

Menhaden Math

The Economic Impact of Atlantic Menhaden on Virginia's Recreational and Commercial Fisheries

Prepared for:

American Sportfishing Association
Coastal Conservation Association
National Coalition for Marine Conservation
Theodore Roosevelt Conservation Partnership

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Executive Summary

Atlantic menhaden are a vital source of food for many fish species, serving as a critical link in the food chain on which a number of highly important commercial and recreational saltwater fisheries, such as striped bass, bluefish and weakfish, depend.

Traditionally, the small, bony menhaden have been an integral part of Virginia's commercial fishing industry, caught and processed into fish meal and oil or used for bait. However, in recent years, menhaden's role in the economy has changed as small community-based fishing operations have been supplanted by larger industrial processors. Today, data from federal and state agencies indicate that the economic value of the menhaden commercial reduction fishery is being eclipsed by an increasingly popular recreational fishery for species that rely on menhaden as a food source.

For more than a decade, fisheries managers have been concerned over menhaden population decline, which has been more than a "blip" on the radar screen. It is borne out by long-term trend data that reveals a consistent decline in the average abundance of young menhaden during the past decade. There are indications that nutritional stress is negatively impacting striped bass populations in the Chesapeake Bay, possibly a result of a weakened menhaden stock.

In response, the Atlantic States Marine Fisheries Commission, the multi-state body that coordinates state management of the stock, capped the harvest in the Chesapeake Bay at current levels for five years until more research can be conducted. Under federal compact, Virginia must adopt this management measure or be found out of compliance by the Secretary of Commerce.

This report, conducted by Southwick Associates and Loftus Consulting, examines the importance of a healthy and well managed menhaden stock to Virginia's commercial and recreational fisheries. Among its findings:

- Nearly 1 million saltwater anglers cast their luck in Virginia waters each year, spending more than \$655 million for marine sportfishing activity.

- The economic value of the menhaden reduction fishery in Virginia is being eclipsed by the recreational fishery for species that rely on menhaden as a food source.
- Of the fish that saltwater anglers most like to catch – the majority depend on menhaden for survival. According to research conducted at the Virginia Institute of Marine Sciences for the Virginia Marine Resources Commission, striped bass, which rely on menhaden as a prime food source, were the sportfish most targeted by saltwater anglers.
- According to data from the Virginia Institute of Marine Science, approximately 30 percent of the economic benefits that marine recreational angling provides to Virginia is due to sportfish dependent on menhaden as a food source.
- Saltwater angling for fish that rely on menhaden as a key part of their diet generates 2,500 full and part-time jobs and \$236 million in overall economic activity.
- Commercial menhaden landings generated approximately \$24 million for the Virginia economy and about 395 full time jobs.



Menhaden Math

Menhaden Population Status

Although the Atlantic menhaden stock is not considered overfished, fisheries managers have been concerned by long-term trend data that reveals a consistent decline in the average abundance of young menhaden during the past decade. There is concern about declines in young fish coming from areas heavily fished by industrial purse seine boats, particularly in the Chesapeake Bay. According to the most recent stock assessment report of the Atlantic States Marine Fisheries Commission, the multi-state body that coordinates state management of menhaden and other fish, the current estimate of recruits to age-0 in 2002 was mediocre (below the 75th percentile), while the current estimate of recruits to age-1 in 2002 (below the 25th percentile). In other words, although there were moderate numbers of fish born, a very small percentage of these survived until age 1. The number of adult fish that produced these young fish was also moderate — below the 75th percentile in terms of historical abundance.ⁱ In addition, there is indication that the nutritional stress that is negatively impacting the striped bass population in the Chesapeake Bay is also the result of a weakened menhaden stock.ⁱⁱ

The Virginia Fisheries

The menhaden fishery constitutes one of the largest commercial fisheries in terms of landings in the United States. The current fishery is composed of a reduction fishery, which uses menhaden in the production of fish oils and other products, and the bait fishery that provides menhaden in other commercial and recreational fisheries. By far, the reduction fishery harvests the majority of fish. Further, the vast majority of menhaden are harvested in two states: Virginia — including Chesapeake Bay — and North Carolina.

Source of Menhaden Catch in the Virginia and North Carolina Fleets, by weight, Averages 1985-1996ⁱⁱⁱ

Chesapeake Bay-Virginia waters	52%
North Carolina coastal waters	17%
Virginia – ocean waters	16%
Other	15%

“Other” = ocean waters of RI, NY, NJ, DE, MD and Delaware Bay.

Reduction Fishery

Virginia’s menhaden reduction fishery is located in Reedville and operated by Omega Protein, the Houston-based company responsible for 90 percent of the industrial catch for reduction on the East Coast.^{iv} In 2004, only 13 vessels participated in the reduction fishery on the Atlantic coast, operating out of Reedville and Beaufort, North Carolina.^v The reduction fishery focuses primarily on age 2+ fish.^{vi} Note that although some menhaden mature at age 2, age-3 fish that are first-time spawners have accounted for most of the stock’s egg production since 1965.^{vii}

From 1985 to 1995, 47 percent of the Atlantic menhaden harvest came from the Chesapeake Bay. From 1996 to 2004, the percentage increased to 58 percent.^{ix}

Although the menhaden reduction fishery’s catch in the Chesapeake Bay recently has averaged approximately 58 percent of the total landings coastwide, landings by weight have declined. Between the period between 1985 and 1999 (when 13 or more vessels fished from the port of Reedville) to the period between 2000 and 2004 (when the reduction fleet was pared to 10 vessels from this port), landings in the Chesapeake Bay by tons has decreased 28 percent.^x

Atlantic menhaden reduction landings (in metric tons) 1985-2004^{viii}

YEAR	LANDINGS
1985	306,665
1986	238,001
1987	326,912
1988	309,293
1989	322,014
1990	401,159
1991	381,413
1992	297,631
1993	320,592
1994	259,988
1995	339,927
1996	292,924
1997	259,140
1998	245,920
1999	171,191
2000	167,253
2001	233,769
2002	174,068
2003	166,097
2004	184,450

Bait Fishery

Unlike the reduction fishery, the menhaden bait fishery exists in many East Coast states, although its annual landings are only a fraction of the overall total. From 1985 to 1997, bait landings averaged 9 percent of these total landings each year. Since 1998, reported bait landings have averaged about 16 percent of the total Atlantic menhaden landings. The

increased percentage is mainly due to better reporting and lower landings in the reduction fishery as fleet size and processing plants declined, and does not necessarily indicate a substantial increase in bait harvest^{xi}. The average landings for baitfish in Virginia alone were 18,000 tons from 1998-2002.^{xii}

Atlantic Menhaden Bait Landings by Region^{xiii}

Year	Region				Total
	New England	Mid-Atlantic: NY through MD	Chesapeake Bay: VA, PRFC, and VA	South Atlantic: NC through FL	
1985	6.15	1.82	16.42	2.27	26.66
1986	13.75	1.31	10.46	2.44	27.96
1987	13.28	1.28	13.49	2.56	30.62
1988	19.73	1.20	12.42	2.88	36.24
1989	9.54	1.52	16.48	3.41	30.95
1990	11.19	4.38	11.05	4.07	30.69
1991	14.47	7.98	10.39	3.38	36.22
1992	12.44	12.73	10.44	3.10	38.72
1993	11.64	13.37	7.63	2.10	34.74
1994	0.43	17.79	6.74	3.17	28.13
1995	3.99	17.19	8.35	1.57	31.11
1996	0.04	16.21	6.49	0.58	23.32
1997	0.04	17.36	6.53	1.66	25.58
1998	1.07	15.17	22.48	1.33	40.06
1999	0.02	12.68	21.94	1.32	35.96
2000	0.15	14.25	19.64	0.93	34.97
2001	0.40	12.17	22.69	1.37	36.63
2002	0.65	11.29	23.72	1.13	36.79
2003	0.12	7.87	24.97	0.79	33.75
2004	0.01	9.53	24.70	0.50	34.74

(x 1,000 metric tons)

Finfish Fisheries Depend on Menhaden

In the Chesapeake Bay and along the entire East Atlantic Coast, menhaden play a significant role in the diets of larger predator fish such as weakfish, bluefish and striped bass. In a study by Kyle Hartman and Dr. Steve Brandt, at the University of Maryland Chesapeake Biological Laboratory, the stomach contents from striped bass, bluefish and weakfish in the Chesapeake Bay were collected and analyzed on a bimonthly basis. Using regression techniques, the live weight or biomass of each of the individual prey species in the stomachs was estimated so that the relative importance of each of them could be determined.^{xiv}

The study found that regardless of season, menhaden constituted an important food source for many recreationally and commercially valuable fish species. These include:

- **Striped Bass:** Menhaden are the most important prey species for striped bass that are two years and older. Seasonally, these fish relied almost completely on menhaden for their diet in November and December. During January and February, this importance dropped only slightly. During the spring and early summer, young spot, older white perch and various marine worms become a larger share of the striped bass diet. Although menhaden constituted a smaller portion of the diets during the mid-late summer months as compared to winter, they still contributed 25 to 50 percent.
- **Weakfish:** Menhaden also are an important part of the weakfish diet, slightly lower in importance than they are to striped bass. Still, age 0 weakfish rely on menhaden for approximately 60 to 90 percent of their diets in July through December; age 1 and 2 weakfish rely on menhaden for 50 to 60 percent during this same time period. During the spring months, menhaden generally constitute less than 15 percent of age 1 and 2 weakfish diets.
- **Bluefish:** Menhaden represent a significant portion of the bluefish diet, constituting nearly 31 percent of the diet of age 0 bluefish after September and October and up to 88 percent of the diets of age 1 and age 2 bluefish. At other times of the year, blue crab, bay anchovy, and

other finfish constituted the major portion of the diets of all ages of bluefish.

Moreover, the timing of the availability of menhaden to these diets for their growth and survival cannot be overemphasized. Menhaden became increasingly important in diets of older and larger predators, particularly in the second half of the year. Much of the growth of striped bass and bluefish occurs during these latter months. According to Hartman and Brandt, "Atlantic menhaden are likely of considerable importance to annual production of striped bass and bluefish because much of the annual growth of these predators occurs when menhaden dominate their diets." In the September to October and November to December sampling periods, menhaden composed over 60 percent of older (age 2+) diets. This is not only important for growth, but also as a nutritional source to prepare striped bass for the winter months and the following spawning season in the spring. Reductions in this important food source during these critical months could have a significant impact on the numbers and availability of economically important finfish such as striped bass, weakfish and bluefish, thus affecting fishing participation.



Menhaden and the Virginia Economy

Traditionally, menhaden have been an integral part of Virginia's commercial fishing industry. However, in recent years, their contribution to the economy has declined and small community-based operations have been supplanted by larger industrial processors. But, more importantly, the economic value of the menhaden reduction fishery is being eclipsed by the recreational fishery for species that rely on menhaden as a food source. And, as outlined below, that trend is continuing.

Recreational Fisheries

Number of Marine Anglers

According to the National Marine Fisheries Service, the federal agency managing saltwater fisheries in federal waters, almost one million marine anglers annually pursue their sport in Virginia waters. In 2004, Virginia hosted 573,000 resident marine anglers and 423,000 non-resident anglers, for a total of 996,000 anglers. In 2004, more than 3.5 million days were fished, nearly four days per angler. Total days of angling were 14 percent higher than in 2003. Since 1998, the number of anglers has increased 58 percent, while the number of days of fishing has increased 21 percent.^{xv,xvi,xvii} Approximately 40 percent of anglers are out-of-state visitors.^{xviii}

Top Recreational Species Dependent on Menhaden

And, of the fish that anglers most like to catch – most depend on menhaden. According to research conducted at the Virginia Institute of Marine Sciences for the Virginia Marine Resources Commission, striped bass, which rely on menhaden as a prime food source, were the sportfish most targeted by saltwater anglers. Bluefish, weakfish and spotted seatrout, all of which rely on menhaden for much of their diet, were also highly prized. The best available data indicates that pursuit of menhaden-dependent sportfish comprised at least 40 percent of all recreational marine fishing trips.^{xix,xx}

Top Species Targeted by Virginia Marine Anglers

1. Any species/no specific species targeted
2. *Striped bass**
3. *Bluefish**
4. Summer flounder
5. *Weakfish / grey trout**
6. Tautog
7. *Speckled or spotted sea trout**
8. Black sea bass
9. Scup
10. Croaker & spot

**Menhaden-dependent species:*

Marine Angling Economics

The most comprehensive picture of the overall economic impact of Virginia's recreational marine fisheries was developed for the Virginia Marine Resources Commission by the Virginia Institute for Marine Science.^{xxi} According to that data, saltwater anglers will spend significant dollars to catch a fish, expending a great deal more than they would to purchase the same fish at retail seafood prices. The study found that in

Expenditures for Marine Angling in Virginia

Travel-Related Expenditures	\$343,120,815
Fishing Tackle & Clothes	\$90,020,895
Boat-Related Expenditures	\$221,980,153
TOTAL	\$655,121,863

2004 anglers spent more than \$655 million for marine sportfishing activities. Approximately one-half of these expenditures were for travel-related items, including fuel, food, lodging, guides and charters.

The most recent data from the Virginia Institute of Marine Science shows that the sportfish most dependent on menhaden as a food source are responsible for approximately 30 percent of the economic benefits that marine recreation angling provides to Virginia. This means that if anglers stopped pursuing menhaden-dependent species, and did not spend their money for other activities, Virginia could lose more than 2,500 jobs and \$138.2 million from the lost salaries, wages and business profits, resulting in a reduction of \$236 million in overall economic activity.

Economic Impacts of Marine Angling in Virginia^{xiii}

	Expenditures	Sales/Output	Income	Employment (full & part time)
All Marine Angling:	\$655,121,863	\$823,739,500	\$478,445,600	9,092
Striped bass:	*	\$168,221,900	\$98,447,100	1,803
Bluefish:	*	\$32,226,400	\$19,017,300	349
Weakfish / grey trout	*	\$24,751,400	\$14,477,700	274
Speckled or spotted seatrout	*	\$10,686,500	\$6,224,800	117
'Menhaden-dependent' fisheries:	*	\$235,886,200	\$138,166,900	2,543
% of All Recreational Fisheries Dependent on Menhaden		28.6%	28.9%	28.0%

**Expenditures for individual species were not listed in the source report. However, the impacts were available.*

Other recent studies reaffirm these findings. An analysis conducted by Southwick Associates for the angling group, Stripers Forever, reviewed participation and expenditure data from the National Marine Fisheries Service. The report found that annual angler expenditures in Virginia for trips targeting striped bass rose from \$63 million in 1994 to \$131.4 million in 2003 – an increase of 109 percent.^{xxiii}

Regional Impacts

Scientists at the Virginia Marine Fisheries Institute also have reviewed the impact of Virginia’s sportfishing by region.^{xxiv} Not unexpectedly, Virginia’s coastal communities, Virginia Beach, Newport News, Accomack, Hampton, Northampton and Norfolk were the greatest beneficiaries.^{xxv}

Commercial Fisheries

Harvests

Compared to sportfishing, data regarding Virginia’s commercial fisheries is limited. Two basic sources exist: the National Marine Fisheries Service for harvest data; and a 2006 study from the Virginia Marine Resources Commission that examines the economic impacts of Virginia’s commercial fisheries, with breakouts for specific fisheries. Due to the low number of vessels operating in the menhaden reduction fishery, specific data for this fishery is difficult to access and assess. Harvest data from the National Marine Fisheries Service is also limited due to confidentiality issues restricting the release of this data.

However, an analysis of the available data does provide some critical benchmarks and trend lines for the fishery. As previously stated, only a handful of boats are responsible for harvesting menhaden for processing in Virginia. And both National Marine Fisheries Service and Virginia Marine Resources Commission figures indicate that since 1985, the average annual landings in the reduction fishery and their economic value to the

Statewide Economic Impacts Generated By Marine Recreational Fishing in Each Region, 2005^{xxvi}

Community	Sales/Economic Activity	Income	Employment
Accomack	\$53,191,000	\$29,971,000	836
Essex	\$7,273,000	\$4,171,000	115
Gloucester	\$38,011,000	\$22,114,000	668
Isle of Wight	\$759,000	\$444,000	13
James City	\$2,710,000	\$1,740,000	33
King George	\$945,000	\$548,000	15
Mathews	\$6,492,000	\$3,869,000	138
Middlesex	\$3,670,000	\$2,058,000	63
Northampton	\$43,349,000	\$26,973,000	699
Northumberland	\$1,086,000	\$647,000	21
Richmond	\$27,000	\$14,000	1
Westmoreland	\$1,114,000	\$596,000	22
York	\$24,410,000	\$13,697,000	402
Chesapeake	\$3,775,000	\$2,220,000	53
Hampton	\$53,275,000	\$30,639,000	757
Newport News	\$70,114,000	\$39,189,000	999
Norfolk	\$37,553,000	\$21,681,000	471
Suffolk	\$6,680,000	\$3,790,000	99
Virginia Beach	\$218,456,000	\$128,563,000	2,856

Estimated Economic Impacts by Region From Recreational Fishing for Species Highly Dependent on Menhaden, 2005

Community	Sales/Economic Activity	Income	Employment
Accomack	\$14,893,480	\$8,391,880	234
Essex	\$2,036,440	\$1,167,880	32
Gloucester	\$10,643,080	\$6,191,920	187
Isle of Wight	\$212,520	\$124,320	4
James City	\$758,800	\$487,200	9
King George	\$264,600	\$153,440	4
Mathews	\$1,817,760	\$1,083,320	39
Middlesex	\$1,027,600	\$576,240	18
Northampton	\$12,137,720	\$7,552,440	196
Northumberland	\$304,080	\$181,160	6
Richmond	\$7,560	\$3,920	0
Westmoreland	\$311,920	\$166,880	6
York	\$6,834,800	\$3,835,160	113
Chesapeake	\$1,057,000	\$621,600	15
Hampton	\$14,917,000	\$8,578,920	212
Newport News	\$19,631,920	\$10,972,920	280
Norfolk	\$10,514,840	\$6,070,680	132
Suffolk	\$1,870,400	\$1,061,200	28
Virginia Beach	\$61,167,680	\$35,997,640	800

state have declined. In 1994, menhaden represented 87 percent of Virginia's total landings by weight, but only 21 percent of the total dockside value.^{xxvii} By 2004, menhaden represented 81 percent of the total landings, but 14 percent of the total dockside value.^{xxviii}

Economic Impact

The expenditures within Virginia's economy resulting from commercial harvests are generated in a different fashion than recreational angling. While recreational expenditures are straight-forward based on angler spending for products and services, expenditures credited to commercial fisheries are created via several steps:

- Commercial harvesters sell their catch, and in turn spend the proceeds, for example, on fuel, wages and supplies.
- Fish houses and processors spend money to process and prepare the product for the final consumer. For many fisheries, this can involve several rounds of "value-added" activities.
- Consumers, whether in restaurants, retail stores or industrial outlets, purchase the product for consumption. For many Virginia-landed fisheries products, the benefit to the state economy ends when the finished or semi-finished product is sold to an out-of-state business or consumer.

Based on the process described above, commercial menhaden landings produce approximately \$24 million for the Virginia economy and about 395 full time jobs. According to its own figures, the reduction fishery in Reedville employs about 260 of these workers. Each level of menhaden harvesting, processing and distribution associated with the reduction fishery stimulates additional economic activity in Virginia, all together totaling \$45 million in 2005.^{xxix,xxx}

Economic Impacts of Commercial Menhaden Landings in Virginia, 2005

Impacts:

Ex-vessel value	\$24,525,000
Total Sales / Output	\$45,297,000
Income	\$26,659,000
Employment (FTEs)	395

** Includes all menhaden landed in Virginia, and not just Chesapeake menhaden. Includes ex-vessel and processing sales and impacts. Excludes landings from "snapper" boats.*

Regional Impacts

The Virginia Institute for Marine Science has data by region on the economic impact of commercial fisheries. However, its figures are not broken out by stock and exclude menhaden. But because Virginia's sole menhaden reduction fishery operates out of Reedville, the majority of the economic benefit of the reduction would reasonably be expected to occur in Northumberland County.

Recreational and Commercial Menhaden-Related Fisheries: Relative Economic Impacts

In 2004, commercial vessels landed \$24.5 million of menhaden in the reduction fishery. Processors and distributors then spent additional dollars to reduce menhaden to its commercial products and generated revenues from the sale of these products. In the same year, anglers spent millions of dollars to pursue the four species highly dependent on menhaden, but the exact dollar figures were not listed in the preliminary report. These dollars were then spent and re-spent by the businesses and their employees who received the funds. These rounds of multiple spending by both the commercial and recreational sectors created economic impacts that benefited all Virginia residents. However, the number of jobs and economic

Estimated Economic Impacts of Industrial Menhaden Landings, Virginia, 2005

	Commercial Menhaden Harvest	Recreationally-Targeted Species Highly Dependent on Menhaden*
Initial Impact	\$24,525,000	n/a
Sales /Output	\$45,297,000	\$235,886,200
Income (payroll + business earnings)	\$26,659,000	\$138,166,900
Employment (FTEs)	395	2,543

* Includes striped bass, seatrout/weakfish and bluefish.

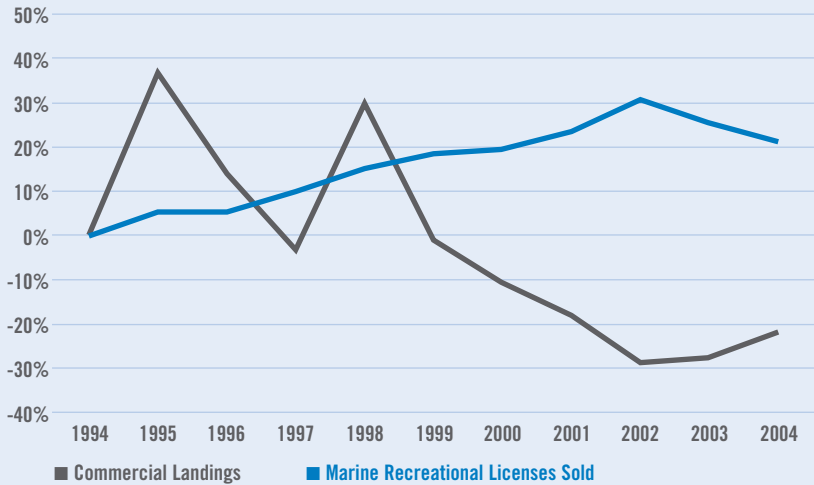
income to the state generated from recreational fishing activities related to species highly dependent on menhaden was significantly higher than the commercial harvesting of the fish.

Future Trends

From 1994 to 2004, the general trends in commercial menhaden harvests and saltwater recreational fishing participation in Virginia have moved in different directions. During that 10 year period, commercial landings have gone downward, decreasing by 20 percent.

However, during that same period of time, recreational activity trended upward. In 2004, 20 percent more marine recreational licenses were sold than in 1994.^{xxxi} Data is not available regarding licenses sold to anglers who specifically target the three stocks highly dependent on menhaden. However, with 40 percent of Virginia’s recreational angling trips targeting fish dependent on menhaden, it is reasonable to assume the upward trend line would be similar.

Figure 1:
Trends in Menhaden-Related Fisheries



Conclusion

Menhaden play an important role in Virginia's marine waters, both ecologically and economically. Sport fisheries dependent on menhaden contribute more than \$235 million in economic activity to Virginia each year, with menhaden's commercial reduction fishery contributing over \$45 million. Both generate jobs, with 2,543 supported from the recreational marine fisheries targeting species dependent on menhaden, and 395 from the industrial menhaden reduction fishery. Each year since 1999, commercial menhaden landings in Virginia have fallen while the number of licensed marine anglers has steadily increased, providing increased economic benefit each subsequent year. In the future, sustaining the maximum economic return of Virginia's menhaden fishery will depend on informed decisions by federal and state management authorities to ensure the fishery is healthy.



Menhaden and Virginia – The “Reel” Numbers

- Virginia resident marine anglers could fill Virginia Tech's Lane Stadium (65,115 seats) over eight times (573,000).
(Source: http://en.wikipedia.org/wiki/Lane_Stadium)
- The total income created by angler expenditures made in pursuit of the four species highly dependent on striped bass (rockfish, bluefish, gray trout and spotted seatrout) is nearly four times greater than the 2006 budget for Virginia's Department of Military Affairs (\$35 million).
(Source: Virginia state budget, <http://dpb.virginia.gov/budget>)
- Resident marine anglers in Virginia (573,000) outnumber Richmond residents (194,000) nearly three to one. (Source: U.S. Census Bureau 2000)
- Virginia's non-resident anglers (423,000) equal over half of the annual number of visitors to Colonial Williamsburg (729,000 in 2004).
(Source: Colonial Williamsburg's online annual report
(<http://www.history.org/Foundation/Annualrpt04/financialresults.cfm>))
- Virginia marine anglers (996,000 anglers) could fill Richmond International Raceway nine times (capacity 107,000). (Source: National Marine Fisheries Service; Raceway data from www.RIR.com)
- Virginia marine anglers, according to the National Marine Fisheries Service, numbered 996,000 in 2004, more people than reside in Virginia's most populous county, Fairfax County (970,000 residents).
(Source: <http://www.shgresources.com/va/almanac/>)
- In 2004, 573,000 state residents fished in Virginia's marine waters, an amount that equals eight percent of the state's population.
(Source: National Marine Fisheries Service, U.S. Census Bureau 2000)

- In 2004, 573,000 state residents fished in Virginia's marine waters, an amount that equals 29 percent of the Virginia residents who voted in the November 2005 state election. (Source: National Marine Fisheries Service, Virginia State Board of Elections)
- Together, commercial and recreational menhaden fisheries support 2,938 jobs in Virginia's economy. If these fisheries were a private company, they would support nearly half as many jobs as employed by Richmond's Carpenter Co., Virginia's sixth largest private company. (Source: Source: Virginia Business Magazine)
- The annual income produced by commercial and recreational menhaden-focused fisheries in Virginia (\$164.8 million) is comparable to the annual income of Advance Auto Parts (\$189.3 million), Virginia's 19th ranked public company. (Source: Virginia Business Magazine)
- The total income generated from commercial and recreational menhaden fisheries for Virginia residents and companies is greater than the U.S. box office receipts for *Harry Potter and the Goblet of Fire*, 2005's second highest grossing movie. (Source: Box Office Mojo (<http://www.boxofficemojo.com/yearly/chart/?yr=2005&p=.htm>))
- If Virginia's resident and non-resident anglers were laid out end-to-end, their length would reach from Virginia Beach to Bristol and back again. (996,000 people @ 5'10" equals 1,100 miles. Va Beach to Bristol = 430 miles per mapquest.com)

End Notes

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- ⁱ ASMFC. 2004. Stock Assessment Report No. 04-01 (Supplement) of the Atlantic States Marine Fisheries Commission. Atlantic Menhaden Stock Assessment Report for Peer Review.
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- ⁱⁱ ASMFC. 2005. Addendum II to Amendment I to the Interstate Fishery Management Plan for Atlantic Menhaden.
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- ⁱⁱⁱ Smith, J.W. 1999. Distribution of Atlantic menhaden, *Brevoortia tyrannus*, purse seine sets and catches from southern New England to North Carolina, 1985-96. NOAA Technical Report NMFS-TR-144. 22 p.
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- ^{iv} ASMFC, 2001. Amendment 1 to the Interstate Fishery Management Plan for Atlantic Menhaden. Fishery Management Report No. 37.
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- ^v ASMFC 2005. 2005 review of the fishery management plan for Atlantic menhaden (*Brevoortia tyrannus*).
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- ^{vi} ASMFC. 2004. Terms of reference & advisory report to Atlantic Menhaden stock assessment peer review. Stock assessment report number 04-01.
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- ^{vii} Vaughan, D.S. and J.W. Smith. 1988. A stock assessment of the Atlantic menhaden, *Brevoortia tyrannus*, fishery. NOAA Technical Report NMFS-TR-63. 18 p.
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- ^{viii} Provided by National Marine Fisheries Service, NOAA Beaufort Laboratory, December 2005.
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- ^{ix} ASMFC. 2005. Addendum II to Amendment I to the Interstate Fishery Management Plan for Atlantic Menhaden.
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- ^x Ibid.
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- ^{xi} Ibid.
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- ^{xii} ASMFC. 2004. Terms of reference & advisory report to Atlantic Menhaden stock assessment peer review. Stock assessment report number 04-01.

^{xiii} Smith, J.W. 1999. Distribution of Atlantic menhaden, *Brevoortia tyrannus*, purse seine sets and catches from southern New England to North Carolina, 1985-96. NOAA Technical Report NMFS-TR-144. 22 p.

^{xiv} Hartman, K.J. and S.B. Brandt. 1995. Trophic resource partitioning, diets, and growth of sympatric estuarine predators. *Transactions of the American Fisheries Society*. 124:520-537.

^{xv} National Marine Fisheries Service, 2005. Fisheries of the United States, 2004. Office of Science and Technology, Fisheries Statistics Division. Silver Spring, MD.

^{xvi} This report relies on existing information to explain the economic contributions from recreational and commercial fisheries dependent on menhaden. Adjustments to data were made when possible to allow better comparisons. In some instances, multiple sources for the same information, such as the number of anglers in Virginia, were located. When this occurred, the sources deemed the most accurate are reported here.

^{xvii} It should be noted that data from the State of Virginia indicates a potentially lower number of marine anglers. Sales of Virginia's marine recreational fishing licenses totaled 126,467 in 2004, a 3.7 percent decrease from 2003, but a 20.8 percent increase over 1994, a trend that basically matches that reported by the National Marine Fisheries Service. However, license sales typically underestimate the actual number of anglers as charter boat customers, youth under 16, seniors over 65, people fishing from their private property, people holding Maryland Chesapeake Bay fishing licenses, and others are exempted from buying a license in Virginia (per a Fishing License Sales Summary provided by the Virginia Department of Game and Inland Fisheries, 2005).

^{xviii} Steinback, Scott and Brad Gentner. 2001. Marine Angler Expenditures in the Northeast Region, 1998. U.S. Department of Commerce, National Marine Fisheries Service. NOAA Technical Memorandum NMFS-S/SPO-47. 72 p.

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- ^{xix} Kirkley, James and David Kerstetter. 1997. Saltwater Angling and its Economic Importance to Virginia. Virginia Institute of Marine Science, College of William and Mary.
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- ^{xx} Spotted seatrout were not included in the analysis by Hartman and Brandt (1995), but spotted seatrout and weakfish share common habitats (Lippson, A.J. and R.L. Lippson. 1984. *Life in the Chesapeake Bay*. Baltimore, Maryland: Johns Hopkins University Press) and food sources where these species overlap (Hildebrand, S.F. and W.C. Schroeder. 1972. *Fishes of the Chesapeake Bay*. Neptune, New Jersey: T.F.H Publications, Inc.) and therefore are included as a species highly dependent on menhaden.
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- ^{xxi} Duberg, John, James E. Kirkley and Thomas Murray. 2006. Economic Contributions of Virginia's Commercial Seafood and Recreational Fishing Industries: A User's Manual for Assessing Economic Impacts. Virginia Institute of Marine Science, College of William and Mary.
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- ^{xxii} This table, derived from Duberg, Kirkley and Murray (2006), presents the economic contributions from all marine angling activities in Virginia plus details for the recreational species highly dependent on menhaden. Please note that the expenditures per species were not listed in the report. Only the impact estimates were available.
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- ^{xxiii} Southwick, Robert I. 2005. The Economics of Recreational and Commercial Striped Bass Fishing. Report prepared for Stripers Forever. 54 p.
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- ^{xxiv} Duberg, John, James E. Kirkley and Thomas Murray. 2006. Economic Contributions of Virginia's Commercial Seafood and Recreational Fishing Industries: A User's Manual for Assessing Economic Impacts. Virginia Institute of Marine Science, College of William and Mary.
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- ^{xxv} Data is not available on the percentage of fishing trips per region that targeted species highly dependent on menhaden, but a general rule of thumb of 28 percent is used to develop rough estimates.

^{xxvi} Duberg, John, James E. Kirkley and Thomas Murray. 2006. Economic Contributions of Virginia's Commercial Seafood and Recreational Fishing Industries: A User's Manual for Assessing Economic Impacts. Virginia Institute of Marine Science, College of William and Mary.

^{xxvii} Kirkley, James. 1997. Virginia's Commercial Fishing Industry: Its Economic Performance and Contributions. Virginia Institute of Marine Science, College of William and Mary.

^{xxviii} Duberg, John, James E. Kirkley and Thomas Murray. 2006. Economic Contributions of Virginia's Commercial Seafood and Recreational Fishing Industries: A User's Manual for Assessing Economic Impacts. Virginia Institute of Marine Science, College of William and Mary.

^{xxix} Derived from the models in Duberg, Kirkley and Murray (2006) and reported by Kirkley (personal communications, 2006).

^{xxx} Impacts from bait menhaden caught by snapper boats are not included, but menhaden products sold as bait or fish attractants by the reduction companies are included. Based on the historic proportion of reduction versus bait landings, it would be reasonable to assume the impacts could be up to nine percent higher if bait landings were included. However, without better data, it is not possible to reasonably add in the additional economic impacts created from bait landings from snapper boats.

^{xxxi} Virginia Department of Game and Inland Fisheries, Fishing License Sales Summary, 2005.

American Sportfishing Association
Coastal Conservation Association
National Coalition for Marine Conservation
Theodore Roosevelt Conservation Partnership

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