

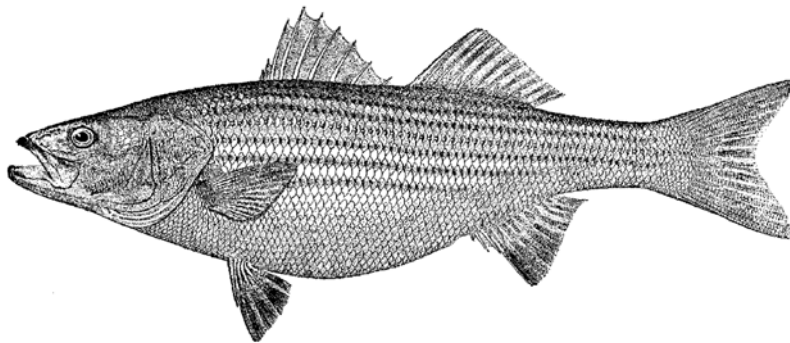
**ATLANTIC STRIPED BASS STUDIES
2003 BIENNIAL REPORT TO CONGRESS**

Submitted to the:

**Committee on Resources of the United States
House of Representatives**

and

**Committee on Congress, Science, and
Transportation of the United States Senate**



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**Striped Bass Studies
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This report is based, in part, on various stock assessment reports of the Striped Bass Technical Committee of the Atlantic States Marine Fisheries Commission. Much of the research and data collection have been conducted by the state fisheries agencies, whose hard work and cooperative efforts are greatly appreciated.

EXECUTIVE SUMMARY

Reauthorization of the Atlantic Striped Bass Conservation Act (ASBCA), in 1997, mandated biennial reports to Congress and to the Atlantic States Marine Fisheries Commission (ASMFC) concerning the progress and findings of continued studies of Atlantic striped bass (*Morone saxatilis*) stocks that extend work of the striped bass study conducted during 1980-1994. These studies include: annual stock assessments, population dynamics studies, investigations of causes of stock fluctuations, effects of environmental factors on recruitment, spawning potential, mortality and abundance, and interactions with other fish.

This report presents the fishery-dependent and fishery-independent data used in the population dynamic studies, describes the analyses conducted by the ASMFC Striped Bass Technical Committee, and provides the results of the most recent stock assessment of the Technical Committee. In addition, this report includes summaries of various research efforts conducted by state and federal fisheries agencies that address continued studies of Atlantic striped bass populations, as required by the ASBCA.

The stock assessment of striped bass is based on information from annual recreational and commercial catches, along with indices of abundance from state and federal sources. The data are used in a population model to determine the number of fish present that can account for the catch and annual fluctuations in the indices. In addition, state and federal agencies participate in a variety of tag and release programs for striped bass. The tag recovery information is used to calculate annual survival rates and annual fishing mortality rates.

The most recent stock assessment conducted in 2003 indicated that striped bass stocks are at high levels of abundance and are supporting increased landings, primarily in the recreational fisheries. Total landings in 2002 were 11,100 metric tons (24.5 million pounds), a 5% decrease from 2001. The largest commercial landings continued to be from the Chesapeake Bay (Maryland and Virginia). New Jersey and Virginia recorded the highest recreational landings although total recreational catch was highest in Massachusetts and Maryland. The number of fish in the population has increased due to moderate fishing mortality and a pattern of consistent production of juvenile fish punctuated by years of high juvenile survival. Estimated abundance of striped bass on January 1, 2003 was 44.8 million fish.

Amendment 6 to the ASMFC Striped Bass Fishery Management Plan was approved by ASMFC in February 2003. The commercial components of Amendment have been implemented in 2003, with the recreational components to be implemented in 2004.

INTRODUCTION

The Atlantic striped bass (*Morone saxatilis*) fishery has gone through significant changes in the last several decades: changes in management measures aimed at conserving the stock, changes in the distribution of catch among users of the stock, and most important, a significant recovery of the stock from low levels of abundance seen during the 1970s and 1980s.

In response to precipitous declines in landings during the 1970s, Congress passed and the President enacted an amendment (P.L. 96-118) to the Anadromous Fish Conservation Act in 1979. The amendment specified that an Emergency Striped Bass Study be undertaken to determine the status of the striped bass stocks and the causes for the decline in the striped bass population. The Emergency Striped Bass Study was conducted each year from 1980 through 1994, and a report was submitted to Congress presenting results of the various research activities that were part of the overall study. The last such report was prepared in 1995 for the 1994 study year.

When Congress reauthorized the Atlantic Striped Bass Conservation Act (ASBCA) (P.L. 98-613) in 1997, it mandated that the Secretaries of Commerce and the Interior provide biennial reports to Congress and the Atlantic States Marine Fisheries Commission (ASMFC) on studies of the Atlantic striped bass resource, including annual stock assessments, population dynamics studies, investigations of causes of fluctuations in the population, effects of environmental factors on recruitment, spawning potential, mortality and abundance, and interactions with other fish. This document constitutes the second such biennial report.

The Technical Committee for the ASMFC Striped Bass Management Board conducts annual assessments of the status of the striped bass populations along the Atlantic coast, from Maine to North Carolina. These assessments are based on fishery-dependent and fishery-independent data collected by the individual states, the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS). These data include catch (including discards) from both the commercial and recreational fisheries, as well as data related to the size and age composition of the catches in these fisheries. Fishery-independent data, obtained through scientific research programs, include indices of juvenile and adult abundance, and the age and size composition of the stock. Also included in the annual assessment are survival estimates determined from tag release and recovery data.

STATUS OF STOCKS

The ASMFC Striped Bass stock assessment sub-committee met in August 2003 to evaluate the status of the striped bass resource and update the previous year's assessment. The assessment includes the Hudson, Delaware, Chesapeake and mixed coastal stocks. The assessment was reviewed and accepted by the ASMFC Striped Bass Technical Committee in October 2003.

Trends in Juvenile Production

Juvenile indices from the Chesapeake Bay (Maryland and Virginia) decreased in 2002 (Figure 1a), although the annual indices have fluctuated without any strong trend since the mid-1990s. Both the Maryland and Virginia indices indicate that strong year classes were produced in 1993, 1996 and 2001. Juvenile indices for the Hudson River stock (Figure 1b) have shown consistent production since the early 1990s with the exception of 2000. The Delaware stock, as indexed by the New Jersey juvenile survey, has shown strong juvenile production throughout the 1990s followed by a declining trend since 1999.

Status of Adult Stocks

Fishery-Independent Indices

The Maryland gillnet survey index of striped bass spawning biomass has remained relatively stable since the early 1990s with the exception of a high value in 1996. The 2002 and preliminary 2003 values were near the median index of the past decade. (Figure 2a). The New York ocean haul seine index peaked during 1996-1998, markedly declined in 1999, but increased in 2000 (Figure 2b). Haul seine indices for 2001 and 2002 were near the median value of the 1987 to 2000 time series. The NMFS Northeast Fisheries Science Center (NEFSC) spring bottom trawl survey index of striped bass abundance (mean number per tow) increased during the mid-1990s and continues to show signs of strong production (Figure 2c). The Rappahannock River, Virginia pound net index provides more information on the Chesapeake Bay striped bass spawning stock. This index has fluctuated without trend since 1991 with peaks in 1999 and 2000. The 2003 estimate was the lowest in the series (Figure 2d). The Connecticut trawl survey

striped bass index increased steadily from 1984 to 1999, declined in 2000 and 2001, (Figure 2e) but has since increased to record high values. The New Jersey trawl index (Figure 2e) peaked in 1996 but has since shown a generally decreasing trend. The Delaware trawl index peaked in 1993 and again in 1999 but decreased to the median values in 2000 and 2001, the last available years in the survey.

The Maryland beach seine index of age-1 fish was a record-high in 2002, supporting the conclusion that juvenile production in 2001 was comparable in magnitude to 1993 (Figure 2f). The Long Island beach seine index of age-1 bass steadily increased throughout the 1990s, and its 2002 value is the highest in the time series (Figure 2f).

Fishery-Dependent Indices

The Massachusetts commercial catch per hour fished has remained stable since 1997 (Figure 3a). Similarly, the Connecticut volunteer angler catch per trip increased through 1996 and has remained stable through 2002 (Figure 3b). The Hudson River index of spawning striped bass (age 8+), derived from bycatch in the shad fishery, increased during the late 1980s and early 1990s and peaked in 1996. During 1997-2001, the index remained near the time series average with the exception of a drop in 2000 (Figure 3c).

Fisheries

Commercial Harvest

Commercial landings in 2002 totaled 654 thousand fish and 6 million pounds (2,723 mt) (Table 1). The landings represented a decrease of 288 thousand fish and 227 thousand pounds compared to 2001 (Table 2). The Chesapeake Region (Maryland, PRFC, and Virginia) accounted for most of the commercial landings, 77% by number (Table 3). Overall, commercial landings represented 26% by number of the total (commercial + recreational) landings in 2002 (Table 2), and 17% by number of the total catch (landings + discards) (Figure 4). The commercial landings were dominated by fish ages 4 to 6 (61% of commercial landings by number).

Recreational Harvest

Recreational statistics were collected as part of the Marine Recreational Fishery Statistics Survey (MRFSS) program. Recreational landings in 2002 were 1.8 million fish totaling 18.5 million pounds (8,409 mt) (Table 1). The landings represented a decrease of 184 thousand fish and 1.1 million pounds from 2001 (Table 2). New Jersey, Virginia, Massachusetts, Maryland and New York accounted for the largest recreational landings in 2002 (Table 3). Overall, recreational landings constituted 74% by number and 76% by weight of the total (commercial + recreational) landings in 2002, and 78% by number of total 2002 catch (landings + discards) (Table 2; Figure 4). Age groups 4 to 8 dominated the recreational landings (69% of landings by number).

Commercial Non-Harvest Mortality

Commercial discards in 2001 and 2002 were estimated using the ratio of commercial to recreational fish tag recovery data, scaled by total recreational discards. Total commercial discards were estimated to be 2.0 million fish in 2001 and 1.0 million fish in 2002 (Table 2). Of these discards, losses due to culling mortality¹ were estimated to be 311 thousand fish in 2001 and 168 thousand fish in 2002. Commercial non-harvest losses in 2001 accounted for 7%, by number, of the total (landings + discard losses: commercial + recreational) 2001 harvest, while losses in 2002 accounted for 4% of the total 2002 harvest (Table 2; Figure 4). Commercial discards were dominated by fish of ages 2 to 6.

Recreational Non-Harvest Mortality

Recreational discards were estimated to be 13.5 million fish in 2001 and 14.0 million fish in 2002 (Table 2). Applying a hooking mortality rate of 8% resulted in estimated losses from hooking mortality of 1.1 million fish in both 2001 and 2002, respectively (Tables 2 and 3). Massachusetts, Maryland, and Maine accounted for most of these losses in 2002 (Table 3). In 2001, recreational discard losses accounted for 25%, by number, of the total annual harvest and

¹ Discard mortality rates used were: 43% for anchor gillnets, 8% for drift gillnets, 8% for hook and line, 35% for otter trawls and 5% for trap and pound nets, and 15% for haul seines.

increased to 30% in 2002 (Table 3, Figure 4). Highest discards occurred on the 1996 year class (age 5 in 2001 and age 6 in 2002).

Total Catch

The total harvest (landings + discard losses: commercial + recreational) of striped bass was 4.3 million fish in 2001 and 3.8 million fish in 2002 (Table 2), similar to the 1995 to 2000 average.

Stock Size Estimates

Population abundance (stock size as of January 1) increased from 4.6 million fish in 1982 to 46.1 million fish in 1997 and subsequently has stabilized at about 45 million fish (Table 4; Figure 5). Population size at the beginning of 2003 was estimated to be 44.8 million fish, with the 2000-2001 year classes (age 2-3) accounting for 57% of the stock. Recruitment of age 1 fish in 2003 (2002 cohort) was estimated to be 3.6 million fish, the lowest since 1987. This follows the 2001 cohort (age 1 in 2002) which was estimated to be 16.9 million fish, the largest in the time series. Estimates of recruitment in the terminal years of the virtual population analysis (VPA) are the least certain and often subject to revision with additional years of information. Abundance of older fish (age 8+) in the stock increased from 200 thousand fish in 1982 to 3.1 million fish in 1998, declined to about 2.9 million fish during 1999 and 2000, but increased to between 3.4 and 3.5 million fish since 2001 (Figure 5).

Fishing Mortality

Average fishing mortality rate (F) for ages 8 through 11 declined from 0.55 to 0.11 between 1982 and 1984, remained relatively stable near 0.18 between 1985 and 1990, then increased to a new stable level near 0.26 between 1991 and 1996. Fishing mortality increased again in 1997 and has since remained around 0.36 (Table 5). F in 2002 was 0.35, equal to an exploitation rate (or harvest rate) of 28%. Fishing mortality on younger striped bass (ages 3 to 8) has varied between 0.18 and 0.25 since 1998. Age specific Fs in 2002 ranged from 0.02 on age 2 to a high of 0.41 (31% harvest rate) on age 9, the 1993 year class.

The average fishing mortality (F) for fish greater than 28 inches determined from the coastal mixed stock tagging programs has decreased over the past several years and was 0.19 in 2002. Producer area (Chesapeake Bay, Delaware Bay and Hudson River) tagging programs have provided average F estimates of 0.27 since 1998.

Spawning Stock Biomass

Female spawning stock biomass (SSB) increased from 1,200 mt (2.6 million pounds) in 1982 to a high of 22,900 mt (50.4 million pounds) in 2001 (Figure 6). The 2002 estimate remained stable at 22,300 mt (49.2 million pounds).

Habitat and Environmental Quality

Several projects have been initiated in recent years to more clearly delineate habitat use by both juvenile and adult striped bass. The FWS's South Atlantic Fisheries Coordination Office, in cooperation with the Atlantic States Marine Fisheries Commission (ASMFC) and NMFS, has initiated analysis of data gathered during the past 16 years of the Southeast Area Monitoring and Assessment Program (SEAMAP) Cooperative Winter Tagging Cruises, to document use of the nearshore Atlantic Ocean by striped bass and other managed species.

The cruise annually captures, tags and releases migratory striped bass from the Hudson, Delaware, Chesapeake Bay and Albemarle-Roanoke stocks while they are present on wintering grounds off southeastern Virginia and northeastern North Carolina. Data collected include depth, temperature, salinity and catch-per-unit-effort. These data have been entered into Geographic Information Systems databases in both FWS and NMFS facilities and are being analyzed to assess the locations of preferred wintering habitats as well as migratory pathways and seasonal habitat use after departure from wintering areas.

Delineation of winter habitat use is critical to assist the U.S. Army Corp of Engineers in assessing the impact of their proposed Dare County Beaches Project (located on the NC Outer Banks) on striped bass. The Corps' project will result in the creation of a seven square mile, twenty feet deep dredge excavation in the midst of striped bass wintering habitat. Before-and-after data are critical to assess the impact of the Corps' activities on striped bass use

of the areas proposed for excavation. Personnel of FWS and NMFS are currently working with the Corps' contractor, Versar, Inc., to ensure that sampling conducted in the area will adequately measure striped bass and other species' habitat use, as well as food habits, since prey habitat requirements are also of concern. Identification of migratory pathways and habitat use during other periods of the year is also critical for assessing the potential impact of other proposed projects on the migratory stocks of striped bass. Striped bass tagged during the cruise have been recaptured as far north as Nova Scotia.

The FWS is also undertaking baseline fishery resource surveys of National Wildlife Refuges to determine use by juvenile striped bass and their prey species. The first such survey, for Alligator River National Wildlife Refuge in northeastern NC, was completed in January 2002, and the data are presently being further analyzed. An initial draft report is presently undergoing extensive revision. Personnel of the U.S. Geological Survey, Biological Resources Division, North Carolina Cooperative Fish and Wildlife Research Unit, are currently studying the impact of striped bass predation upon juvenile river herring and shad, in Albemarle Sound, and that work will further elucidate habitat relationships between the species and its prey.

Personnel of both FWS and NMFS are working with the ASMFC to produce a Diadromous Species Habitat Source Document. This report will document habitat requirements for striped bass and other east coast diadromous species under Commission management. A draft document should be available by December 31, 2003.

STATUS OF MANAGEMENT

Atlantic striped bass management is based on the Atlantic Striped Bass Fishery Management Plan (FMP) of the ASMFC. The 14 coastal jurisdictions (12 States from Maine through North Carolina, Washington D.C. and the Potomac River Fisheries Commission), NMFS and FWS have principal management responsibility under this FMP. The ASMFC Striped Bass FMP, first adopted in 1981, has undergone six Amendments through 2003. The initial FMP and its first four Amendments provided a series of management measures that lead to the rebuilding of the Atlantic striped bass stocks. Amendment 4, implemented in 1989, addressed the reopening of the fishery during the initial period of stock recovery. As the status of the stock continued to improve, the adaptive strategy of the Amendment 4 allowed revisions

to management measures addressing the changing circumstances. This resulted in adoption of six successive Addendums to Amendment # 4, during 1989-1994, and the declaration of recovery, as of January 1, 1995.

Amendment 5 established the management program for the recovered striped bass stock. The management program for the commercial and recreational fisheries was based on maintaining a target fishing mortality without exceeding it. The recreational fishery was regulated with creel and size limits, while the commercial fishery was regulated with annual quota. Since 1995, the Commission adopted five addenda to respond to changing circumstances in the fishery. Management under Amendment 5, and its several addenda, became cumbersome due to the large range of management programs implemented by the states and jurisdictions. Additionally, there were concerns that the Amendment did not include enough safeguards to prevent exceeding the fishing mortality targets. To address complexity of striped bass management, as well as several other concerns, the Commission began development of the next amendment for striped bass.

In February 2003, the Commission adopted Amendment 6 to the Interstate Fishery Management Plan for Striped Bass, replacing all previous amendments and addenda. The goal of Amendment 6 is:

"To perpetuate, through cooperative interstate fishery management, migratory stocks of striped bass; to allow a commercial and recreational fisheries consistent with the long-term maintenance of a broad age structure, a self-sustaining spawning stock; and also to provide for the restoration and maintenance of their essential habitat" (ASMFC 2003).

In support of this goal, Amendment 6 adopts the following objectives: prevent overfishing; maintain the spawning stock biomass at or above the target level, provide consistent measures throughout the species' range while allowing the flexibility to implement alternative strategies; foster quality and economically viable fisheries; maximize the cost effectiveness of current information gathering and prioritize state obligations to minimize costs of monitoring and management; adopt a long-term management regime; and establish a fishing mortality target that increases older striped bass (age 15 and older) in the population.

Amendment 6 introduces the control rule as a tool to determine the status of the striped bass population, establishing target and threshold values for fishing mortality rate and for female spawning stock biomass. The threshold F is the fishing mortality rate that allows for maximum sustainable yield (F_{msy}), currently estimated to be $F=0.41$. The target fishing mortality ($F=0.30$) provides a higher long-term yield from the fishery and adequate protection to ensure that the striped bass population is not reduced to a level where the spawning potential is adversely affected. The threshold female spawning stock biomass, 30.9 million pounds (14,000 mt), is slightly greater than the female spawning stock biomass at the time the population was declared restored in 1995 (30.7 million pounds). The target female spawning stock biomass is set at 125% of the spawning stock biomass threshold (38.6 million pounds, 17,500 mt).

Amendment 6 Control Rule

	FISHING MORTALITY RATE	FEMALE SPAWNING STOCK BIOMASS
TARGET	F = 0.30*	38.6 million pounds
THRESHOLD	F = 0.41	30.9 million pounds

**The target fishing mortality rate for the Chesapeake Bay and Albemarle-Roanoke stock is $F=0.27$*

The management programs for the recreational and commercial fisheries are based on maintaining the control rule. In general, the recreational fisheries are constrained by a two fish creel limit and a 28-inch minimum size limit. Commercial fisheries are still regulated with an annual quota, but the quota allocated to each jurisdiction has been restored to its average landings during the 1972-1979 base period. The management programs for the Chesapeake Bay and Albemarle Sound fisheries were granted the flexibility to implement a commercial and recreational management program that utilizes a size limit no smaller than 18 inches and does not exceed a target fishing mortality of 0.27. Amendment 6 continues to permit conservation equivalency, allowing states to propose different size and bag limits as long as the overall management regime achieves the target F . States are also required to carry out specific fishery-dependent and fishery-independent monitoring programs. Prior to Amendment 6, the Commission has recommended the continued prohibition on the harvest of striped bass in the Exclusive Economic Zone (EEZ). Due to the population growth over the last several years,

Amendment 6 recommends the Secretary of Commerce consider the reopening of the EEZ to the harvest of striped bass under regulations consistent and complementary to the interstate management program. NMFS has initiated the public process to determine whether such a reopening is appropriate, and to evaluate possible management alternatives.

While Amendment 6 was approved in February of 2003, only the commercial management measures have been implemented to date. The Amendment 6 recreational management measures will be implemented as of January 1st, 2004. More specific information on the objectives, management programs, implementation, and compliance measures for this amendment is provided in the ASMFC Amendment 6 document (ASMFC 2003). Additional information regarding recent striped bass management may be found in “2002 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Atlantic Striped Bass (*Morone saxatilis*)”.

SUMMARY AND CONCLUSIONS

The results of the most recent (2003) striped bass stock assessment indicate that stock abundance is very high and that fishing mortality in 2002 ($F=0.35$) is slightly above the target fishing mortality ($F=0.31$) but below the fishing mortality threshold ($F=0.41$). Abundance increased steadily between 1982 and 1997 and the adult stock size (ages 8-13) during 2001-2003 was the highest in the last two decades (Figure 7). The appearance of strong cohorts, such as 1993, 1996 and 2001-2002 year classes have contributed to the high biomass levels.

Overall, the Atlantic stocks of striped bass appear to be abundant in number, capable of producing strong incoming year classes and are being fished at levels within the bounds of the current Fishery Management Plan.

All management partners, NMFS, FWS, ASMFC, and the States, will continue to work together through monitoring of the different segments of the populations, continuing research studies to understand how environmental conditions affect stocks, and use of adaptive management measures to ensure Atlantic striped bass populations continue to maintain optimal levels. Through these partnerships and shared responsibilities, the Atlantic striped bass resource will continue to be a widely recognized fishery management success, and will serve as a model for future management of interjurisdictional resources.

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Table 1. Atlantic Coast landings of striped bass in metric tons and numbers from 1981 to 2002 (recreational information not available prior to 1981).

Year	<u>Commercial</u>		<u>Recreational</u>		<u>Total</u>	
	MT	N	MT	N	MT	N
1981	1,744		524		2,268	
1982	992	428,630	1,144	217,256	2,136	645,886
1983	639	357,541	1,217	299,444	1,856	656,985
1984	1,104	870,871	579	114,463	1,683	985,334
1985	4,312	174,621	372	133,522	4,684	308,143
1986	68	17,681	501	114,623	569	132,304
1987	63	13,552	388	43,755	451	57,307
1988	117	33,310	570	86,725	687	120,035
1989	91	7,402	332	37,562	423	44,964
1990	313	115,636	1,010	163,242	1,323	278,878
1991	460	153,798	1,653	262,469	2,113	416,267
1992	638	230,714	1,830	300,180	2,468	530,894
1993	777	312,860	2,564	428,719	3,341	741,579
1994	805	307,443	3,084	565,167	3,889	872,610
1995	1,555	534,914	5,675	1,089,183	7,230	1,624,097
1996	2,178	766,518	6,003	1,175,112	8,181	1,941,630
1997	2,679	1,058,181	7,267	1,515,296	9,946	2,573,477
1998	2,936	1,223,828	5,771	1,366,353	8,707	2,590,181
1999	2,941	1,103,812	6,245	1,319,794	9,186	2,423,606
2000	3,003	1,057,712	7,756	1,924,001	10,759	2,981,713
2001	2,826	941,733	8,889	2,012,314	11,715	2,954,047
2002	2,723	654,032	8,409	21,828,367	11,132	2,482,429

Table 2. Total striped bass discard and harvest in numbers and % of total by fishery component, 2001 and 2002.

2002				
Fishery Component	Discard	Discard Losses	Landings	Total Catch
Recreational	13,981,720	1,118,538 (29.7%)	1,828,367 (48.5%)	2,946,905 (78.2%)
Commercial	1,084,765	168,201 (4.5%)	654,062 (17.3%)	822,263 (21.8%)
Research			1,317 (0.1%)	1,317 (0.1%)
Total	15,066,485	1,286,739 (34.1%)	2,483,746 (65.9%)	3,770,485 (100.0%)
2001				
Fishery Component	Discard	Discard Losses	Landings	Total Catch
Recreational	13,456,350	1,076,508 (24.8%)	2,012,314 (46.3%)	3,088,822 (71.1%)
Commercial	2,023,439	310,900 (7.2%)	941,733 (21.7%)	1,252,633 (28.8%)
Research			2,343 (0.1%)	2,343 (0.1%)
Total	15,479,789	1,387,408 (31.9%)	2,956,390 (68.1%)	4,343,798 (100.0%)

Table 3. Commercial landings, recreational landings and recreational discard losses and total (excluding commercial discards) in number (000s of fish) for 2001 and 2002, by state.

States	Commercial Landings 2001	Commercial Landings 2002	Recreational Landings 2001	Recreational Landings 2002	Recreational Discards 2001	Recreational Discards 2002	Totals 2001	Totals 2002
Maine	0	0	59.9	71.9	69.6	111.4	129.5	183.3
New Hampshire	0	0	15.3	12.9	13.1	19	28.4	26
Massachusetts	40.3	44.9	288	309.6	432.9	457.5	761.2	812
Rhode Island	10.9	11.7	80.1	78.1	30.2	42.5	121.2	132.3
Connecticut			53.4	51.6	88.6	76.3	142	127.9
New York	58.3	47.1	189.7	200.5	65.1	48.2	313.1	295.8
New Jersey			560.2	436.5	77.3	58.6	637.5	495.1
Delaware	34.3	30.4	41.2	32.1	14.8	9.1	90.3	71.6
Maryland	538.8	296.6	382.6	284.1	231.2	234.3	1152.6	815
Potomac River Fisheries Commission	87.8	80.3	*	*	*	*	*	*
Virginia	148.3	127.2	301.8	319.2	49.7	56.5	499.8	502.9
North Carolina	22.9	15.8	40	32.5	4	5.1	66.9	53.4
Total	941.7	645.1	2012.3	1828.4	1076.5	1118.5	4030.5	3601

Table 4. Estimated population abundance, thousands at ages 1 to13, 1982-2003. Total in millions of fish.

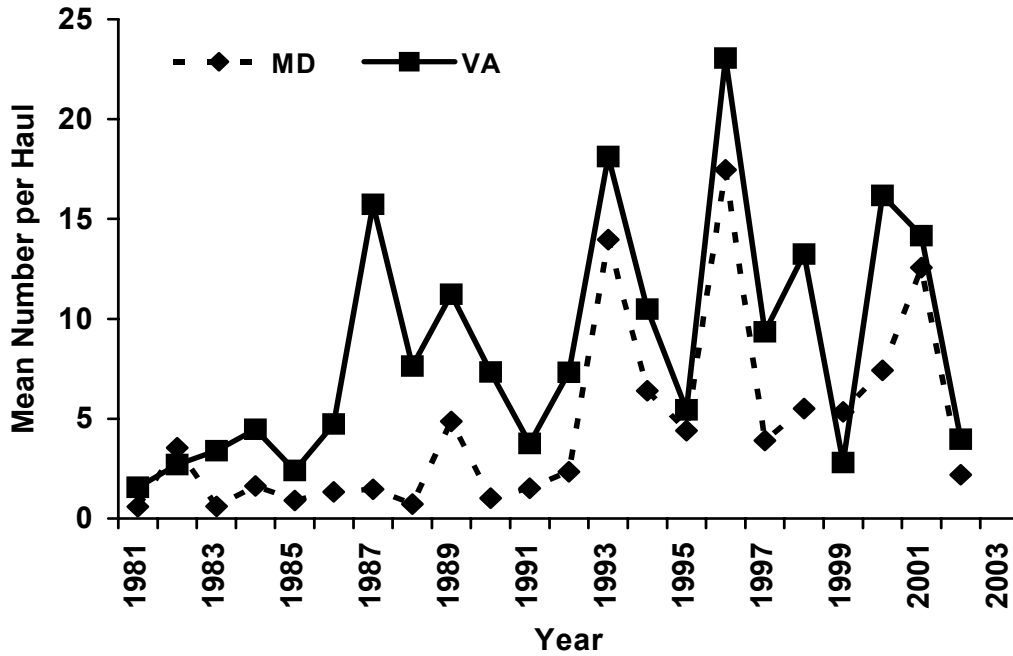
AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	1445	2915	2243	3300	2633	3481	4634	5137	7573	7125	7612	8412	13083	10957	10792	10668	8231	9590	6186	15061	16929	3607
2	927	1242	2506	1925	2839	2256	2995	3986	4421	6517	6131	6549	7240	11255	9428	9288	9180	7060	8246	5289	12931	14547
3	856	700	967	1655	1590	2424	1932	2549	3397	3762	5541	5235	5572	6097	9292	8028	7730	7731	5969	6797	4402	10932
4	740	500	438	553	1330	1309	2052	1624	2120	2809	3103	4584	4334	4473	4822	7405	6460	6204	6253	4749	5451	3506
5	245	433	253	301	439	1022	1079	1707	1335	1651	2224	2496	3643	3461	3436	3563	5587	4906	4732	4467	3527	4263
6	114	157	235	162	205	332	817	830	1373	988	1271	1750	1881	2795	2617	2463	2497	3769	3620	3129	3077	2509
7	85	81	99	154	99	146	262	613	626	1028	757	993	1335	1404	1970	1829	1572	1677	2584	2394	2050	1964
8	41	51	52	68	93	67	114	188	485	443	801	594	774	1024	1019	1293	1200	1094	1133	1543	1528	1289
9	27	20	40	41	43	58	51	75	142	355	304	626	449	586	705	685	769	788	732	687	885	987
10	22	13	14	33	29	28	44	31	55	104	251	208	463	294	364	477	404	463	500	482	402	507
11	44	9	8	10	25	20	21	32	23	41	67	175	109	323	171	251	299	243	271	299	304	247
12	31	28	4	6	8	18	16	15	25	15	22	49	112	60	230	109	161	170	119	178	163	181
13+	35	67	143	77	50	118	46	67	97	123	86	92	74	55	106	90	233	172	126	172	209	218
Total 8 - 13+ (KK)	0.2	0.2	0.3	0.2	0.2	0.3	0.3	0.4	0.8	1.1	1.5	1.7	2	2.3	2.6	2.9	3.1	2.9	2.9	3.4	3.5	3.4
Total (KK)	4.6	6.2	7	8.3	9.4	11.3	14.1	16.9	21.7	25	28.2	31.8	39.1	42.8	45	46.1	44.3	43.9	40.5	45.2	51.9	44.8

Table 5. Fishing mortality at age and average across ages, 1982-2002.

AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0
2	0.13	0.1	0.26	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.04	0.01	0.03	0.02	0.02	0.04	0.03	0.02
3	0.39	0.32	0.41	0.07	0.04	0.02	0.02	0.03	0.04	0.04	0.04	0.04	0.07	0.08	0.08	0.07	0.07	0.06	0.08	0.07	0.08
4	0.39	0.53	0.23	0.08	0.11	0.04	0.03	0.05	0.1	0.08	0.07	0.08	0.07	0.11	0.15	0.13	0.13	0.12	0.19	0.15	0.1
5	0.3	0.46	0.3	0.24	0.13	0.07	0.11	0.07	0.15	0.11	0.09	0.13	0.11	0.13	0.18	0.21	0.24	0.15	0.26	0.22	0.19
6	0.2	0.31	0.27	0.34	0.18	0.08	0.14	0.13	0.14	0.12	0.1	0.12	0.14	0.2	0.21	0.3	0.25	0.23	0.26	0.27	0.3
7	0.36	0.29	0.22	0.36	0.25	0.1	0.18	0.08	0.2	0.1	0.09	0.1	0.12	0.17	0.27	0.27	0.21	0.24	0.37	0.3	0.31
8	0.58	0.09	0.1	0.32	0.33	0.11	0.26	0.13	0.16	0.22	0.1	0.13	0.13	0.22	0.25	0.37	0.27	0.25	0.35	0.41	0.29
9	0.61	0.17	0.06	0.19	0.26	0.13	0.35	0.16	0.17	0.2	0.23	0.15	0.27	0.33	0.24	0.38	0.36	0.31	0.27	0.39	0.41
10	0.71	0.37	0.17	0.12	0.22	0.12	0.15	0.14	0.15	0.29	0.21	0.5	0.21	0.39	0.22	0.32	0.36	0.39	0.36	0.31	0.33
11	0.31	0.74	0.1	0.11	0.16	0.08	0.21	0.11	0.27	0.47	0.16	0.29	0.44	0.19	0.31	0.29	0.42	0.56	0.27	0.46	0.37
12	0.65	0.25	0.09	0.16	0.25	0.13	0.25	0.15	0.17	0.22	0.22	0.23	0.24	0.35	0.23	0.35	0.36	0.33	0.31	0.35	0.38
13+	0.65	0.25	0.09	0.16	0.25	0.13	0.25	0.15	0.17	0.22	0.22	0.23	0.24	0.35	0.23	0.35	0.36	0.33	0.31	0.35	0.38
Ages 8,11	0.55	0.34	0.11	0.18	0.24	0.11	0.24	0.14	0.19	0.29	0.18	0.27	0.26	0.28	0.25	0.34	0.35	0.38	0.31	0.39	0.35
Ages 3,8	0.37	0.33	0.25	0.23	0.17	0.07	0.13	0.08	0.13	0.11	0.08	0.1	0.11	0.15	0.19	0.22	0.19	0.18	0.25	0.24	0.21

Figure 1. Striped bass juvenile abundance indices.

a. Young of year (YOY) indices for the Chesapeake stock, Maryland and Virginia surveys, 1981 to 2002.



b. Young of year (YOY) indices for the Hudson (NY) and Delaware Bay (NJ) stocks, 1981 to 2002.

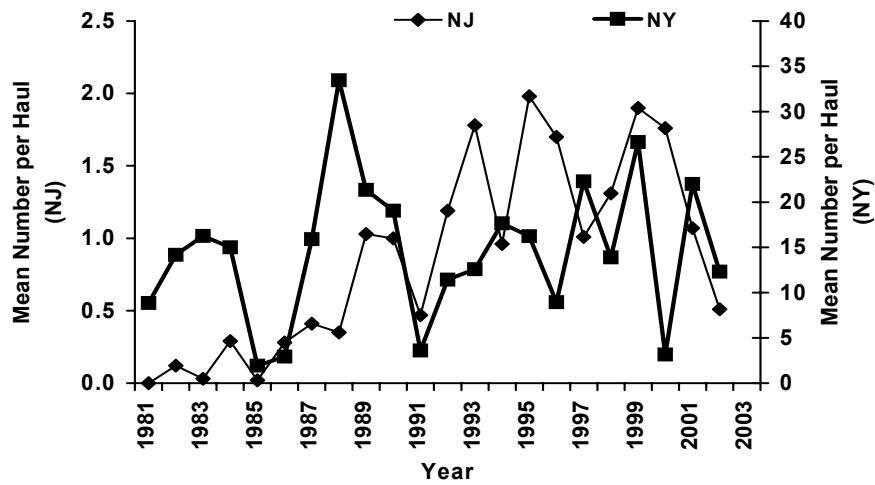
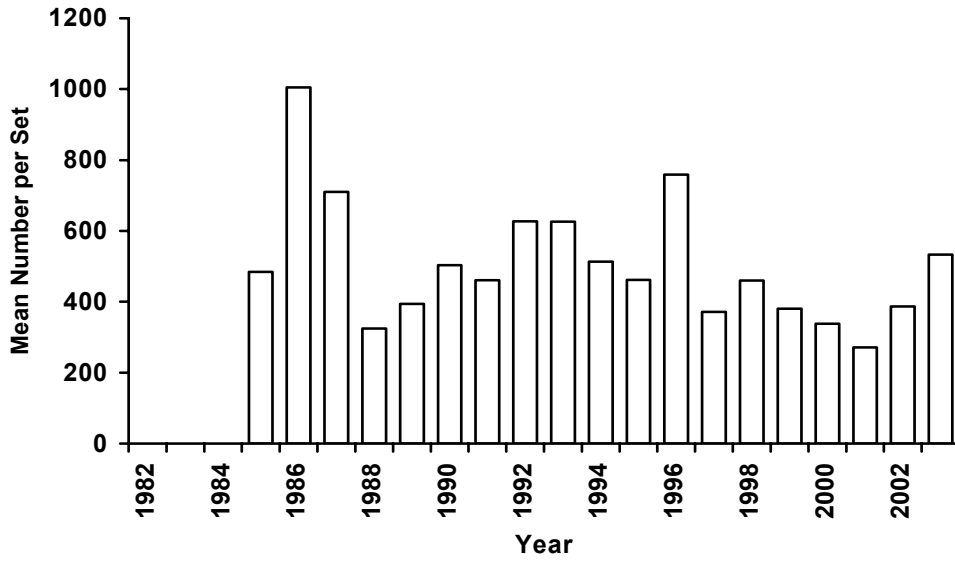
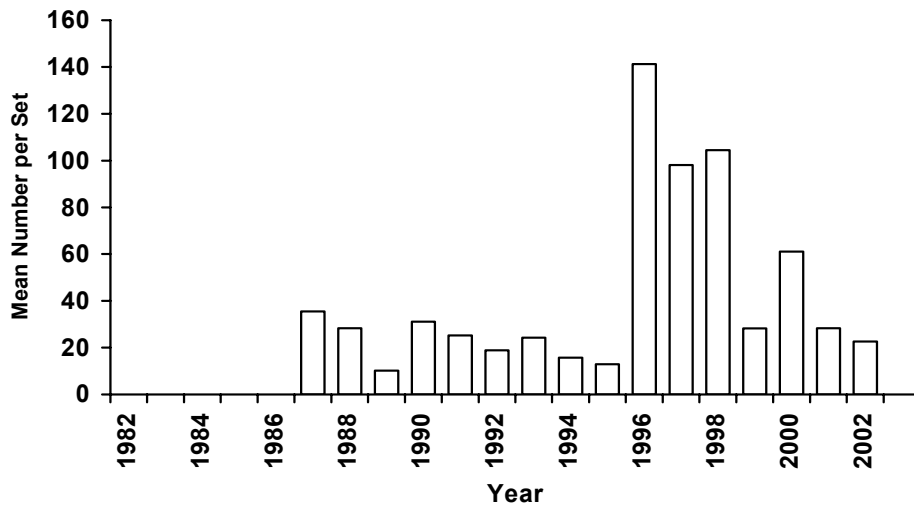


Figure 2. Striped bass fishery-independent indices of adult abundance.

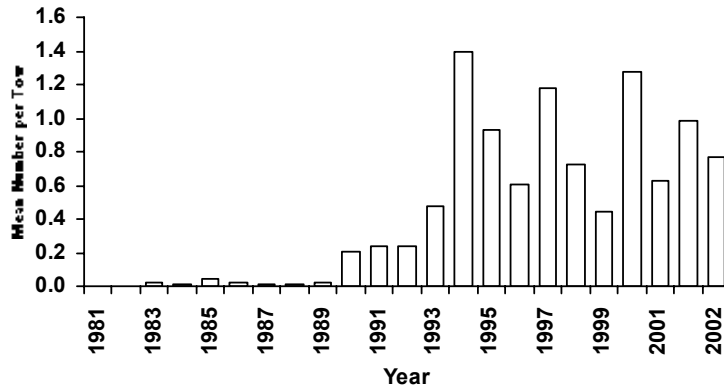
a. Maryland index of striped bass spawning stock abundance, ages 2 and older, 1985 to 2003.



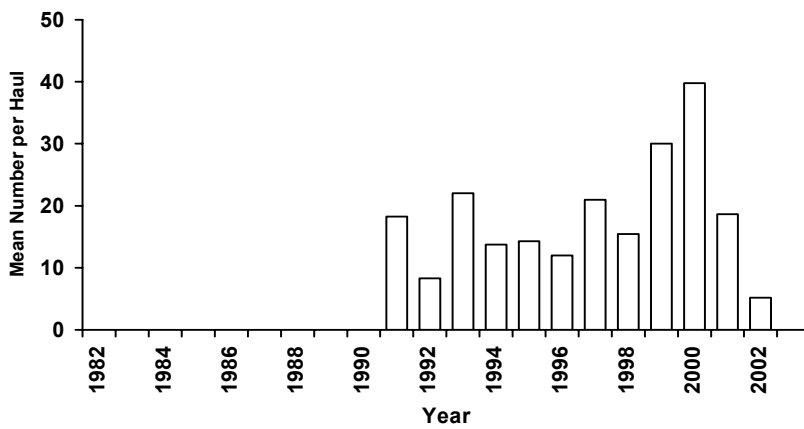
b. New York ocean haul seine index of striped bass abundance (catch per set), ages 5 and older.



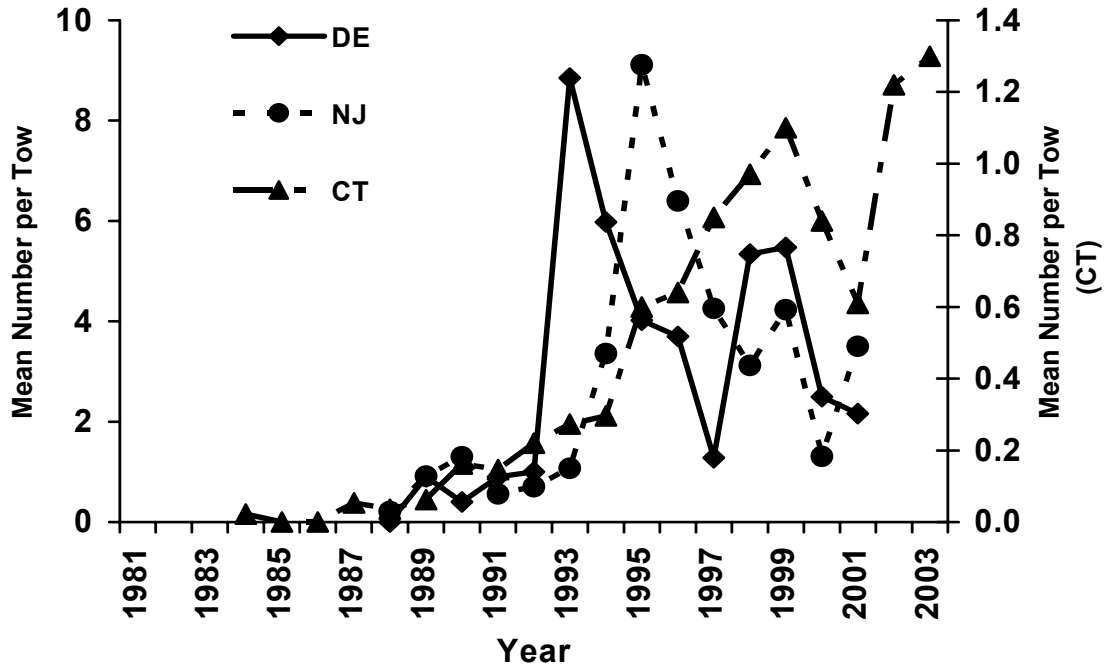
c. NMFS/NEFSC bottom trawl survey index of striped bass abundance (mean number per tow), ages 2 and older.



d. Virginia Rappahannock River pound net index of striped bass abundance.



e. Indices of striped bass abundance from Delaware, New Jersey, and Connecticut trawl surveys.



f. Indices of age 1 striped bass abundance for Long Island and Maryland.

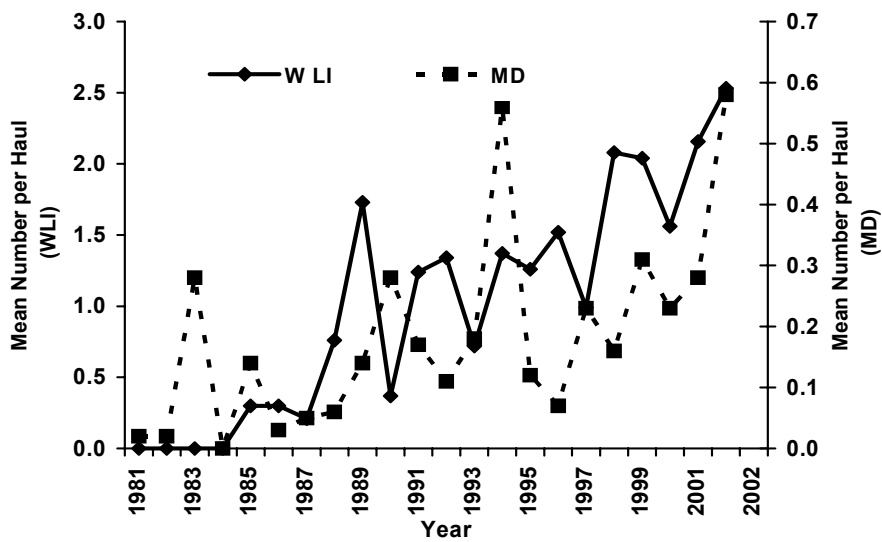
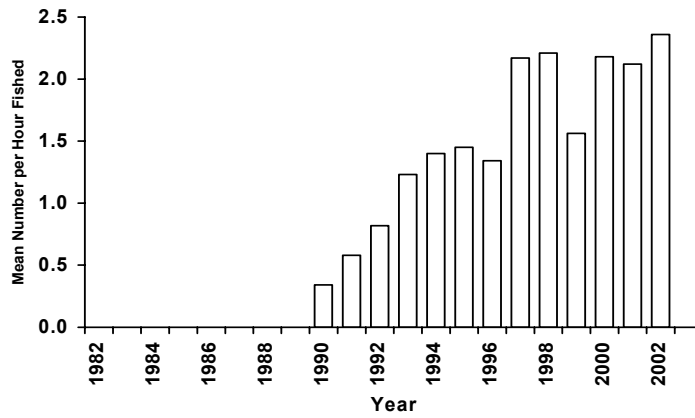
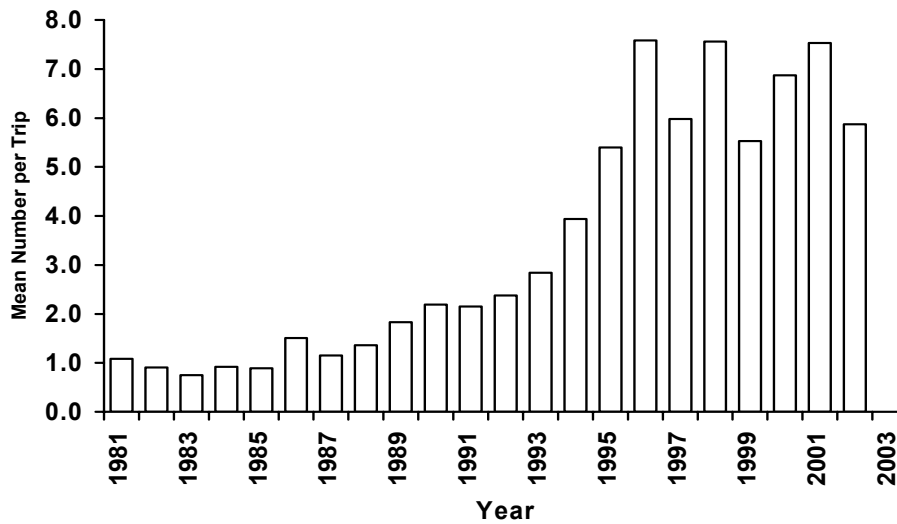


Figure 3, Striped bass fishery-dependent indices of abundance.

a. Massachusetts commercial striped bass catch per unit effort, for fish age 8 and older, 1990 to 2002.



b. Connecticut volunteer angler striped bass catch per trip for 1981 to 2002.



c. Hudson River shad bycatch indices of striped bass abundance, 1986 to 2001.

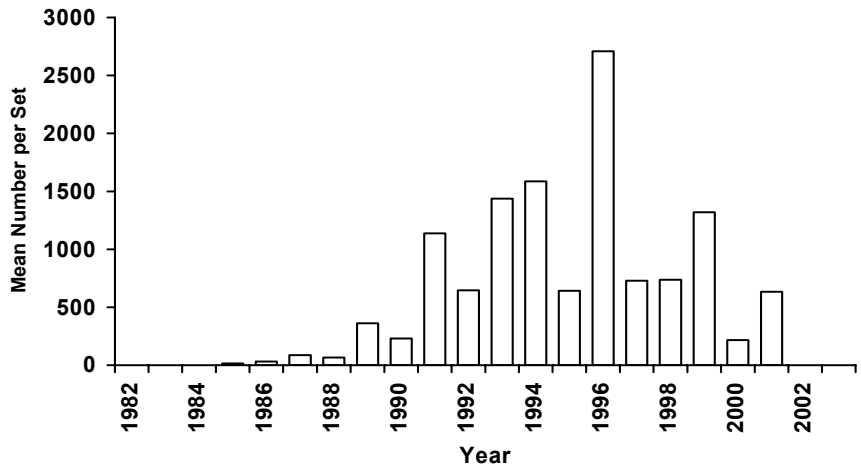


Figure 4. Percentage recreational and commercial catch (harvest and discard) in number for 2002.

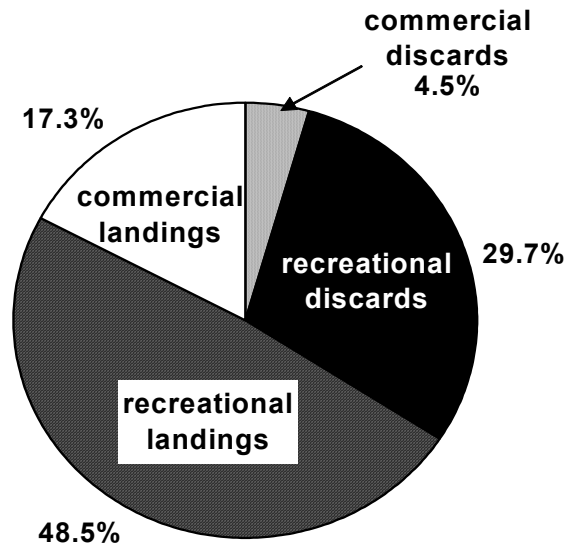


Figure 5. Striped bass population abundance (age 1 and greater, and age 8 and older) from the 2002 VPA results.

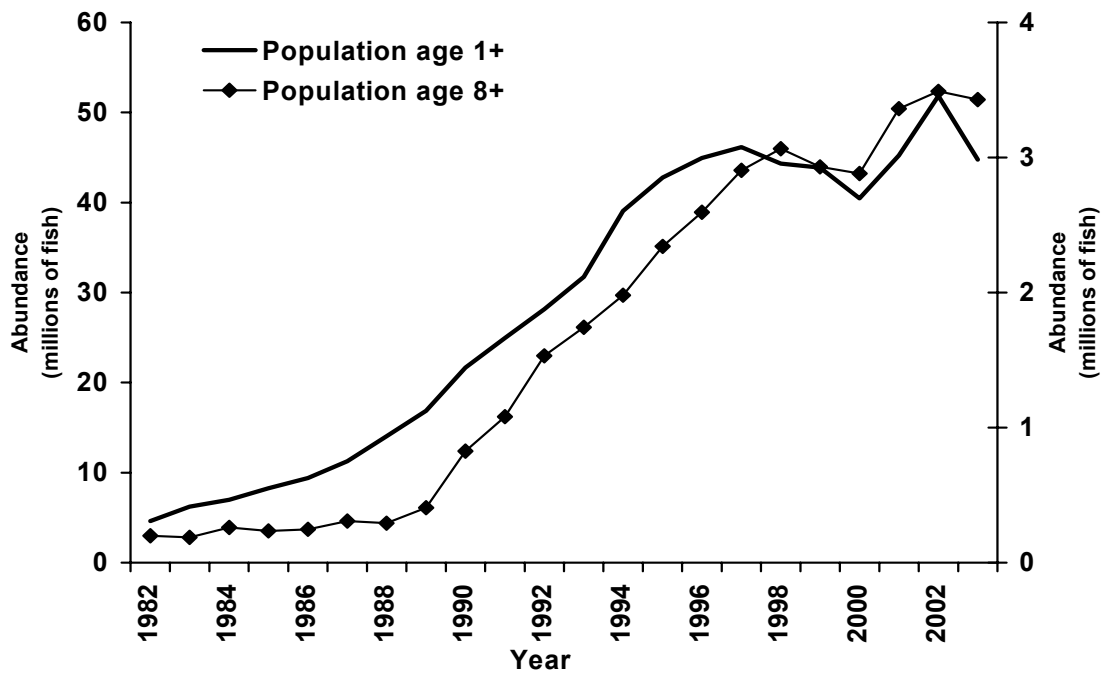


Figure 6. Trend in female spawning stock biomass, 1982 to 2002.

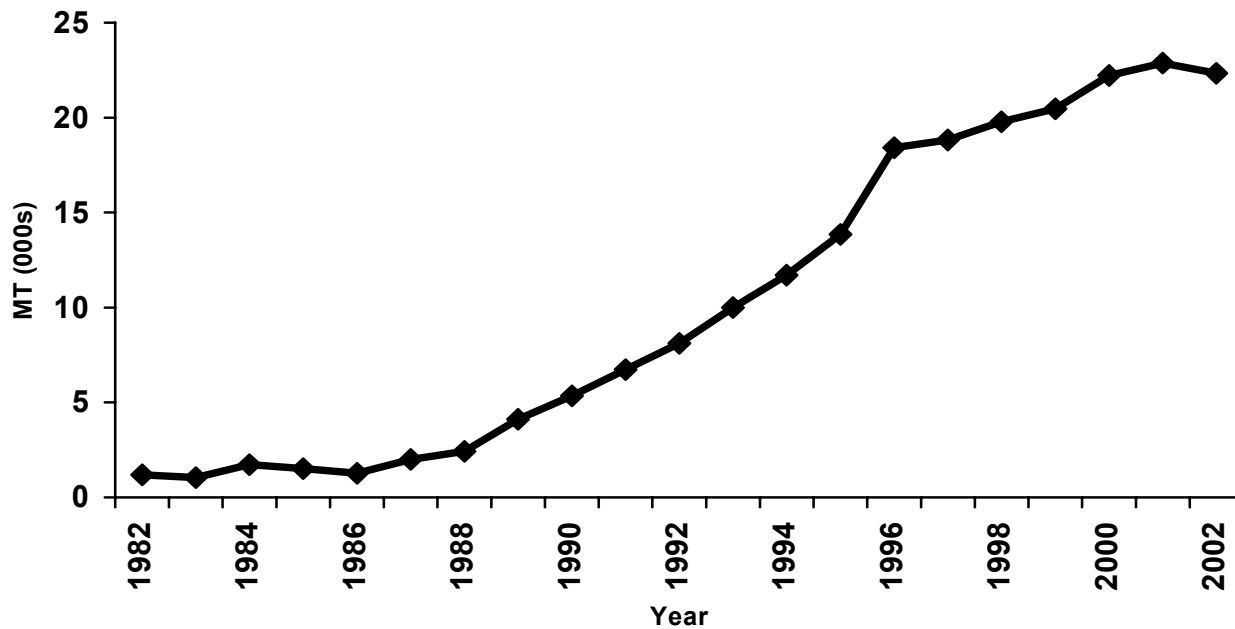


Figure 7. Estimated striped bass abundance of age 8 to 13 fish for 1982-2003, total striped bass catch of fish ages 8 to 13 for 1982 to 2002, and striped bass fishing mortality for age 8 to 11 fish from 1982 to 2002.

