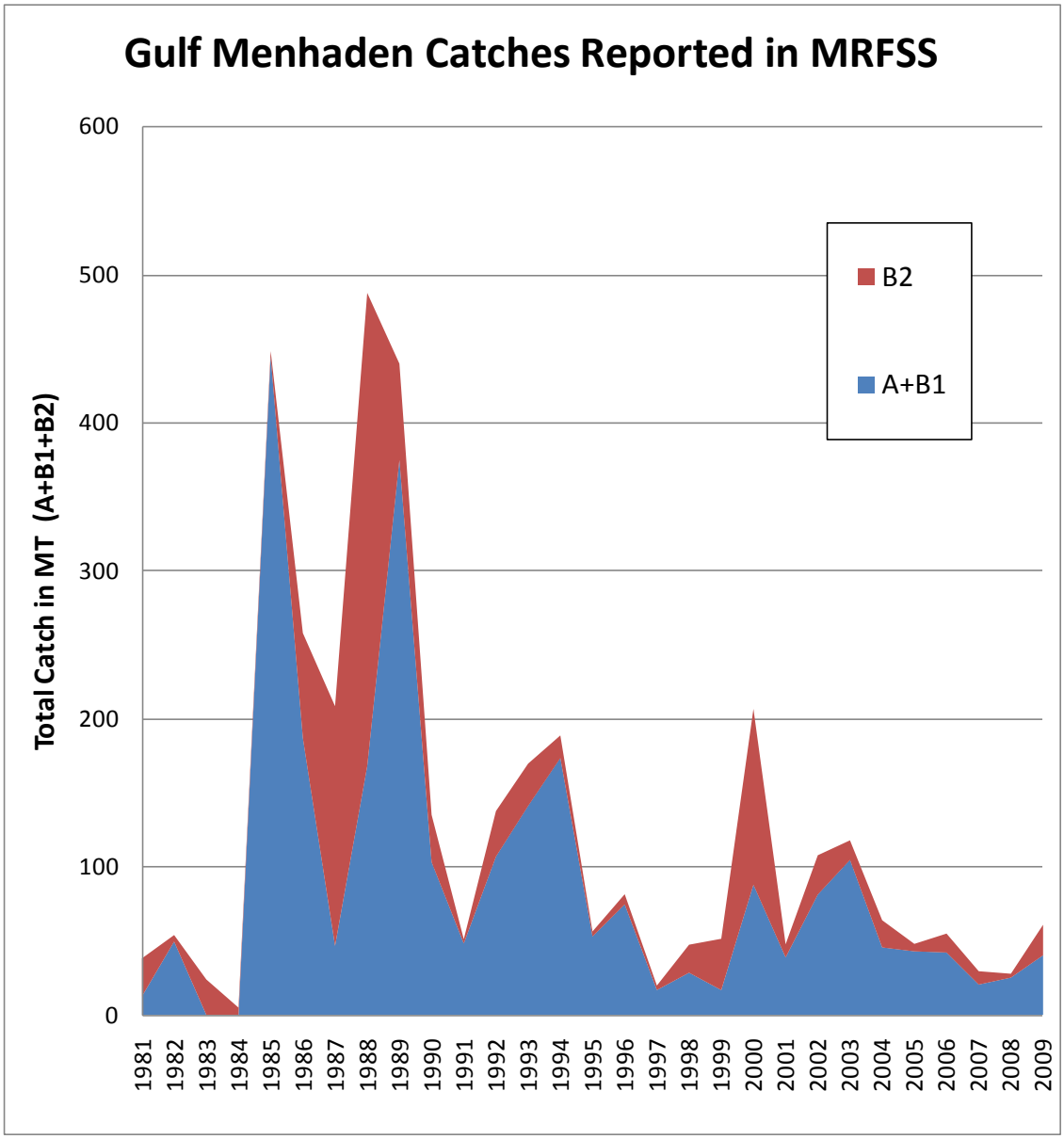

Figure 7. Total gulf menhaden landings along the Gulf of Mexico coast of the U.S., 1873-2010. Reconstructed landings were developed from historical reports for 1873-1947. Reduction landings maintained at NMFS Beaufort are combined with bait and recreational landings for 1948-2010.