ATLANTIC STRIPED BASS STUDIES
2005 BIENNIAL REPORT TO CONGRESS

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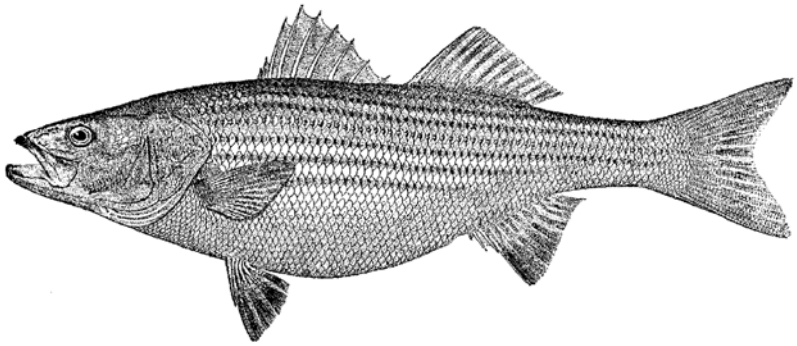

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Striped Bass Studies

2005 Biennial Report to Congress

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ACKNOWLEDGMENTS

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 has 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 2005 indicated that striped bass stocks are at high levels of abundance and are supporting increased landings, primarily in the recreational fisheries. Total landings in 2004 were 15,171 metric tons (33.4 million pounds), a 9.5% increase from 2003. 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. The number of fish in the population has remained stable due to moderate fishing mortality and a pattern of consistent production of juvenile fish punctuated by years of high juvenile survival. Fishing mortality in 2003 was 0.29 which was below the target and threshold levels. Mortality increased in 2004 to 0.40 but remained below the threshold mortality. Estimated abundance on January 1, 2005 of striped bass age 1 and greater was 65.3 million fish and the spawning stock biomass was 24,900 mt (54.9 million pounds). Fishing mortality has been increasing steadily since 2000 and is approaching the threshold level under the Amendment 6 Control Rule.

Amendment 6 to the ASMFC Striped Bass Fishery Management Plan was approved by ASMFC in February 2003. The commercial components of Amendment 6 were implemented in 2003, with the recreational components 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 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 re-authorized 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 fourth 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 2005 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 2005. Estimation of stock size and mortality rates are based on a virtual population analysis (VPA) model that includes recreational and commercial landings, and discards for 1982-2004. The model is calibrated with data from various federal and state abundance indices derived from fishery-independent surveys and fishery monitoring programs.

Trends in Juvenile Production

Juvenile indices from the Chesapeake Bay (Maryland and Virginia) decreased in 2004 relative to 2003 (Figure1a), although each of the indices was slightly above its long-term average (Maryland 1955-2005 and Virginia 1967-2005). Both indices indicate that strong year classes were produced in 1993, 1996, 2001 and 2003. A juvenile index for the Hudson River stock (Figure 1b) has shown consistent production since the early 1990s (with the exception of 2000) and the 2003 and 2004 indices were slightly above and below, respectively, the time series average. The Delaware stock, as indexed by the New Jersey juvenile survey, has shown strong juvenile production since the 1990s. A low index value in 2002 was followed by a record-high 2003 index.

Status of Adult Stocks

Fishery-Independent Indices

The Maryland gillnet survey index of striped bass spawning biomass has increased steadily since 2002. The preliminary 2005 index was the second highest value in the 21-year time series (Figure 2a). The New York ocean haul seine index peaked during 1997-1998, markedly declined until 2002, but increased in both 2003 and 2004 (Figure 2b). The 2004 index was the fourth highest since the survey began in 1987. 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, remained relatively high through 2003, but declined to slightly lower levels in 2004 and 2005 (Figure 2c). The Rappahannock River, Virginia pound net

index provides additional information on the Chesapeake Bay striped bass spawning stock. This index peaked in 2000 but declined to a record-low value in 2002. The index increased in both 2003 and 2004, with the latter value the second highest in the series (Figure 2d). The Connecticut trawl survey striped bass index increased steadily from 1984 to 1999, peaked in 2001, and has since declined somewhat (Figure 2e). The New Jersey trawl index (Figure 2e) increased steadily between 1988 and 1996, fluctuated between 1997 and 2003, and sharply increased in 2004 to the highest value in the series. The Delaware trawl index peaked in 1996 and again in 2000 but has since trended downward (Figure 2f) to very low values in 2004 and 2005. In contrast, a separate spawning stock survey in Delaware River has suggested an upward trend in abundance since 2002 (Figure 2f).

The Maryland beach seine index of age-1 fish peaked in 2002 and 2004 supporting the conclusion that juvenile production in 2001 and 2003 was well above average (Figure 2g). The western Long Island Sound beach seine index of age-1 bass steadily increased throughout the 1990s, with the 2002 and 2004 values the highest in the time series (Figure 2g).

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 index increased in the early 1990s and remained high and stable since 1995 (Figure 3b). An index of abundance, calculated as catch per effort from the Marine Recreational Fisheries Statistics Survey (MRFSS), increased during the mid-1990s to a peak in 1997 with modest declines afterwards (Figure 3c).

Fisheries

Commercial Harvest

Commercial landings in 2004 totaled 907 thousand fish and 7.3 million pounds (3,297 mt) (Table 1). The landings represented an increase of 38 thousand fish and 154 thousand pounds compared to 2003 (Table 2). Commercial landings have remained relatively stable since 1997. The Chesapeake Region (Maryland, PRFC and Virginia) accounts for most of the commercial landings, 77% by number and 58% by weight (Table 3). On average, commercial fisheries have represented 27% by number of the total landings (commercial + recreational) since 2002 (Table

2, Figure 4). The commercial landings were dominated by fish ages 4 to 8 (65% 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 2004 were 2.4 million fish totaling 26.2 million pounds (11,874 mt) (Table 1). The landings represented a decrease of 154,000 fish but an increase of 3.5 million pounds (1,582 mt) from 2003 (Table 2). Virginia, New Jersey, Massachusetts, Maryland and North Carolina accounted for the largest recreational landings in 2004 (Table 3). Overall, recreational landings constituted 74% by number and 77% by weight of the total (commercial + recreational) landings in 2003-2004, and 74% by number of total 2003-2004 catch (landings + discards) (Table 2; Figure 4). Age groups 6 to 10 dominated the recreational landings (63% of landings by number).

Commercial Non-Harvest Mortality

Commercial discards in 2003 and 2004 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 2.4 million fish in 2003 and 4.1 million fish in 2004 (Table 2). Of these discards, losses due to culling mortality[1] were estimated to be 262 thousand fish in 2003 and 519 thousand fish in 2004. Commercial non-harvest losses in 2003 accounted for 5%, by number, of the total (landings + discard losses: commercial + recreational) 2003 harvest, while losses in 2004 accounted for 10% of the total 2004 harvest (Table 2; Figure 4). Commercial discards were dominated by fish of ages 3 to 7.

Recreational Non-Harvest Mortality

Recreational discards were estimated to be 14.6 million fish in 2003 and 17.2 million fish in 2004 (Table 2). Applying a hooking mortality rate of 8% resulted in estimated losses from hooking mortality of 1.2 million fish in 2003 and 1.4 million fish in 2004 (Tables 2 and 3). Massachusetts and Maryland accounted for the highest percent of these losses in 2003 and 2004

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

(Table 3). In 2003, recreational discard losses accounted for 24%, by number, of the total annual harvest and 27% in 2004 (Table 2; Figure 4). Highest discards occurred on three year old fish in both 2003 and 2004.

Total Catch

The total catch (commercial and recreational landings + commercial and recreational discard losses) of striped bass was 4.8 million fish in 2003 and 5.2 million fish in 2004 (Table 2). The 2004 catch was the highest since 1982, which is the first year in the catch time series used in the stock assessment.

Stock Size Estimates

Population abundance (stock size as of January 1) increased from 4.8 million fish in 1982 to 60.1 million fish in 1997 and subsequently has stabilized at about 59 million fish (Table 4; Figure 5). Population size at the beginning of 2005 was estimated to be 65.3 million fish, with the 2001 and 2003 year classes (ages 2 and 4) accounting for 45% of the stock. Recruitment of age 1 fish in 2005 (2004 cohort) was estimated to be 12.7 million fish, which is near the median recruitment since 1995 when the stock was declared recovered. This follows the 2003 cohort (age 1 in 2004), which was estimated to be 22.3 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 218 thousand fish in 1982 to 6.0 million fish in 2001 and has since varied between 5.9 and 6.7 million fish (Figure 5).

Fishing Mortality

Average fishing mortality rate (F) for ages 8 through 11 declined from 0.54 to 0.11 between 1982 and 1984, remained relatively stable near 0.16 between 1985 and 1990, then increased gradually to 0.29 in 2003. Fishing mortality increased sharply in 2004 to 0.40 although the terminal year estimate in a virtual population analysis (VPA) generally has the greatest uncertainty (Table 5). The equivalent 2004 exploitation rate (or harvest rate) was 31%. Average fishing mortality on younger striped bass (ages 3 to 8) has varied between 0.13 and 0.20 since

1995. Age specific Fs in 2004 ranged from 0.04 on age 2 to a high of 0.50 (37% harvest rate) on age 9, the 1995 year-class.

The average fishing mortality (F) for fish greater than 28 inches determined from the coastal mixed stock tagging programs has increased over the past several years and was 0.29 in 2004. Producer area (Chesapeake Bay, Delaware Bay and Hudson River) tagging programs have provided average F estimates that steadily increased from 0.22 in 1995 to 0.31 in 2004.

Spawning Stock Biomass

Female spawning stock biomass (SSB) increased from 1,270 mt (2.8 million pounds) in 1982 to a high of 27,500 mt (60.6 million pounds) in 2002 (Figure 6). The 2004 SSB remained stable at 24,900 mt (54.9 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 18 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 and Delaware River, 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 (GIS) 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 Corps 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. Discussions were initiated during 2005 between FWS staff and Rutgers University faculty regarding potential collaboration for implantation of sonic tags in migratory striped bass offshore. Detection of the sonic-tagged fish could occur at existing receivers off New Jersey and within a possibly expanded receiver network, enabling spatial and temporal refinement of migratory pathways.

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, 2005.

Concerns Relative to Health of Chesapeake Bay Striped Bass

Recent cases of an infectious disease, called mycobacteriosis, in Chesapeake Bay striped bass have raised concern about the impact of this disease on the overall health of the coastal striped bass population. The prevalence and distribution of mycobacteriosis in Chesapeake Bay striped bass, as well as young-of-the-year menhaden is being evaluated through a project supported by the NOAA Chesapeake Bay Office. The number of mycobacterial cases observed

through the fall of 2005 is notable, but appear to be lower than previously reported. Preliminary data indicate that potentially up to 43% of older striped bass may be infected with mycobacteria, though the long-term effects of such infections, on individual fish or on the overall population, are not yet known. Young-of-the-year menhaden were also examined and a low, but notable occurrence of mycobacteria was found (0-20%) indicating that menhaden may be a susceptible host. Additional collections from a second field season are currently underway.

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 led to the rebuilding of the Atlantic striped bass stocks. In addition, several states closed their state waters to fishing for striped bass during the 1980s. 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 Amendment 4 allowed revisions to management measures addressing the changing circumstances, through adoption of six successive Addenda to Amendment # 4, during 1989-1994. In addition, in November 1990, NMFS implemented a Federal ban on the harvest and possession of striped bass in the EEZ to support efforts of the ASMFC and to aid in the recovery of striped bass along the east coast. The striped bass population was declared recovered, 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 size limits and an 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 13 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, maintains the current high level of spawning potential and provides adequate protection to increase the number of older striped bass in the population. 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 size limits and 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 rate 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.

The States were required to fully implement the provisions of Amendment 6 on 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 "2005 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Atlantic Striped Bass (*Morone saxatilis*)."

Amendment 6 requires that an addendum be developed to collect information on striped bass discards. The objective of this addendum will be to collect the data necessary to determine if there are specific fisheries that result in discard levels that will have a significant negative impact on achieving the goals of Amendment 6. The ASMFC Striped Bass Technical Committee and Management Board are currently developing this addendum.

SUMMARY AND CONCLUSIONS

The results of the most recent (2005) striped bass stock assessment indicate that stock abundance is very high. Spawning stock biomass exceeded the target level by more than 40% but fishing mortality in 2004 (F=0.40) was between the target (F=0.30) and threshold (F=0.41) fishing mortality rates. Abundance increased steadily between 1982 and 1997 and the adult stock size (ages 8-13) during 2001-2005 was the highest in the last two decades (Figure 7). The appearance of strong cohorts - 1993, 1996, 2000, 2001 and 2003 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. Recent increases in fishing mortality since 2000 may be a cause for concern if the trend continues in 2006.

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.

REFERENCES

Atlantic States Marine Fisheries Commission. Source Document for the Supplement to the Striped Bass FMP- Amendment #4. ASMFC Fisheries Management Report (1990).

Atlantic States Marine Fisheries Commission. Amendment #5 to the Interstate Fishery

Management Plan for Atlantic Striped Bass. ASMFC Fisheries Management Report #24 , (1995).

Atlantic States Marine Fisheries Commission. Source document to Amendment 5 to the Interstate Fishery Management Plan for Atlantic Striped Bass. G. Shepherd and N. Lazar (eds.). Fishery Management Report No. 34, (1998).

Atlantic States Marine Fisheries Commission. 2005 Summary Report of the Status of the Atlantic Striped Bass. Report of the ASMFC Striped Bass Technical Committee. (October 2005).

Atlantic States Marine Fisheries Commission. Summary Report of the Status of the Atlantic Striped Bass. Report of the ASMFC Striped Bass Technical Committee. (October 2005).

Atlantic States Marine Fisheries Commission. Amendment #6 to the Interstate Fishery Management Plan for Atlantic Striped Bass. ASMFC Fisheries Management Report # 41, (2003).

Table 1. Atlantic Coast landings of striped bass in metric tons and numbers from 1981 to 2004 (recreational information not available prior to 1981).

	Commercial		Recreational		Total	
Year	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	571	86,705	688	120,015
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	1,089,223	7,230	1,624,137
1996	2,178	766,518	6,003	1,199,253	8,181	1,965,771
1997	2,679	1,058,181	7,267	1,646,971	9,946	2,705,152
1998	2,936	1,223,828	5,771	1,468,542	8,707	2,692,370
1999	2,941	1,103,812	6,245	1,448,800	9,186	2,552,612
2000	3,003	1,057,712	7,947	2,012,685	10,950	3,070,397
2001	2,826	941,733	8,889	2,085,126	11,715	3,026,859
2002	2,723	654,032	8,409	1,970,495	11,132	2,624,527
2003	3,227	868,987	10,362	2,536,272	13,589	3,405,259
2004	3,297	907,328	11,874	2,381,823	15,171	3,289,151

Table 2. Total striped bass discard and harvest in numbers and % of total by fishery component, 2003 and 2004.

2003

Fishery Component	Discard	Discard Losses	Landings	Total Catch
Recreational	14,611,333	1,168,907 (24.2%)	2,536,272 (52.4%)	3,705,179 (76.6%)
Commercial	2,352,983	262,078 (5.4%)	868,987 (18.0%)	1,131,065 (23.4%)
Total	16,964,316	1,430,985 (29.6%)	3,405,259 (70.4%)	4,836,244 (100.0%)

2004

Fishery Component	Discard	Discard Losses	Landings	Total Catch
Recreational	17,167,874	1373430 (26.5%)	2,381,823 (46.0%)	3,755,253 (72.5%)
Commercial	4,108,753	518,847 (10.0%)	907,328 (17.5%)	1,426,175 (27.5%)
Total	21,276,627	1,892,277 (36.5%)	3,289,151 (63.5%)	5,181,428 (100.0%)

Table 3. Commercial landings, recreational landings and recreational discard losses and total (excluding commercial discards) in number (000s of fish) for 2003 and 2004, by state.

States	Commercial Landings		*Recreational Landings*		Recreational Discards		*Totals*	*Totals*
	2003	2004	*2003*	*2004*	2003	2004	*2003*	*2004*
Maine	0	0	*56.9*	*36.1*	67.7	59.2	*124.6*	*95.3*
New Hampshire	0	0	*24.9*	*10.1*	20.8	15.7	*45.7*	*25.8*
Massachusetts	55.4	60.6	*407.1*	*406.6*	348.9	470.3	*811.4*	*937.5*
Rhode Island	15.5	15.9	*115.5*	*74.0*	35.9	50.3	*166.9*	*140.2*
Connecticut			*94.4*	*72.4*	67.4	87.2	*161.8*	*159.6*
New York	68.4	70.4	*313.8*	*242.8*	86.7	117.8	*468.9*	*431.0*
New Jersey			*391.8*	*421.0*	74.1	109.8	*465.9*	*530.8*
Delaware	31.5	28.4	*29.5*	*23.9*	13.5	12.0	*74.5*	*64.3*
Maryland	439.5	461.1	*525.2*	*313.9*	372.2	291.8	*1336.9*	*1066.8*
PRFC*	83.1	92.0	*	*	*	*	*83.1*	*92.0*
Virginia	161.8	148.0	*455.8*	*467.4*	77.6	138.9	*695.2*	*754.3*
North Carolina	13.8	31.0	*121.5*	*313.7*	3.9	20.6	*139.2*	*365.3*
Total	869.0	907.4	*2536.3*	*2381.9*	1168.9	1373.6	*4574.2*	*4662.9*

* Potomac River Fisheries Commission

Table 4. Estimated population abundance, thousands at ages 1 to 13+, 1982-2005. Total in millions of fish.

AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	1534	3181	2401	3579	2763	3944	5219	5609	8419
2	997	1318	2735	2062	3080	2368	3393	4489	4827
3	866	760	1033	1852	1707	2631	2028	2892	3831
4	758	508	490	610	1500	1410	2230	1707	2415
5	259	449	260	345	487	1168	1166	1861	1406
6	121	169	248	168	243	373	943	905	1504
7	92	86	109	166	105	180	298	721	690
8	40	57	57	77	102	71	142	219	578
9	25	19	45	45	50	66	55	100	169
10	22	11	14	37	33	35	51	35	76
11	65	9	6	10	29	23	27	38	26
12	31	46	4	5	8	22	19	20	30
13+	35	111	145	60	49	140	54	89	118
Total	4.8	6.7	7.5	9.0	10.2	12.4	15.6	18.7	24.1
8+	0.2	0.3	0.3	0.2	0.3	0.4	0.3	0.5	1.0

Table 4 (cont'd). Estimated population abundance, thousands at ages 1 to 13+, 1982-2005. Total in millions of fish.

AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	16562	13338	12932	15586	10625	10982	8261	15490	18024
2	9523	14250	11476	11130	13412	9121	9444	7075	13300
3	6383	8061	11863	9786	9309	11373	7750	7829	5940
4	5302	5171	6502	9609	7866	7563	9401	6282	6339
5	4107	4294	4028	4995	7372	6116	5909	7176	4846
6	2104	3194	3321	2965	3665	5305	4669	4142	5408
7	1573	1596	2296	2425	1946	2682	3890	3298	2921
8	936	1228	1175	1568	1663	1416	1983	2666	2305
9	488	726	876	818	966	1187	998	1418	1851
10	535	327	482	627	498	632	831	710	1031
11	144	386	198	351	410	323	407	585	501
12	163	91	282	131	238	265	182	295	408
13+	107	74	116	111	345	269	191	286	525
Total	47.9	52.7	55.6	60.1	58.3	57.2	53.9	57.3	63.4
8+	2.4	2.8	3.1	3.6	4.1	4.1	4.6	6.0	6.6

Table 5. Fishing mortality at age and average across ages, 1982-2004.

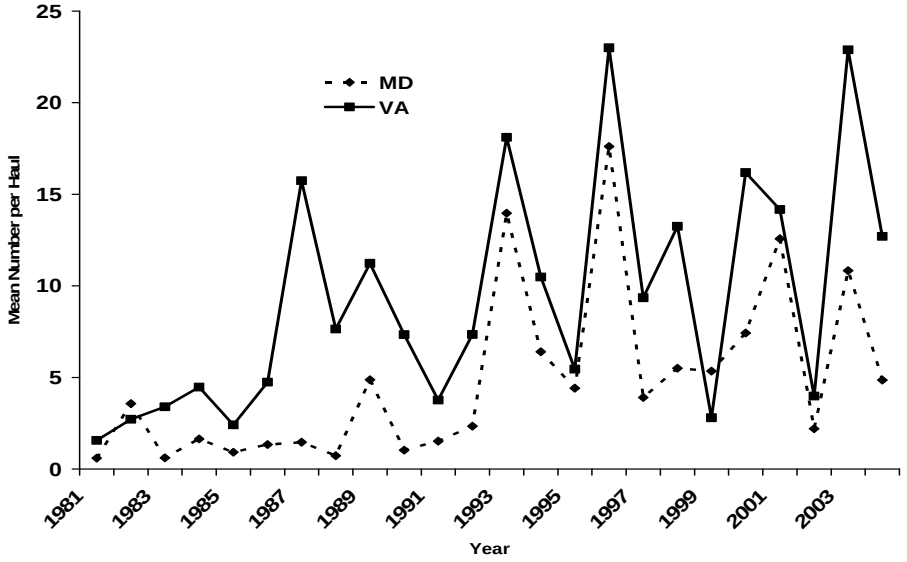
AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.12	0.09	0.24	0.04	0.01	0.01	0.01	0.01	0.01
3	0.38	0.29	0.38	0.06	0.04	0.02	0.02	0.03	0.04
4	0.37	0.52	0.20	0.07	0.10	0.04	0.03	0.04	0.09
5	0.28	0.44	0.29	0.20	0.12	0.06	0.10	0.06	0.14
6	0.19	0.29	0.25	0.32	0.15	0.07	0.12	0.12	0.13
7	0.33	0.26	0.20	0.33	0.24	0.08	0.16	0.07	0.18
8	0.59	0.08	0.09	0.28	0.29	0.10	0.20	0.11	0.14
9	0.67	0.18	0.05	0.17	0.22	0.11	0.32	0.12	0.14
10	0.71	0.44	0.18	0.10	0.19	0.10	0.13	0.13	0.11
11	0.20	0.73	0.13	0.11	0.14	0.07	0.16	0.09	0.23
12	0.64	0.14	0.09	0.20	0.25	0.10	0.21	0.11	0.13
13+	0.64	0.14	0.09	0.20	0.25	0.10	0.21	0.11	0.13
Ages 8, 11	0.54	0.36	0.11	0.16	0.21	0.10	0.20	0.11	0.15
Ages 3, 8	0.36	0.31	0.23	0.21	0.16	0.06	0.11	0.07	0.12

Table 5 (cont'd). Fishing mortality at age and average across ages, 1982-2004.

AGE	1994	1995	1996	1997	1998	1999	2000	2001
1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
2	0.02	0.03	0.01	0.03	0.01	0.01	0.04	0.02
3	0.06	0.06	0.06	0.07	0.06	0.04	0.06	0.06
4	0.06	0.10	0.11	0.12	0.10	0.10	0.12	0.11
5	0.10	0.11	0.16	0.16	0.18	0.12	0.21	0.13
6	0.13	0.18	0.16	0.27	0.16	0.16	0.20	0.20
7	0.10	0.16	0.23	0.23	0.17	0.15	0.23	0.21
8	0.10	0.19	0.21	0.33	0.19	0.20	0.19	0.22
9	0.25	0.26	0.18	0.35	0.27	0.21	0.19	0.17
10	0.18	0.35	0.17	0.28	0.28	0.29	0.20	0.20
11	0.31	0.16	0.26	0.24	0.29	0.43	0.17	0.21
12	0.16	0.23	0.19	0.33	0.23	0.22	0.19	0.20
13+	0.16	0.23	0.19	0.33	0.23	0.22	0.19	0.20
Ages 8, 11	0.21	0.24	0.21	0.30	0.26	0.28	0.19	0.20
Ages 3, 8	0.09	0.13	0.16	0.20	0.14	0.13	0.17	0.15

Figure 1. Striped bass juvenile abundance indices.

a. Young of year (YOY) indices for the Chesapeake stock, Maryland and Virginia surveys, 1981 to 2004.



b. Young of year (YOY) indices for the Hudson (NY) and Delaware Bay (NJ) stocks, 1981 to 2004.

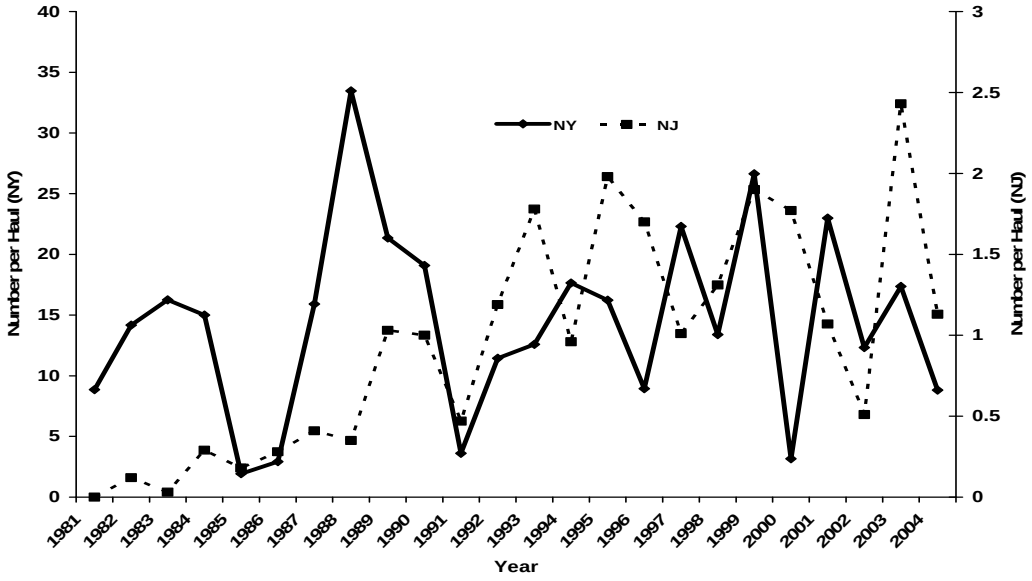
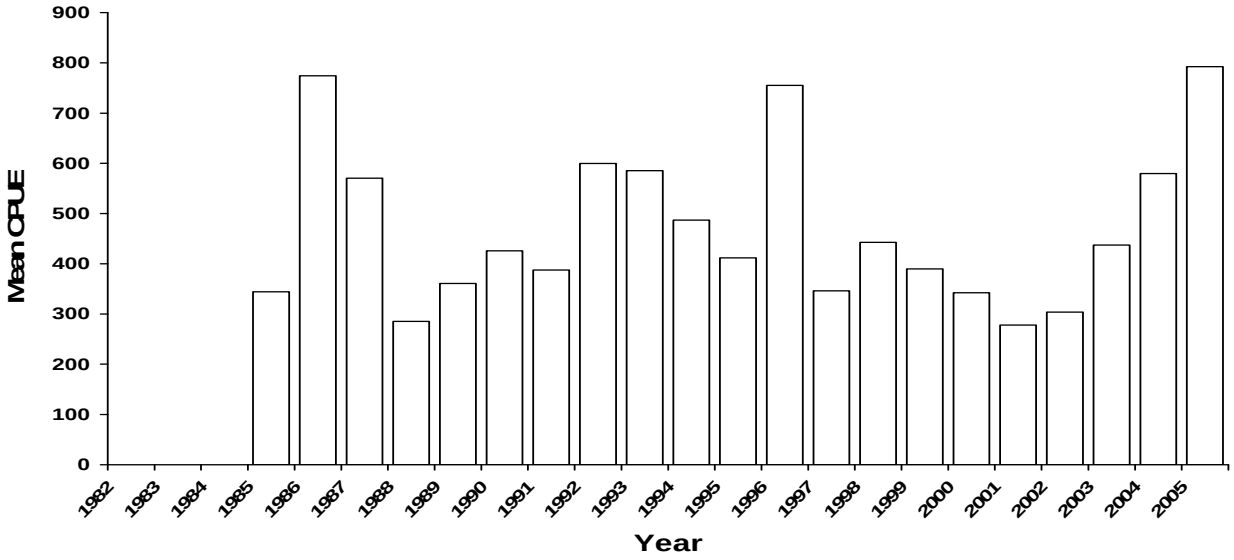
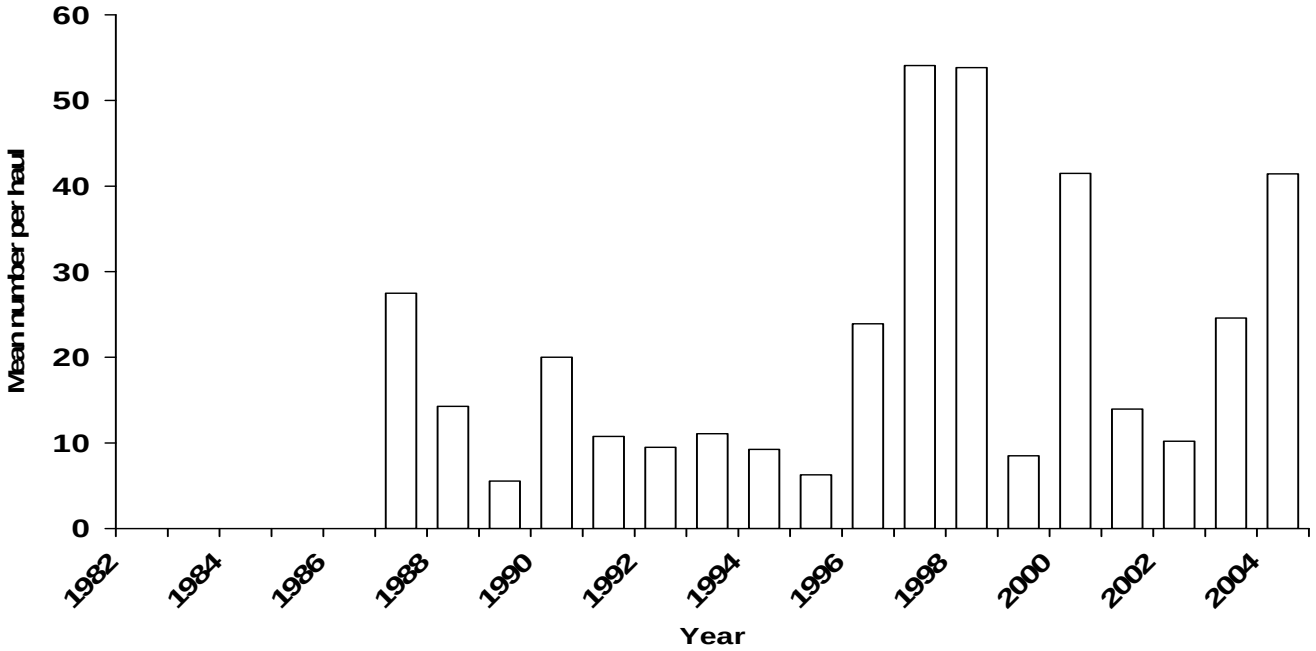


Figure 2. Striped bass fishery-independent indices of adult abundance.

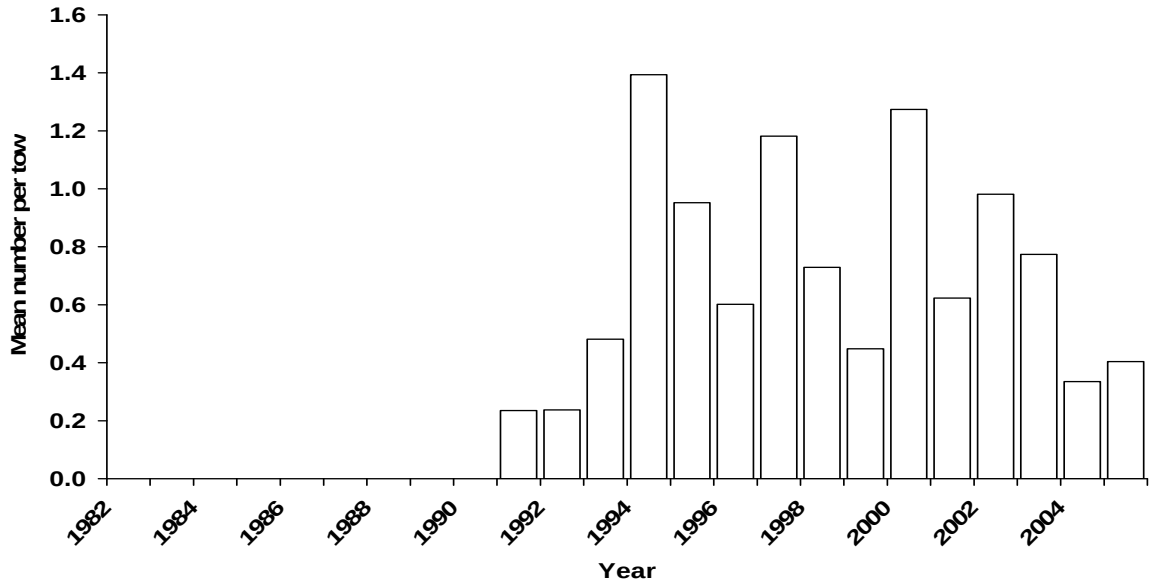
a. Maryland index of striped bass spawning stock abundance, ages 3 and older, 1985 to 2005.



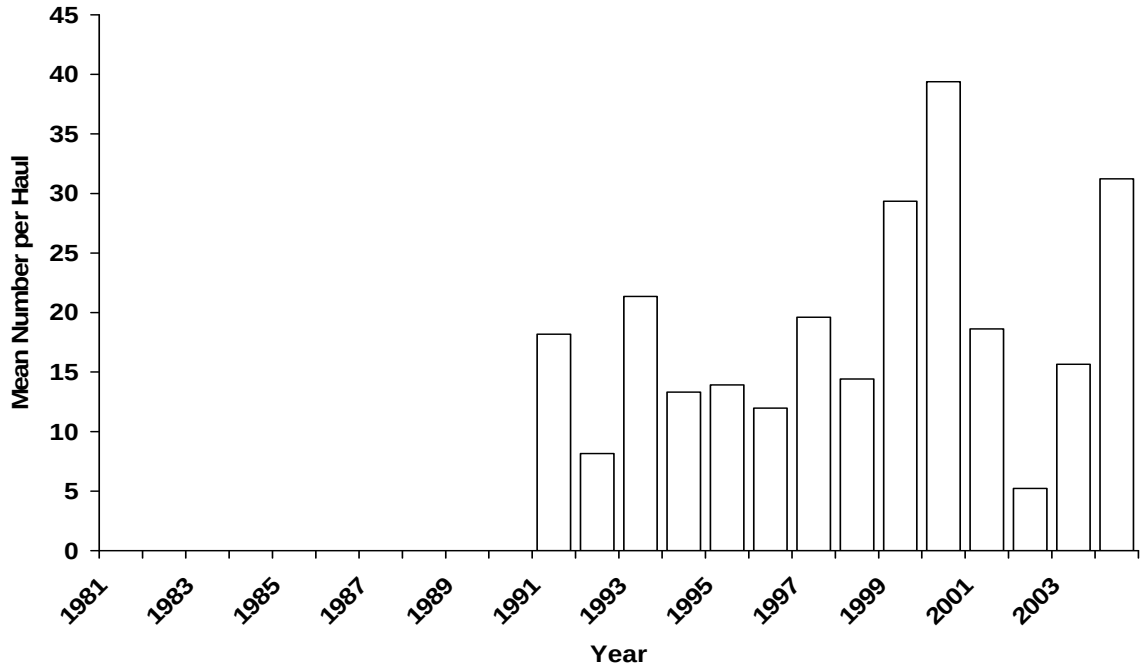
b. New York ocean haul seine index of striped bass abundance (catch per set), ages 5 and older.



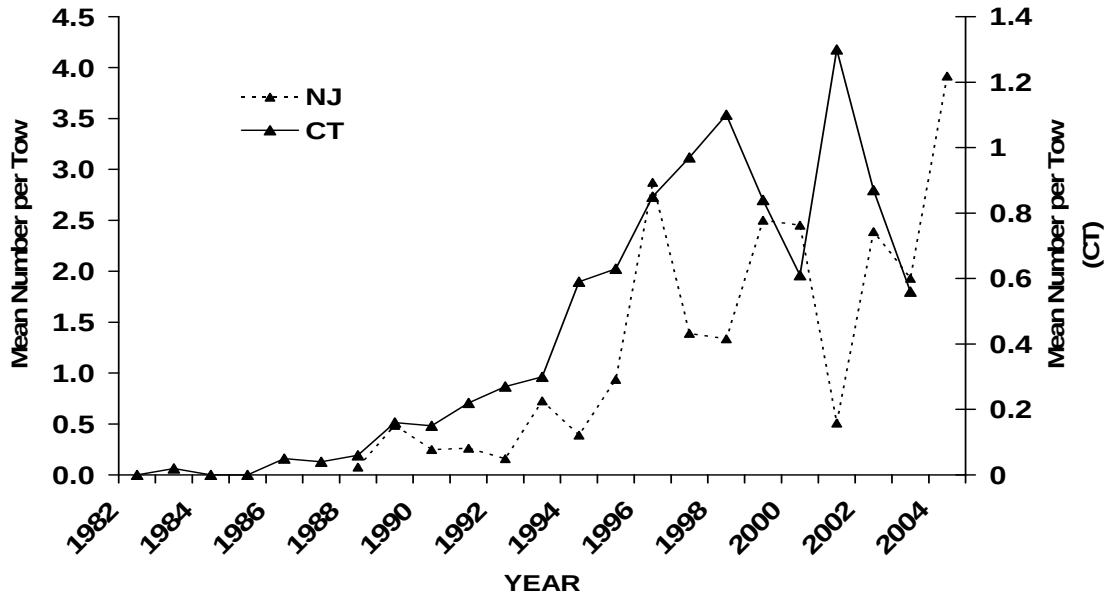
c. NMFS/NEFSC bottom trawl survey index of striped bass abundance (mean number per tow), ages 2 through 9.



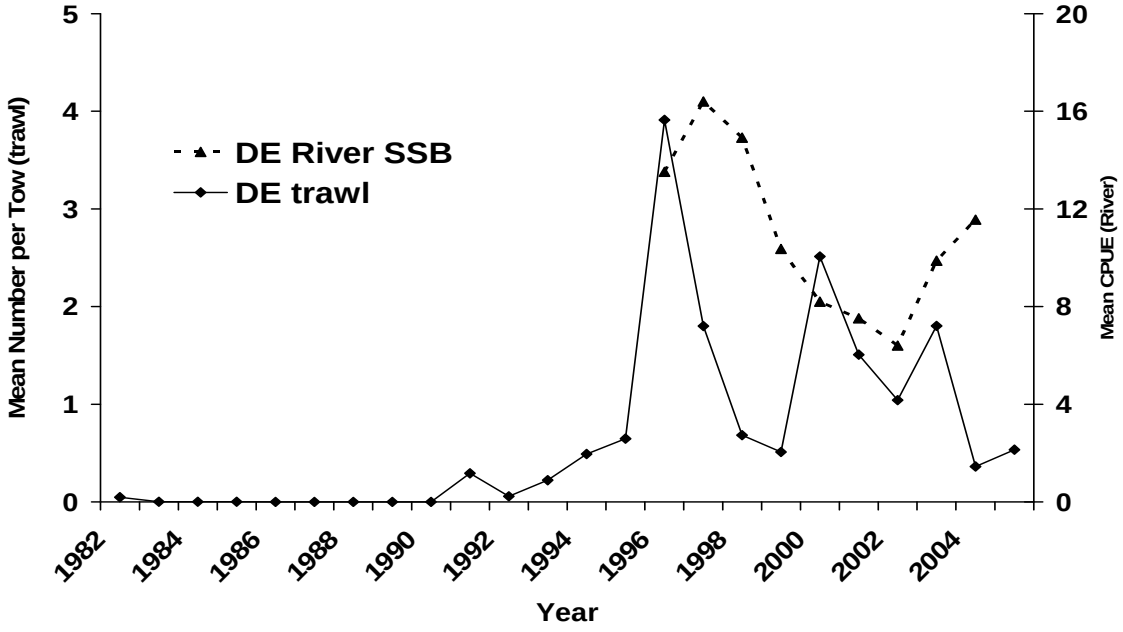
d. Virginia Rappahannock River pound net index of striped bass abundance.



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



f. Indices of striped bass abundance from Delaware Bay and Delaware River surveys .



g. Indices of age 1 striped bass abundance for western Long Island Sound and Maryland portion of the Chesapeake Bay.

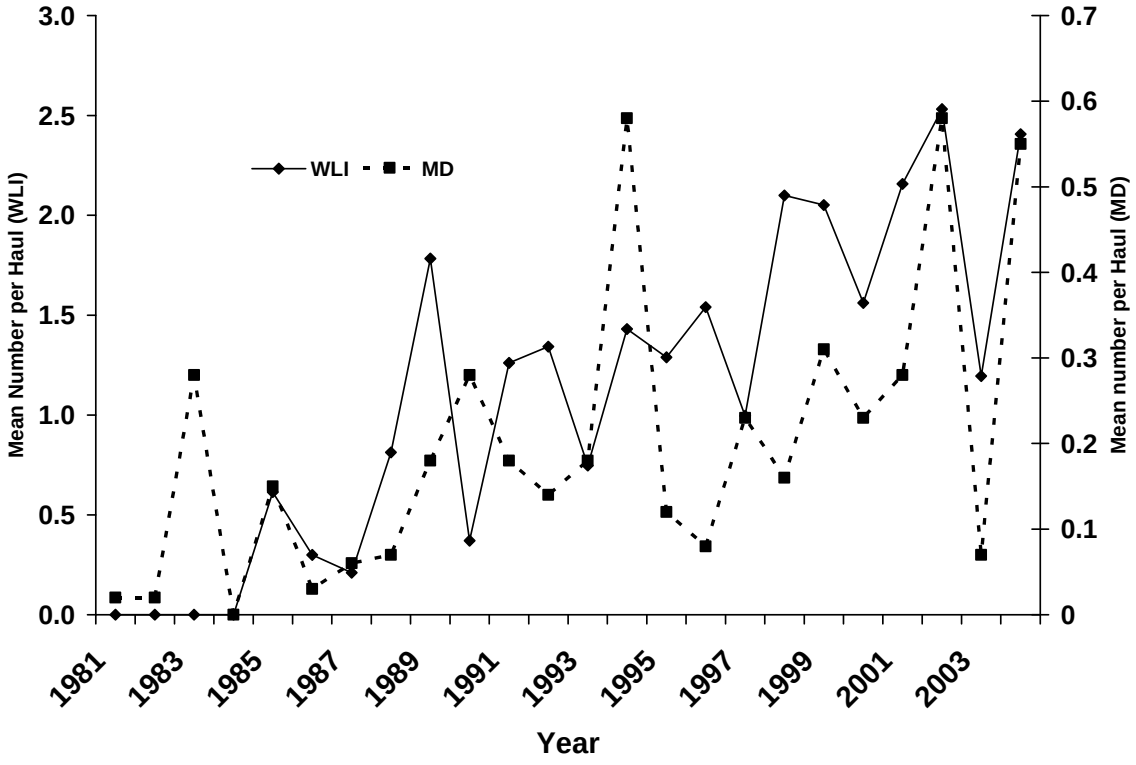
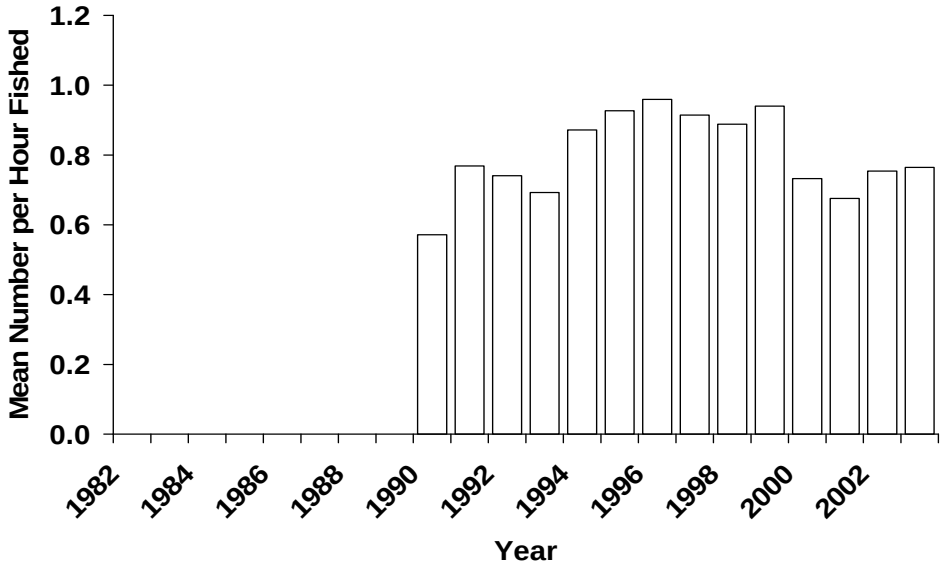
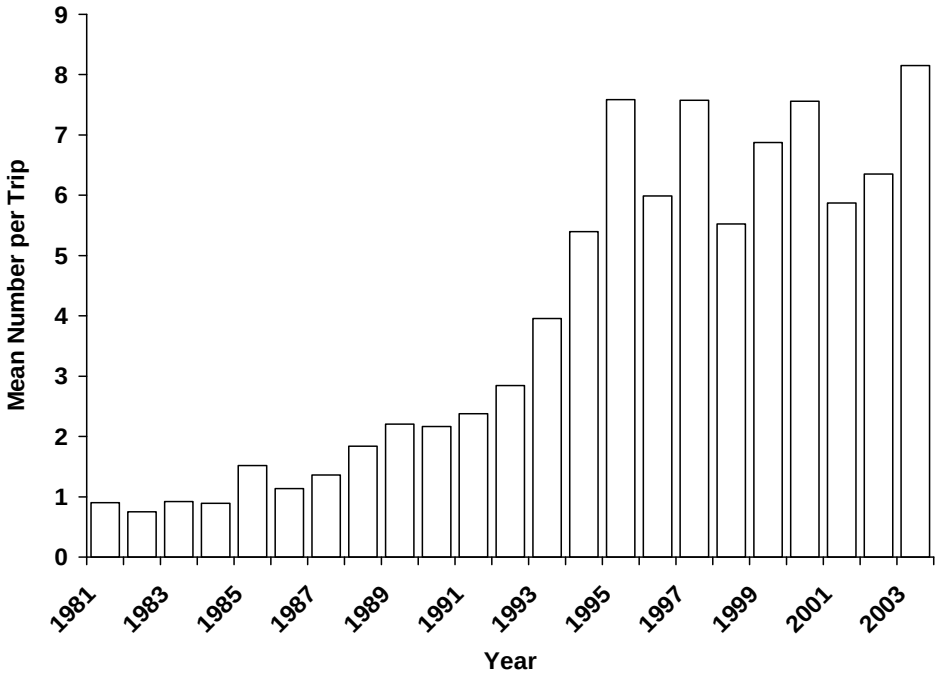


Figure 3. Striped bass fishery-dependent indices of abundance.

a. Massachusetts commercial striped bass catch per unit effort, for fish age 7 and older, 1990 to 2004.



b. Connecticut volunteer angler striped bass catch per trip for 1981 to 2004.



c. Marine Recreational Fisheries Statistics Survey (MRFSS) mean catch per trip of striped bass from Maine to North Carolina since 1987.

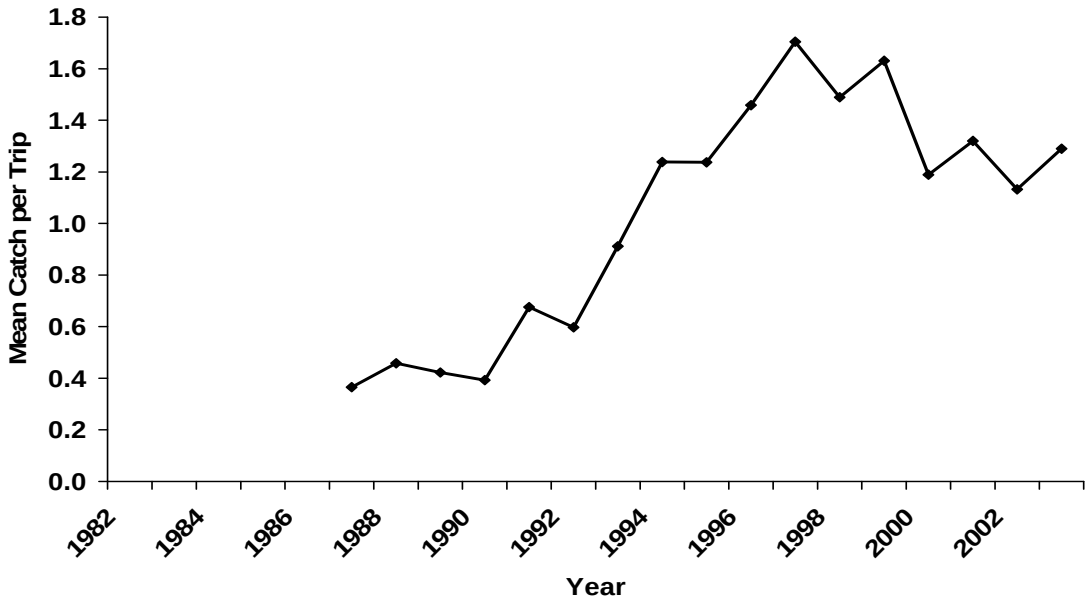


Figure 4. Percentage recreational and commercial catch (harvest and discard) in number for 2003 and 2004.

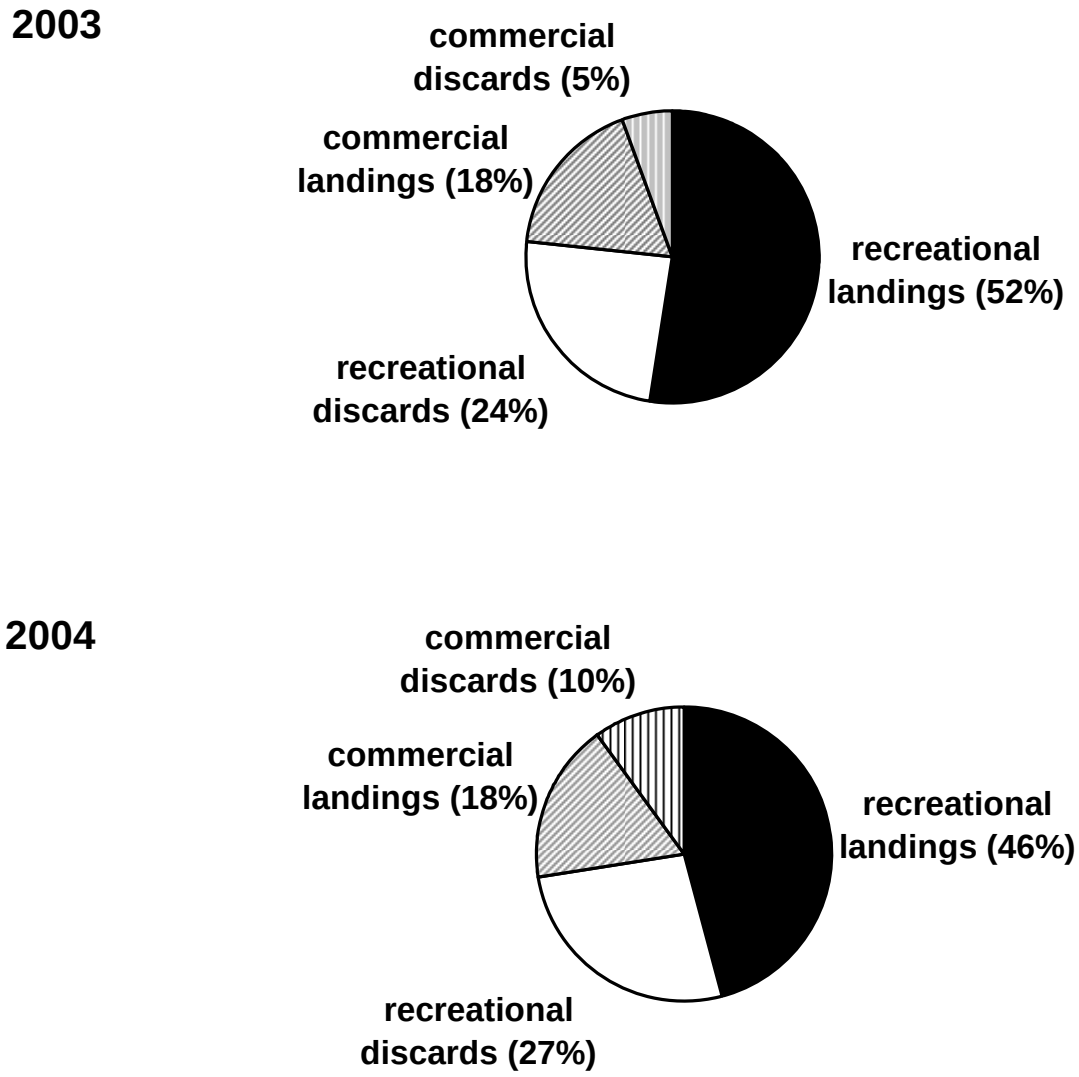


Figure 5. Striped bass population abundance (age 1 and greater, and age 8 and older) from the 2004 VPA results.

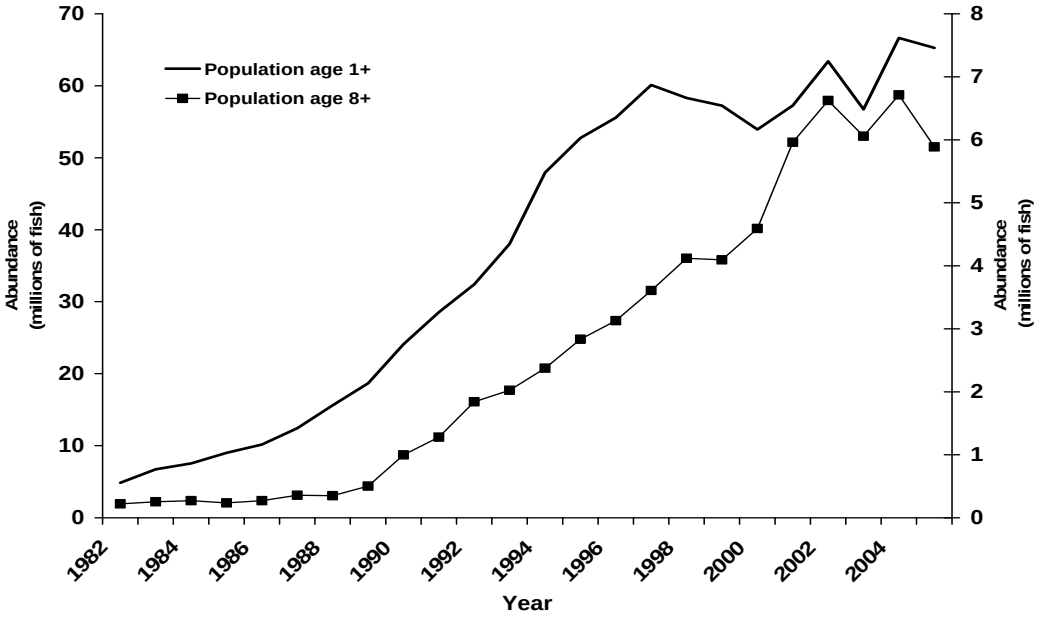


Figure 6. Trends in female spawning stock biomass, 1982 to 2004, from the 2004 VPA results.

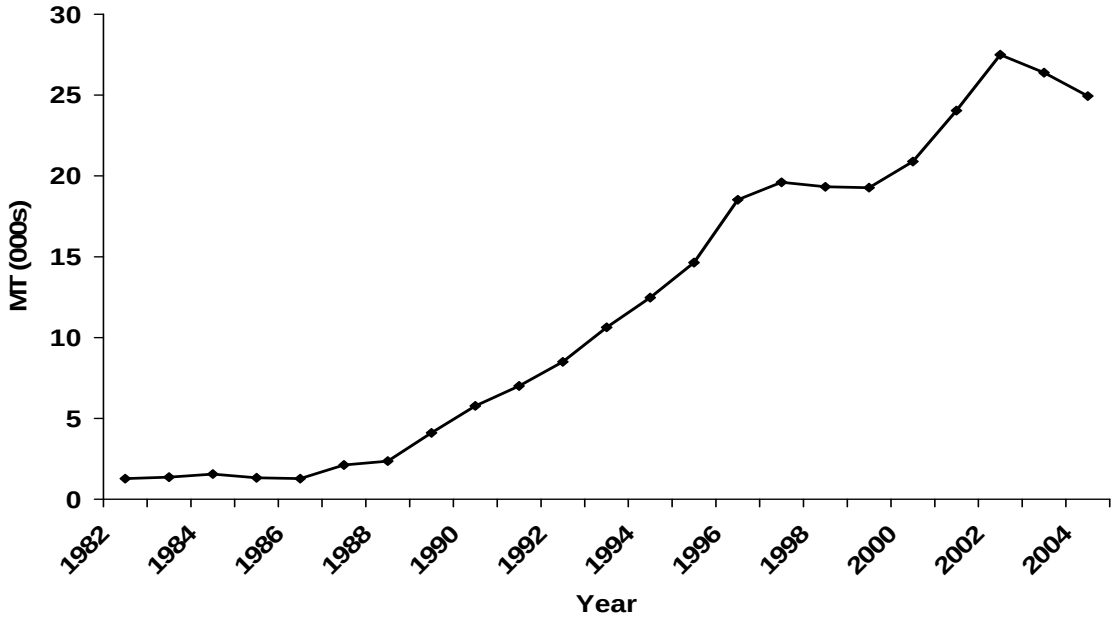


Figure 7. Estimated striped bass abundance of age 8 and older fish for 1982 – 2005, total striped bass catch of fish ages 8 and older and striped bass fishing mortality for age 8 and older fish from 1982 to 2004. Abundance estimates are derived from 2004 VPA results.