2009 Biennial Report to Congress on the Progress and Findings of Studies on Striped Bass Populations

Photo courtesy of SEAMAP Winter Tagging Cruise

Submitted to the:
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and
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LIST OF ACRONYMS

ACCSP	Atlantic Coastal Cooperative Statistics Program
ASMFC	Atlantic States Marine Fisheries Commission
CPUE	Catch Per Unit of Effort
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
F	Fishing Mortality Rate
FMP	Fishery Management Plan
FWS	U.S. Fish and Wildlife Service
ISFMP	Interstate Fishery Management Program
MSY	Maximum Sustainable Yield
mt	metric tons
NEFSC	Northeast Fisheries Science Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OY	Optimal Yield
SARC	Stock Assessment and Review Committee
SAW	Stock Assessment Workshop
SEAMAP	Southeast Area Monitoring and Assessment Program
SSB	Spawning Stock Biomass

DEFINITIONS

Commission: Unless otherwise noted, refers to the Atlantic States Marine Fisheries Commission.
Committee: Unless otherwise noted, refers to the Atlantic States Marine Fisheries Commission's Atlantic Striped Bass Technical Committee.
Striped Bass: Refers to migratory Atlantic striped bass (*Morone saxatilis*).
Striped Bass Act: Refers to the Atlantic Striped Bass Conservation Act as amended in 1997.

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EXECUTIVE SUMMARY

Introduction

The 1997 reauthorization of the Atlantic Striped Bass Conservation Act (Striped Bass Act) mandated biennial reports to Congress and to the Atlantic States Marine Fisheries Commission (Commission) from the secretaries of the Department of Commerce and the Department of the Interior concerning the progress and findings of studies of migratory Atlantic striped bass (*Morone saxatilis*). The Striped Bass Act specifically requests updates on studies that include, but are not limited to: annual stock assessments, investigations on the causes of fluctuations in migratory Atlantic striped bass populations, the effects of environmental factors on the recruitment, spawning potential, mortality, and abundance of migratory Atlantic striped bass populations, and investigations of interactions between migratory Atlantic striped bass and other fish. This document is the sixth such report to Congress and includes data available through 2009 with emphasis on the 2007 and 2008 calendar years.

Status of the Stock

- Migratory striped bass are not overfished.
- Overfishing is not occurring on migratory striped bass.
- Total commercial catch (landings and dead discards) in 2007 and 2008 were 1.75 million and 1.40 million fish, respectively.
- Total recreational catch (landings and dead discards) in 2007 and 2008 were 3.67 million and 3.18 million fish, respectively.
- Total migratory striped bass harvest (commercial and recreational catch and discard) in 2007 and 2008 is estimated at 5.4 million fish and 4.59 million fish, respectively. The 2007 and 2008 harvests are slightly below the two previous years.

Habitat and Environmental Quality

- In January 2009 the Atlantic States Marine Fisheries Commission published: Atlantic Coast Diadromous Fish Habitat: A Review of Utilization, Threats, Recommendations for Conservation, and Research Needs (available online at: http://asmfc.org/habitat.htm). The striped bass chapter includes: 1)Description of striped bass habitat; 2)The identification and distribution of striped bass habitat areas of particular concern; 3)Present condition of habitat; and 4)Significant environmental, temporal, and spatial factors affecting the distribution of striped bass.

Management Changes

- Although there has been a change in the Presidential administration, the regulation of striped bass has remained status quo. Former President Bush's Executive Order (October 2007) prohibiting the sale of striped bass caught in the EEZ remains in effect.
- The Commission's Addendum I to Amendment 6 of the Striped Bass Interstate Management Plan (November 2007) also remains in effect.
- The Commission adopted new biological reference points as recommended by the 46th Northeast Regional Stock Assessment Review Committee in 2008.

Conclusions

Atlantic migratory striped bass stocks have remained stable over the past several years. Total abundance has declined slightly since 2004 resulting in slightly lower total catches in 2007 and 2008 than in the previous two years. Striped bass stocks are at high levels of abundance and the stock is not overfished, nor is overfishing occurring. In 2008, there was an increase in recruitment (age 1 fish abundance) over the previous two years, which were below the average for the restored stock. The stock continues to be fished at levels below the reference points detailed in the current fishery management plan. It is expected that catches will increase in 2011 but decline through 2014 based on projections of 8-year and older striped bass, assuming recent fishing mortality and recruitment rates continue. Studies documenting striped bass habitat requirements at all life stages are continuing. The completion of a comprehensive documentation and review of utilization, threats, recommendations for conservation, and research needs for Atlantic striped bass habitat was completed in 2009. Disease in striped bass continues to be of concern, but studies are continuing to make progress on identifying the impacts and causes. At this time, current studies regarding Atlantic striped bass are providing important data to successfully manage this fishery.

INTRODUCTION

In response to precipitous declines in Atlantic striped bass landings during the 1970s, Congress passed, and President Carter 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 conducted to determine the status of striped bass stocks and causes for the decline in striped bass populations. This 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 a part of the study. The last such report was prepared in 1995 for the 1994 study year. In 1981 the Atlantic States Marine Fisheries Commission (Commission) developed a coastwide management plan for Atlantic striped bass to be implemented by its member states. In 1984 Congress passed, and President Reagan enacted, the Atlantic Striped Bass Conservation Act (Striped Bass Act) to support and encourage the development, implementation, and enforcement of the interstate fisheries management plan for Atlantic striped bass. When the Striped Bass Act was amended in 1997, it mandated that the Secretaries of Commerce and the Interior provide biennial reports to Congress and the Commission on studies of the Atlantic striped bass resource.

The Commission maintains an Atlantic Striped Bass Technical Committee (Committee) comprised of state, federal, Commission, university and/or other specialized personnel with scientific and technical expertise and knowledge of the striped bass fishery. The Committee principally reviews the status of the stock and other technical assignments per the request of the Commission's Atlantic Striped Bass Management Board on a regular basis. Data for stock assessments and other analyses are collected and submitted by individual states, NOAA's National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (FWS) for use by the Committee.

STATUS OF THE STOCK

In 2009 the Commission's Striped Bass Technical Committee updated the 2007 stock assessment with data through 2008 and determined that the estimated female spawning stock biomass (SSB) was 148% of the target and 185% of the SSB threshold. Estimated fishing mortality rates were 0.21 or less, below both the target and threshold values.

Commercial Catch

Commercial catch (landings and dead discards) in 2007 totaled 1.75 million fish, equal to the 2005 catch. The 2008 catch declined slightly to 1.40 million fish. Commercial landings have remained fairly level over the past 10 years (Tables 1-2). Most of the commercial landings come from the states of Maryland and Virginia, which together account for approximately 70% of the commercial catch in 2007 and 2008. Table 3 details state landings data.

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Recreational Catch

Estimated recreational catch (landings and dead discards) in 2007 totaled 3.67 million fish, which was less than 2006 but very close to the catch realized in 2005. The 2008 estimated catch decreased to 3.18 million fish, the lowest catch since 2002. Hook and line discard mortality is estimated at 8% of released fish. Recreational landings occur primarily in the states of Massachusetts, New York, New Jersey, Maryland, and Virginia. Maryland's 2008 estimated recreational catch decreased by over 200,000 to an estimated 448,271 fish landed, leaving it second to New York in total fish landed. It is expected that catches will increase in 2011 but decline through 2014 based on projections of 8-year and older striped bass, assuming recent fishing mortality and recruitment rates continue.

Trends in Stock Size

Overall, since 2003 fishing mortality continues to have modest increases while spawning stock biomass (SSB) and abundance have declined. However, it is expected that consistent recruitment into the fishery, punctuated by the exceptional 2003 year class (the largest year class since at least 1982), will offset declines in abundance and SSB through 2011 but is expected to decline thereafter through 2014. The 2008 year class was slightly above the recent average. It is also important to note that SSB and fishing

mortality remain well within the targets and thresholds of the fishery management plan as recently updated (see Amendment 6 control rule pg. 10), thus no additional management action is warranted at this time.

HABITAT AND ENVIRONMENTAL QUALITY

Studies on striped bass habitat use and environmental quality have continued during the 2007-2008 time period. The U.S. Fish and Wildlife Service's South Atlantic Fisheries Coordination Office, in cooperation with the Commission, NMFS, and other partners, continues to gather data on nearshore striped bass abundances via the Southeast Area Monitoring and Assessment Program (SEAMAP) Cooperative Winter Tagging Cruises (Cruise). A 23-year cruise summary report is expected to be released by late 2010 A Summary Fact Sheet for the Cruise was published in 2009 (available from ASMFC or the FWS South Atlantic Fisheries Coordination Office). Selected information on striped bass habitat use on the wintering grounds off Virginia and North Carolina was provided in the 2007 stock assessment document (see the appendices of the 46th SAW document).

Catch data from the 2007-2010 Cruises indicated that migratory striped bass distribution during winter off the coast of VA and NC appears to be shifting. Striped bass have been consistently caught further north, and/or further offshore of the positions where fish were most often captured during 1988-2006. A detailed analysis of the entire dataset is currently being conducted to assess what factors may be causing the distribution shift.

Additional insight into migratory striped bass habitat use is being provided through the use of acoustic tags. Dr. Ken Able and students have implanted acoustic tags in adult migratory striped bass and have learned a great deal about the behavior and habitat use of individual fish (see http://www.stripertracker.org/; also see Able et al. 2007, Ng et al. 2007, and Grothues et al. 2009). Striped bass with the tags are detected in receivers placed at various locations along the U.S. East Coast, enabling determination of their migratory patterns and residence time in specific habitats. The initial pilot studies have been completed and proposals are pending to move to a new study phase.

In January 2009, the Commission, in partnership with the FWS, NMFS, and West Virginia University, prepared and published: Atlantic Coast Diadromous Fish Habitat: A Review of Utilization, Threats, Recommendations for Conservation, and Research Needs. This comprehensive volume has a chapter on striped bass that includes: 1)Description of striped bass habitat; 2)The identification and distribution of striped bass habitat areas of particular concern; 3)Present condition of habitat; and 4)Significant environmental, temporal, and spatial factors affecting the distribution of striped bass. This publication will greatly enhance the ability of scientists and managers to locate in one place a full accounting a striped bass habitat. The publication is available online at the ASMFC web site (http://www.asmfc.org/habitat.htm).

Striped Bass Health

Disease issues continue to be an area of concern for striped bass. Specifically, a chronic, progressive bacterial disease known as mycobacteriosis is affecting a large proportion of adult fish, primarily in Chesapeake Bay. The disease is caused by several species of the genus Mycobacterium. Symptoms in striped bass include visceral lesions, appearing grossly as greyish-white nodules (granulomas) predominantly found in the spleen and kidney, and external lesions. The issue has been under investigation by area researchers since 1996, however many questions still remain.

Mycobacteriosis has been affecting striped bass since at least 1984, based on available archived tissues (Jacobs et al. 2009a). However, the current high prevalence of disease (~50-70%) in adult Chesapeake Bay striped bass has led to much public concern. Multiple survey and experimental efforts conducted by state, federal and academic researchers suggest the following:

1) Disease development is age dependent with prevalence increasing through approximately age 5 in Chesapeake Bay (Rhodes et al. 2004, Gauthier et al. 2008);

2) Recent efforts using force of infection models suggest that there may be significant mortality associated with this disease. Initial estimates suggest the probability of survival of infected striped bass may be reduced to 69% of un-infected cohorts (Gauthier et al. 2008). Further modeling and tag and recapture efforts are ongoing which will serve to refine estimates.

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3) Limited efforts outside of Chesapeake Bay have demonstrated the disease is present, but at lower prevalence in Delaware Bay (Ottinger et al. 2007), Roanoke River and Albermarle Sound, NC (Overton et al. 2006), Hudson River (Mark Fast, SUNY Long Island, Personal Communication), and the coastal migratory stock (Matsche et al. In Press);

4) Multiple species of Mycobacteria are involved, however their relative roles are not fully understood (Rhodes et al. 2004, Stine et al. 2009). The predominant isolate, M. shottsii, has also been isolated from Hudson River and Roanoke River striped bass, as well as Chesapeake Bay white perch (Morone Americana) (Stine et al. 2010). Some of the species isolated are capable of infecting humans.

5) Little is known about the ecology of the mycobacteria infecting striped bass, or how they are transmitted;

6) Stressors such as poor water quality or fish nutrition may play a role; however, limited data are available addressing these hypotheses in wild fish. Poor fish nutrition has been demonstrated to enhance the severity and progression of disease in laboratory studies (Jacobs et al. 2009b). Other stressors have yet to be evaluated.

While several individual research projects are addressing components of this issue, the major effort currently underway is a large-scale tagging study led by the Virginia Institute of Marine Sciences and the Maryland Department of Natural Resources. This approach will allow for an improved understanding of the progression of this disease as well as refining estimates of disease-associated mortality.

STATUS OF MANAGEMENT

Atlantic striped bass management is based on the Atlantic Striped Bass Interstate Fishery Management Plan (FMP) of the Commission. 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 2009. 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 Commission and to aid in the recovery of striped bass along the east coast. In 1995, the ASMFC adopted Amendment 5 to the FMP to reopen the fishery and to reduce the likelihood of overfishing. Since 1995, the Commission adopted five addenda to respond to changing circumstances in the fishery. To address complexity of striped bass management, as well as several other concerns, the Commission developed, and in 2003 adopted Amendment 6 to the FMP.

Amendment 6, the current governing amendment to the FMP, introduced a control rule as a tool to determine the status of the striped bass population, establishing target and threshold values for fishing mortality rate and female spawning stock biomass. The threshold F is the fishing mortality rate that allows for maximum sustainable yield (Fmsy). The target fishing mortality rate 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 female spawning stock biomass (SSB) threshold is equivalent to the size of the SSB in 1995, when the population was declared restored. The SSB target is 125% of the threshold value. These biological reference points were reviewed as part of the 2007 Stock Assessment and Review Committee's (SARC) review of the stock assessment. Specifically, the SARC recommended that the fishing mortality rate target and the female spawning stock biomass reference points be re-estimated based upon the statistical catch at age (SCA) model used in the assessment. The current estimates of the biological reference points for striped bass, as adopted by the Commission in August 2008, are in the table below. Based on the reference points, the stock is not overfished, nor is overfishing occurring. The 2009 stock assessment update indicated that female SSB is 148% of the SSB target and 185% of the threshold.

	Previous Biological Reference Points		Revised Biological Reference Points	
	Fishing Mortality Rate*	Female Spawning Stock Biomass	Fishing Mortality Rate*	Female Spawning Stock Biomass
Threshold	0.41	14,000 mt	0.34	30,000 mt
Target	0.30	17,500 mt	0.30	37,500 mt

*The target fishing mortality rate for the Chesapeake Bay and Albemarle-Roanoke stock is 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 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 regulations as long as the overall management regime achieves the target fishing mortality rate. States are also required to carry out specific fishery-dependent and fishery-independent monitoring programs.

In October 2007, in an effort to further strengthen existing striped bass conservation and enforcement in the EEZ, President George W. Bush issued an executive order stating that it is the policy of the United States to conserve striped bass for the recreational, economic, and environmental benefits. This Order encourages Federal and state management that supports state designation of striped bass as a gamefish where appropriate. Additionally, this Order called for action prohibiting the sale of striped bass caught in the EEZ. Although it was determined that existing regulations implemented by NMFS meet the goals of the Order, the ability of NMFS to amend striped bass regulations in the future is constrained.

In November of 2007, the Commission adopted Addendum I to Amendment 6. The purpose of this addendum was to implement a bycatch monitoring and research program as required by Amendment 6. The monitoring program was designed to increase the accuracy of data on striped bass discards from both the commercial and recreational fisheries. This addendum also recommended an angler education program to help decrease discard mortality in the recreational fishery.

SUMMARY AND CONCLUSIONS

Atlantic striped bass stocks have declined in abundance since 2004 resulting in slightly lower total catches in 2007 and 2008 than in the previous two years. However, the stock is not overfished, nor is overfishing occurring. 2008 saw an increase in recruitment (age-1 fish abundance) over the previous two years, which were below the average for the restored stock. The stock continues to be fished at levels within the bounds of the current fishery management plan. Studies documenting striped bass habitat requirements at all life stages are continuing with 2009 seeing the completion of the comprehensive documentation and review of utilization, threats, recommendations for conservation, and research needs for Atlantic striped bass habitat. Disease in striped bass continues to be of concern, but studies are continuing to make progress on identifying the impacts and causes. At this time, current studies regarding Atlantic striped bass are providing important data to successfully manage this fishery.

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Table 1. Atlantic Coast landings of striped bass in metric tons and numbers from 1981 to 2008 (recreational information not available prior to 1981).

Year	Commercial		Recreational			Total	
	metric tons	*number*	*metric tons*	*number*		*metric tons*	*number*
1982	992	428,630	1,144	217,256		2,135	645,886
1983	639	357,541	1,224	307,134		1,863	664,675
1984	1,104	870,871	582	117,993		1,685	988,864
1985	431	174,621	376	139,494		807	314,115
1986	63	17,681	502	115,576		565	133,257
1987	63	13,552	388	43,755		451	57,307
1988	117	33,310	578	92,499		694	125,809
1989	91	7,402	336	38,074		427	45,476
1990	313	115,636	1,010	163,242		1,323	278,878
1991	668	153,798	1,653	262,469		2,321	416,267
1992	650	230,714	1,830	300,530		2,480	531,244
1993	794	312,860	2,563	428,719		3,357	741,579
1994	806	307,443	3,083	565,671		3,889	873,114
1995	1,555	534,914	5,709	1,108,553		7,264	1,643,467
1996	1,541	766,518	6,040	1,199,957		7,581	1,966,475
1997	2,679	1,058,181	7,336	1,648,127		10,015	2,706,308
1998	2,936	1,223,828	5,850	1,457,057		8,786	2,680,885
1999	2,963	1,103,783	6,335	1,446,388		9,299	2,550,171
2000	3,038	1,057,711	8,060	2,025,113		11,099	3,082,824
2001	2,843	941,733	8,880	2,085,130		11,723	3,026,863
2002	2,740	654,062	8,449	1,973,171		11,189	2,627,233
2003	3,199	868,987	10,405	2,545,052		13,603	3,414,039
2004	3,332	907,501	12,596	2,615,629		15,928	3,523,130
2005	3,240	968,206	11,567	2,335,391		14,807	3,303,597
2006	3,073	1,049,587	13,814	2,774,542		16,887	3,824,129
2007	3,192	1,019,600	11,156	2,316,200		14,348	3,335,800
2008	3,281	1,006,700	12,310	2,235,700		15,591	3,242,400

Table 2. Total striped bass dead discard and harvest in numbers by fishery component, 2007 and 2008.

2007

Fishery Component	Harvest	Bycatch	Discards		Total Removals
Recreational	2,316,200	16,869,100	1,349,500		3,665,700
Commercial	1,019,600		726,700		1,746,300
Total	3,335,800	16,869,100	2,076,200		5,415,400

2008

Fishery Component	Harvest	Bycatch	Discards		Total Removals
Recreational	2,235,700	11,854,600	948,400		3,184,100
Commercial	1,006,700		395,400		1,402,100
Total	3,242,400	11,854,600	1,343,800		4,590,400

Table 3. Commercial landings, recreational landings and recreational discard losses and total (excluding commercial discards) in number (thousands of fish) for 2007 and 2008, by state.

	Commercial landings number (000s)		Recreational landings number (000s)		Recreational discards number (000s)		Total number (000s)	
	2007	2008	2007	2008	2007	2008	2007	2008
ME	-	-	71.4	49.2	88.4	37.6	159.8	86.8
NH	-	-	7.1	6.6	23.1	6.7	30.2	13.3
MA	54.3	61.1	347.1	343.3	461.8	291.3	863.2	695.7
RI	12.2	16.6	102.1	56.1	59.3	34.8	173.6	107.5
CT	-	-	109.9	113.0	146.6	189.8	256.5	302.8
NY	78.3	73.3	370.7	448.3	116.5	102.2	565.5	623.8
NJ	-	-	206.3	318.1	119.6	116.2	325.9	434.3
DE	30.7	31.9	10.1	17.0	20.1	20.9	60.9	69.8
MD	598.5	594.7	679.0	442.3	239.8	112.4	1517.3	1149.4
PRFC	86.7	81.7	-	-	-	-	86.7	81.7
VA	140.6	134.6	367.0	397.0	73.1	35.4	580.7	567.0
NC	16.6	12.9	45.5	44.9	1.3	1.1	63.4	58.9
Total	1017.9	1006.8	2316.2	2235.8	1349.6	948.4	4683.7	4191.0

Table 4. Estimated population abundance, thousands at ages 1 to 13+, 1982-2008, from the 2009 catch at age model. Total in millions of fish.

	Age														
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total	8+
1982	2,175	1,816	1,821	1,565	506	228	173	122	95	95	86	116	74	8,873	589
1983	4,730	1,869	1,262	1,066	891	287	129	98	69	54	54	49	108	10,667	432
1984	4,069	4,061	1,157	600	486	403	130	58	44	31	24	24	71	11,160	254
1985	4,047	3,498	3,023	767	390	315	262	84	38	29	20	16	62	12,552	249
1986	3,676	3,477	2,976	2,512	616	303	238	193	61	27	21	15	55	14,171	373
1987	4,850	3,160	2,968	2,497	2,056	492	237	183	147	46	21	16	53	16,724	465
1988	5,800	4,171	2,707	2,519	2,092	1,699	402	192	147	118	37	16	54	19,957	566
1989	6,740	4,982	3,545	2,242	2,010	1,607	1,266	293	138	105	83	26	50	23,086	694
1990	9,606	5,794	4,257	2,984	1,847	1,621	1,273	989	227	106	80	64	58	28,905	1,523
1991	7,934	8,264	4,929	3,509	2,384	1,449	1,260	985	764	175	82	62	94	31,890	2,162
1992	8,306	6,825	7,035	4,073	2,815	1,880	1,132	981	766	594	136	64	121	34,728	2,662
1993	10,724	7,147	5,824	5,865	3,319	2,263	1,501	902	780	609	472	108	147	39,659	3,017
1994	21,166	9,226	6,083	4,811	4,703	2,614	1,767	1,168	700	606	472	366	198	53,880	3,510
1995	13,684	18,208	7,841	4,996	3,820	3,660	2,015	1,356	894	536	463	361	431	58,265	4,042
1996	15,588	11,769	15,400	6,324	3,846	2,859	2,702	1,479	993	654	392	339	579	62,924	4,436
1997	17,823	13,387	9,958	12,583	4,951	2,903	2,105	1,959	1,063	710	466	279	653	68,842	5,131
1998	10,849	15,300	11,288	8,050	9,660	3,638	2,070	1,473	1,357	731	487	319	638	65,860	5,005
1999	10,598	9,318	12,948	9,227	6,307	7,301	2,682	1,503	1,060	972	522	347	682	63,468	5,087
2000	8,201	9,106	7,908	10,678	7,346	4,874	5,527	2,005	1,115	784	716	385	757	59,403	5,762
2001	13,603	7,042	7,695	6,436	8,298	5,490	3,546	3,955	1,421	786	551	503	801	60,126	8,016
2002	16,207	11,684	5,964	6,303	5,061	6,305	4,073	2,592	2,867	1,025	566	396	936	63,979	8,381
2003	9,435	13,923	9,908	4,905	4,993	3,884	4,734	3,017	1,905	2,098	748	412	970	60,934	9,151
2004	22,707	8,102	11,761	8,054	3,804	3,721	2,816	3,374	2,130	1,337	1,468	523	965	70,761	9,797
2005	10,020	19,493	6,830	9,502	6,177	2,791	2,649	1,967	2,332	1,463	916	1,003	1,016	66,158	8,696
2006	7,377	8,601	16,413	5,498	7,239	4,491	1,965	1,828	1,342	1,581	988	617	1,360	59,300	7,717
2007	5,769	6,330	7,228	13,136	4,145	5,187	3,108	1,331	1,223	891	1,046	652	1,304	51,350	6,447
2008	13,282	4,953	5,337	5,842	10,083	3,045	3,697	2,174	921	841	611	716	1,338	52,839	6,601

Table 5. Fishing mortality at age and average across ages, 1982-2008, from the 2009 catch at age model.

	Age													Age	Age
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+	8-13+	3-8
1982	0.00	0.21	0.39	0.41	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.41
1983	0.00	0.33	0.59	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.63
1984	0.00	0.15	0.26	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
1985	0.00	0.01	0.04	0.07	0.10	0.13	0.15	0.17	0.18	0.18	0.19	0.19	0.19	0.18	0.11
1986	0.00	0.01	0.03	0.05	0.08	0.10	0.11	0.12	0.13	0.13	0.14	0.14	0.14	0.13	0.08
1987	0.00	0.00	0.01	0.03	0.04	0.05	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.04
1988	0.00	0.01	0.04	0.08	0.11	0.14	0.17	0.18	0.19	0.20	0.20	0.21	0.21	0.20	0.12
1989	0.00	0.01	0.02	0.04	0.07	0.08	0.10	0.11	0.11	0.12	0.12	0.12	0.12	0.11	0.07
1990	0.00	0.01	0.04	0.07	0.09	0.10	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.09
1991	0.00	0.01	0.04	0.07	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.08
1992	0.00	0.01	0.03	0.05	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.06
1993	0.00	0.01	0.04	0.07	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.08
1994	0.00	0.01	0.05	0.08	0.10	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.10
1995	0.00	0.02	0.06	0.11	0.14	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.13
1996	0.00	0.02	0.05	0.09	0.13	0.16	0.17	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.13
1997	0.00	0.02	0.06	0.11	0.16	0.19	0.21	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.16
1998	0.00	0.02	0.05	0.09	0.13	0.15	0.17	0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.13
1999	0.00	0.01	0.04	0.08	0.11	0.13	0.14	0.15	0.15	0.15	0.16	0.16	0.16	0.15	0.11
2000	0.00	0.02	0.06	0.10	0.14	0.17	0.18	0.19	0.20	0.20	0.20	0.21	0.21	0.20	0.14
2001	0.00	0.02	0.05	0.09	0.12	0.15	0.16	0.17	0.18	0.18	0.18	0.18	0.18	0.18	0.12
2002	0.00	0.01	0.05	0.08	0.11	0.14	0.15	0.16	0.16	0.16	0.17	0.17	0.17	0.16	0.11
2003	0.00	0.02	0.06	0.10	0.14	0.17	0.19	0.20	0.20	0.21	0.21	0.21	0.21	0.21	0.14
2004	0.00	0.02	0.06	0.12	0.16	0.19	0.21	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.16
2005	0.00	0.02	0.07	0.12	0.17	0.20	0.22	0.23	0.24	0.24	0.24	0.25	0.25	0.24	0.17
2006	0.00	0.02	0.07	0.13	0.18	0.22	0.24	0.25	0.26	0.26	0.27	0.27	0.27	0.26	0.18
2007	0.00	0.02	0.06	0.11	0.16	0.19	0.21	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.16
2008	0.00	0.02	0.06	0.11	0.15	0.18	0.20	0.21	0.21	0.21	0.22	0.22	0.22	0.21	0.15

Figure 1. Estimated abundance and fishing mortality for striped bass age 8 and older, and total striped bass catch of fish ages 8 and older, 1982-2008. Abundance and fishing mortality estimates are derived from 2009 catch at age model results.

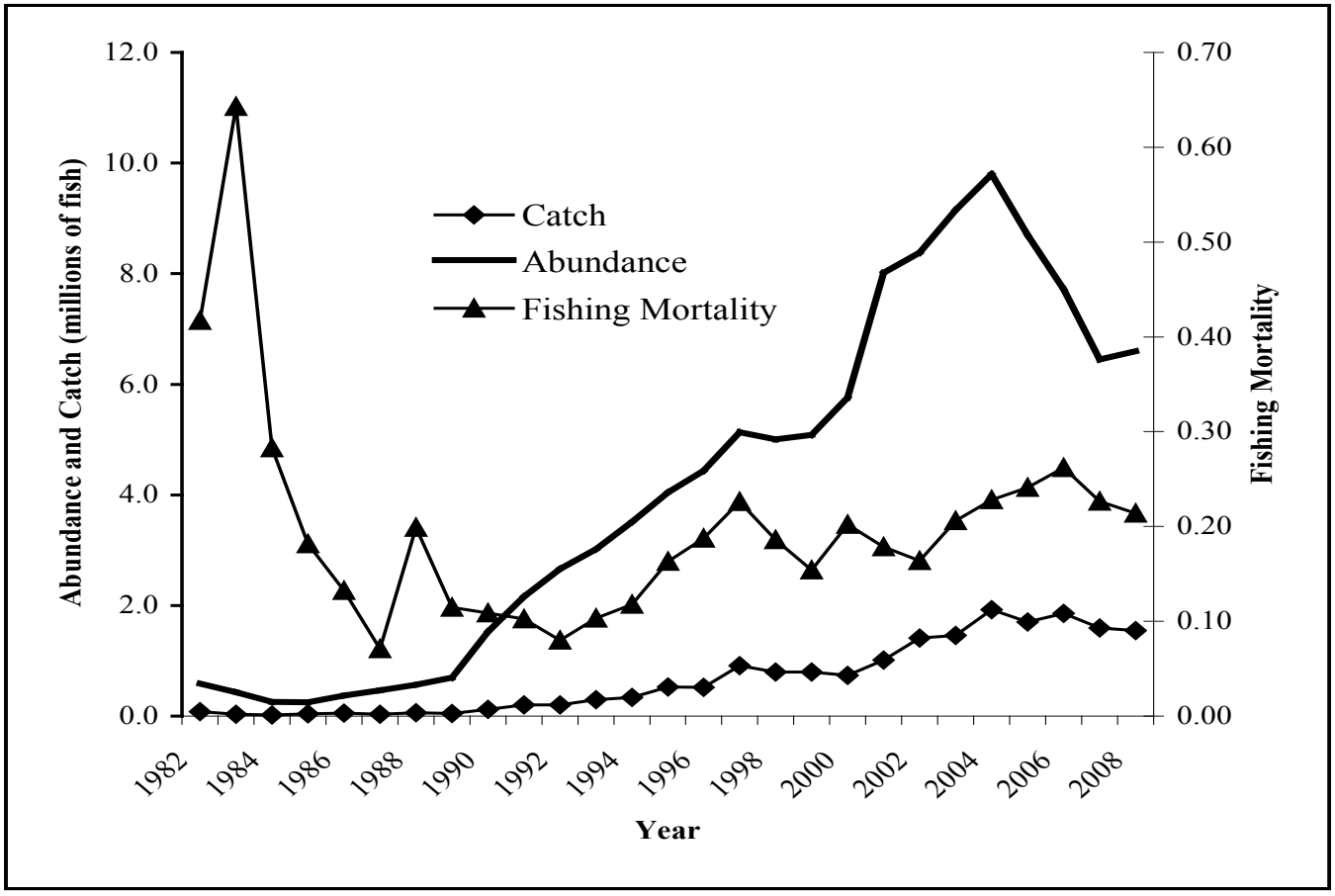
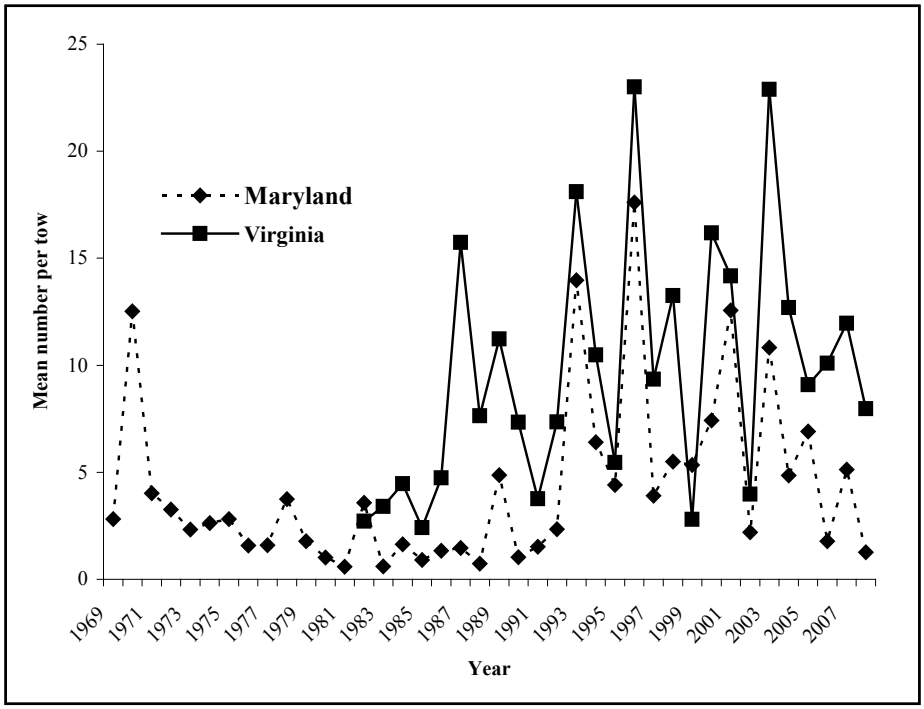


Figure 2.

a. Young of year (YOY) indices for the Chesapeake stock, Maryland and Virginia surveys, 1969 to 2009.



b. Young of year (YOY) indices for the Hudson (NY) and Delaware Bay (NJ) stocks, 1981 to 2009.

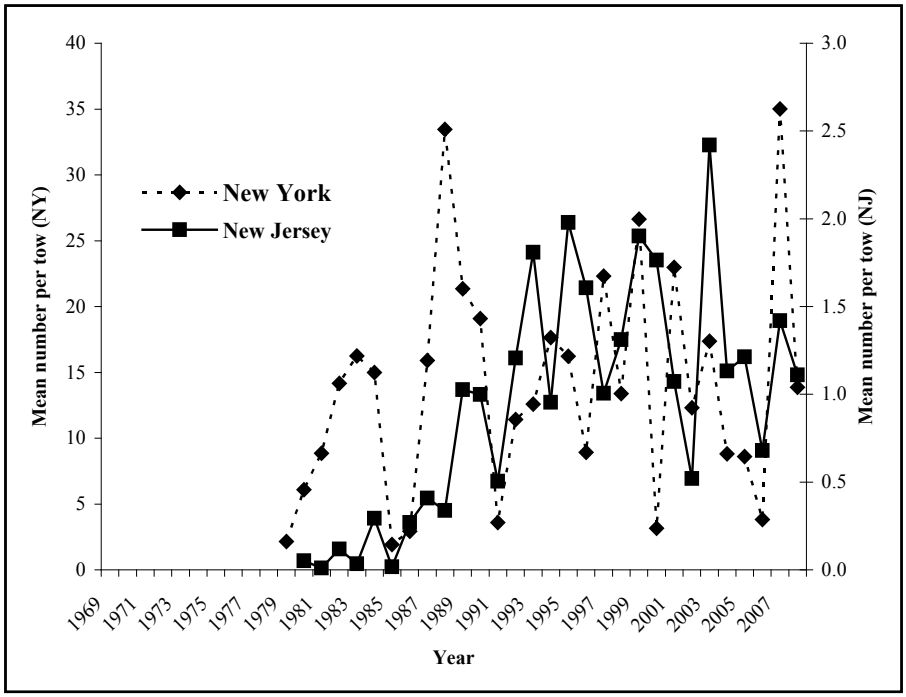
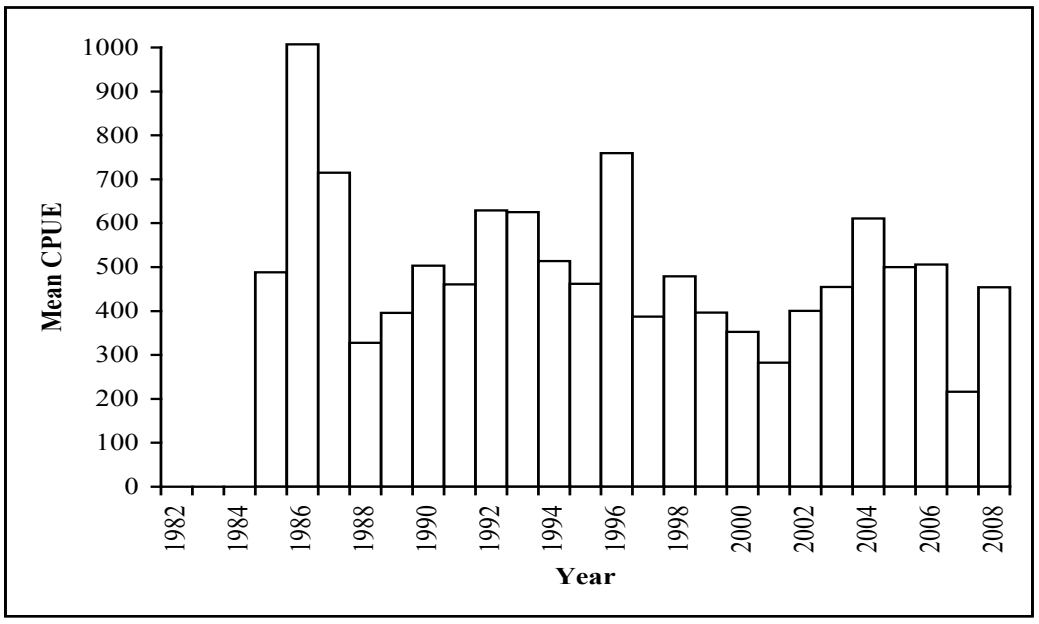
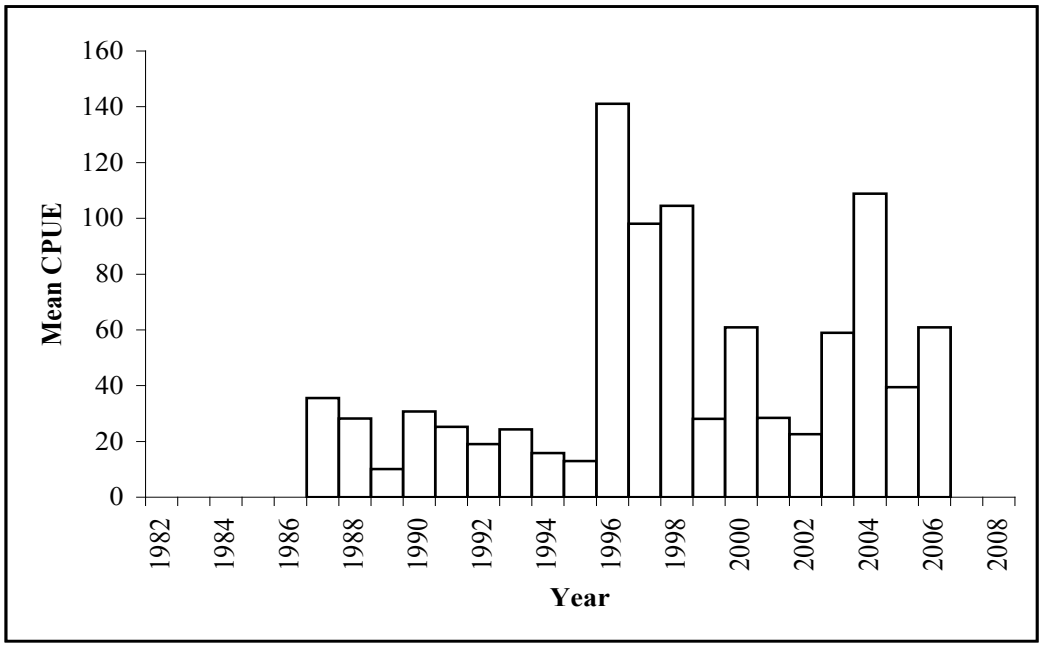


Figure 3.

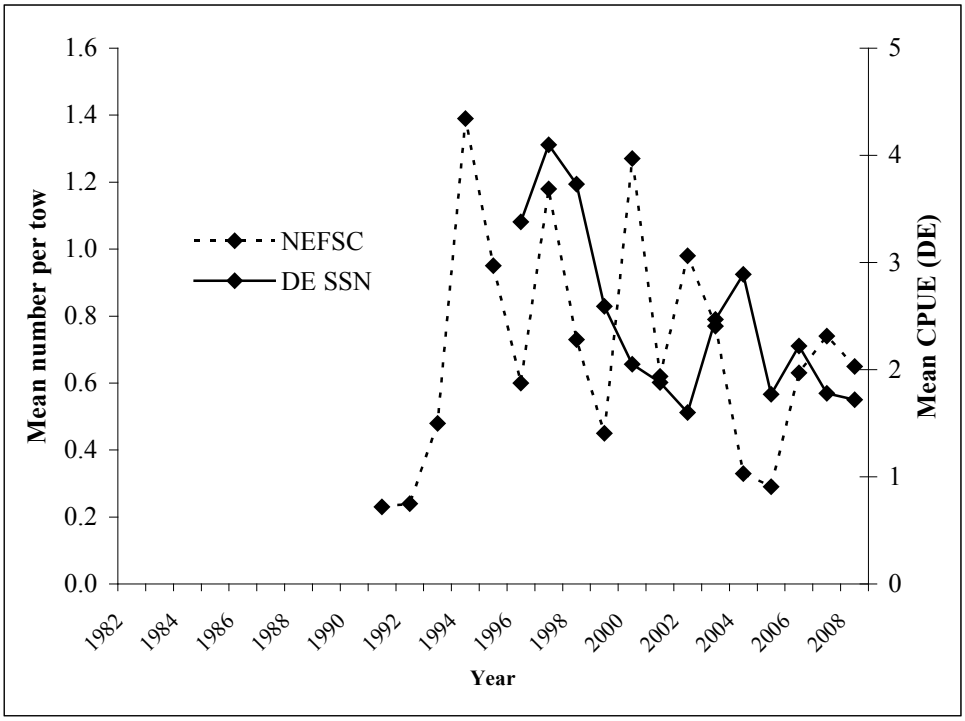
a. Maryland index of striped bass spawning stock abundance, ages 3 and older, 1985 to 2008.



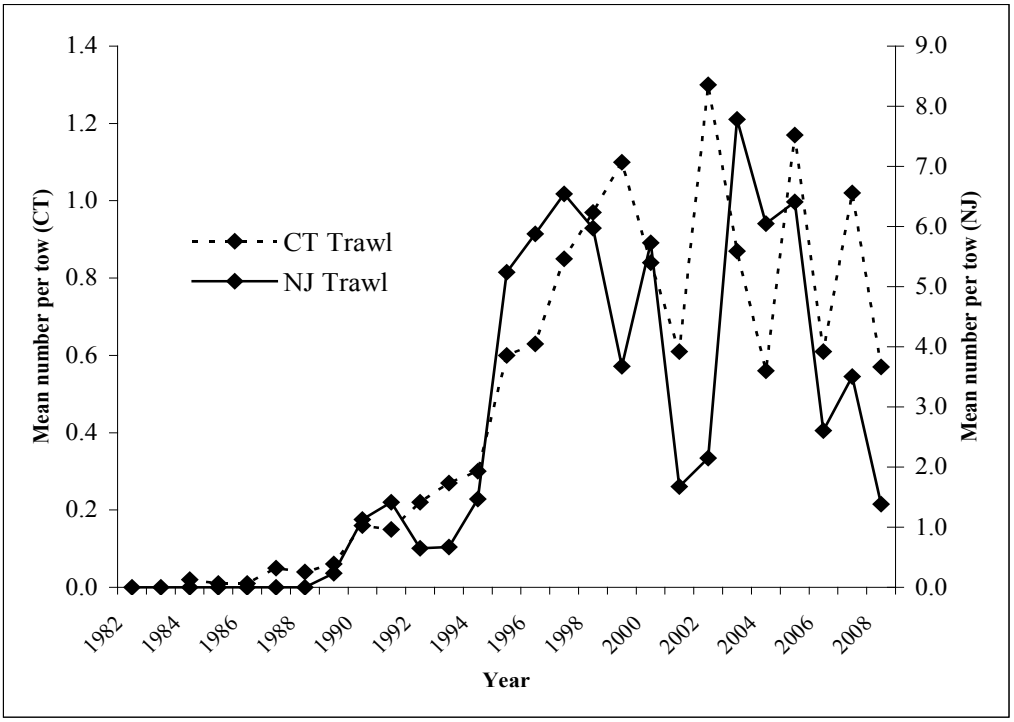
b. New York ocean haul seine index of striped bass abundance (catch per set), ages 3 and older, 1987-2006.



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



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



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

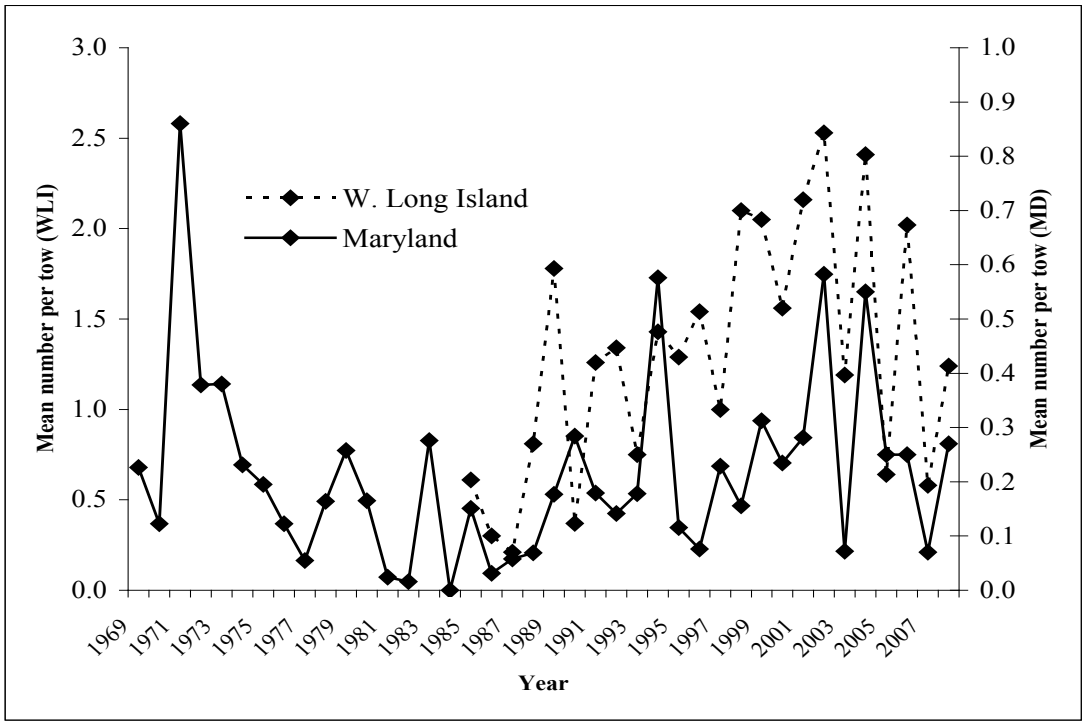
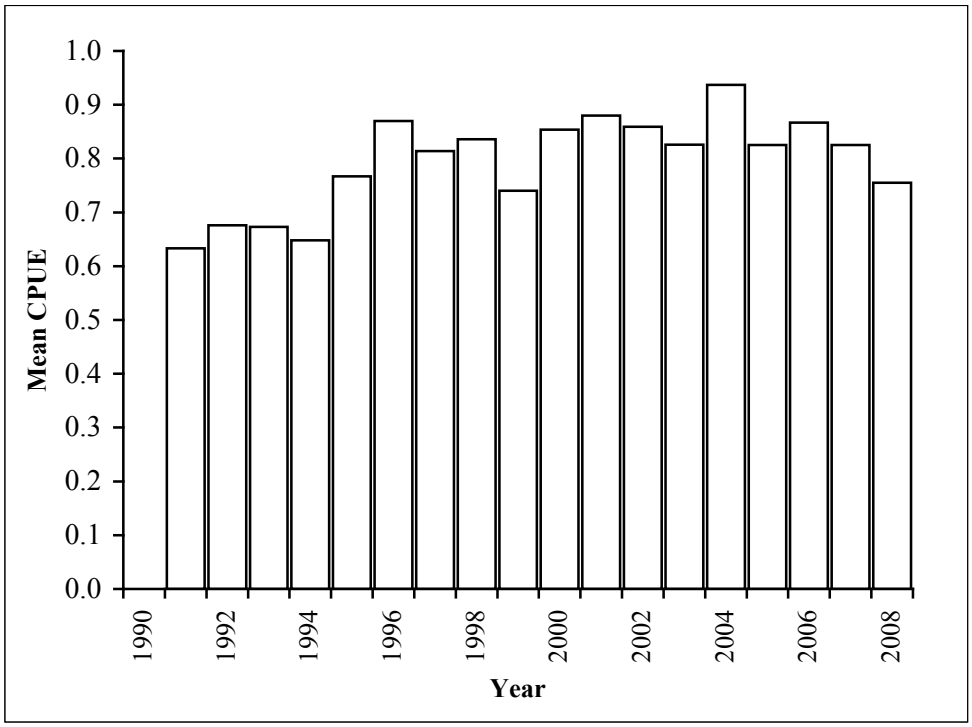


Figure 4.

a. Massachusetts commercial striped bass catch per unit effort, for fish age 7 and older, 1991 to 2008.



b. Connecticut volunteer angler striped bass catch per trip for 1982 to 2008.

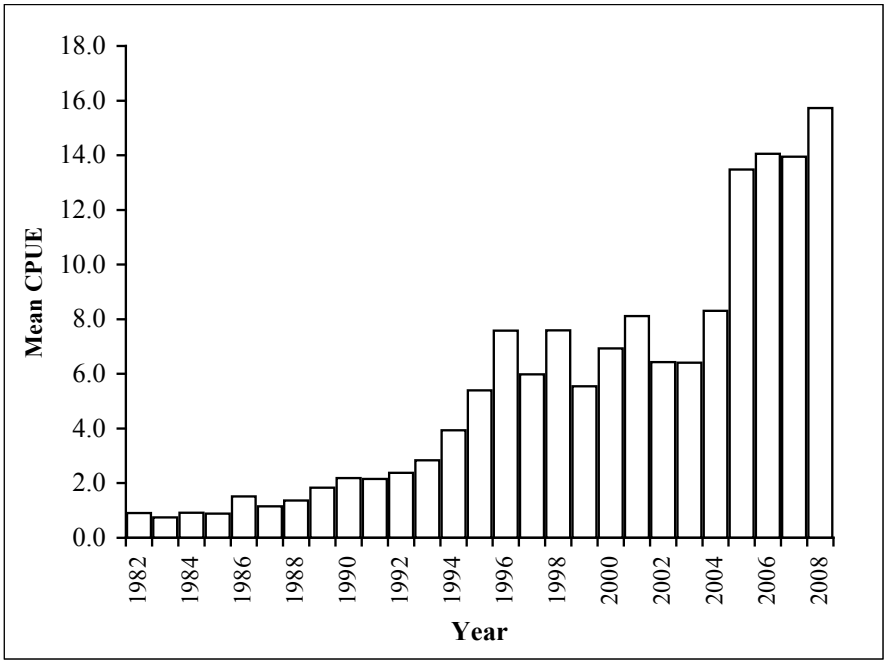
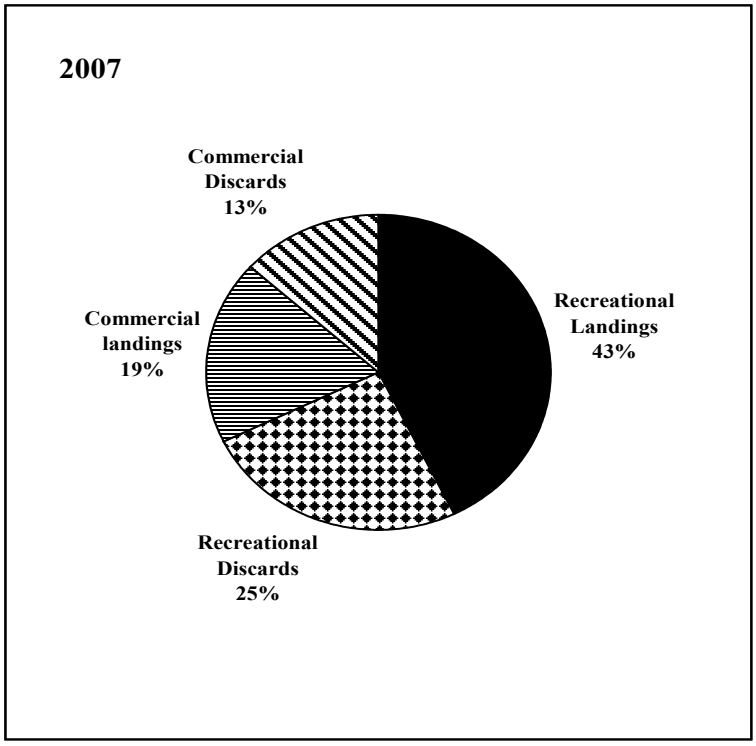


Figure 5. Percentage recreational and commercial catch (harvest and discard) in number for 2007 and 2008.



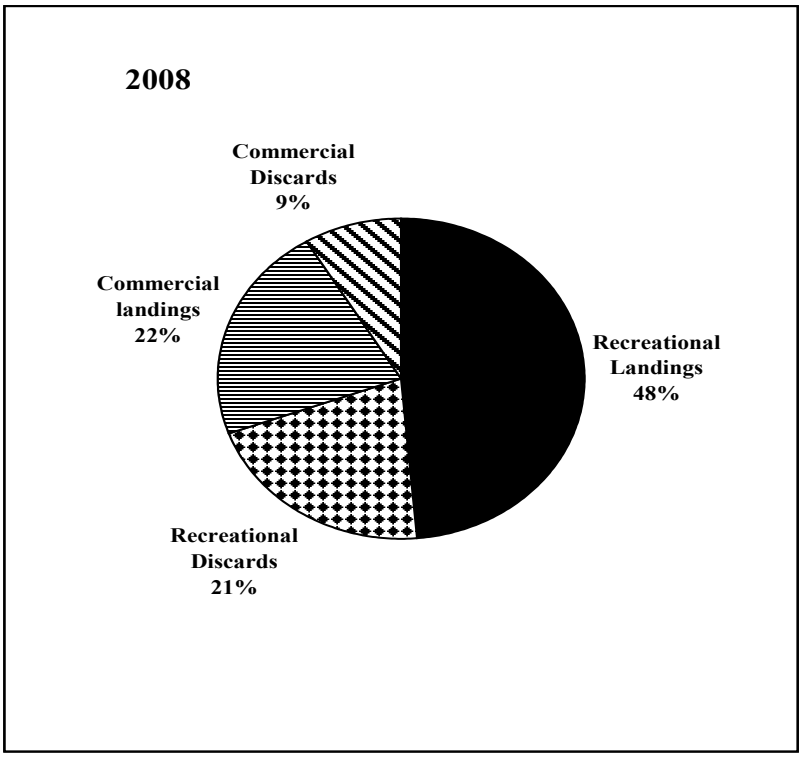


Figure 6. Striped bass population abundance (age 1 and older, and age 8 and older) from the 2009 catch at age model results.

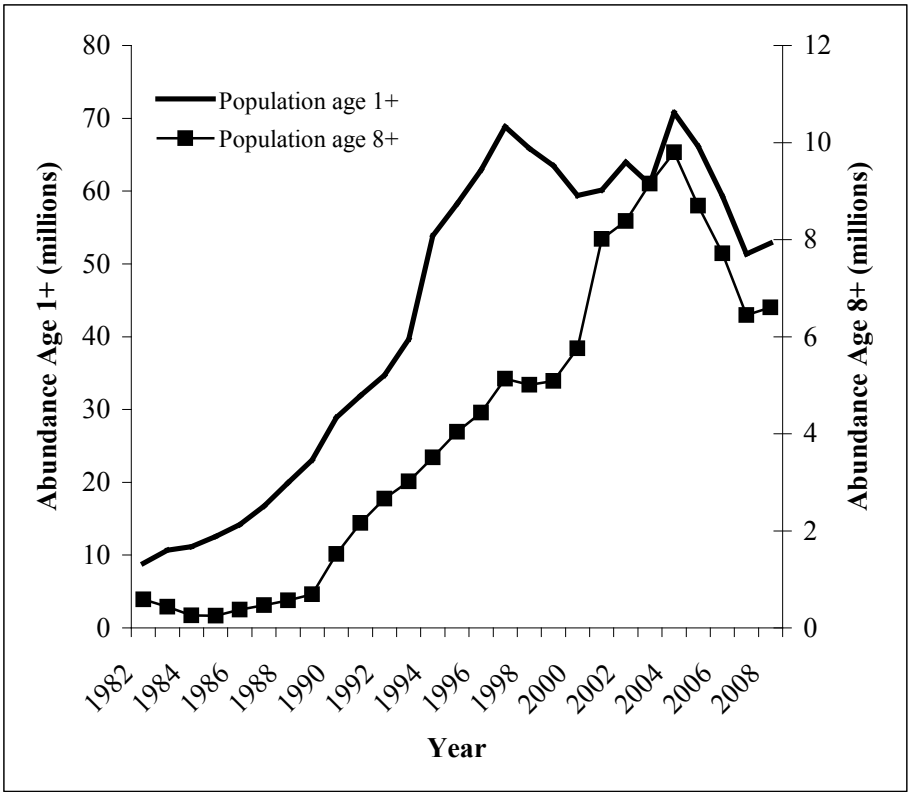
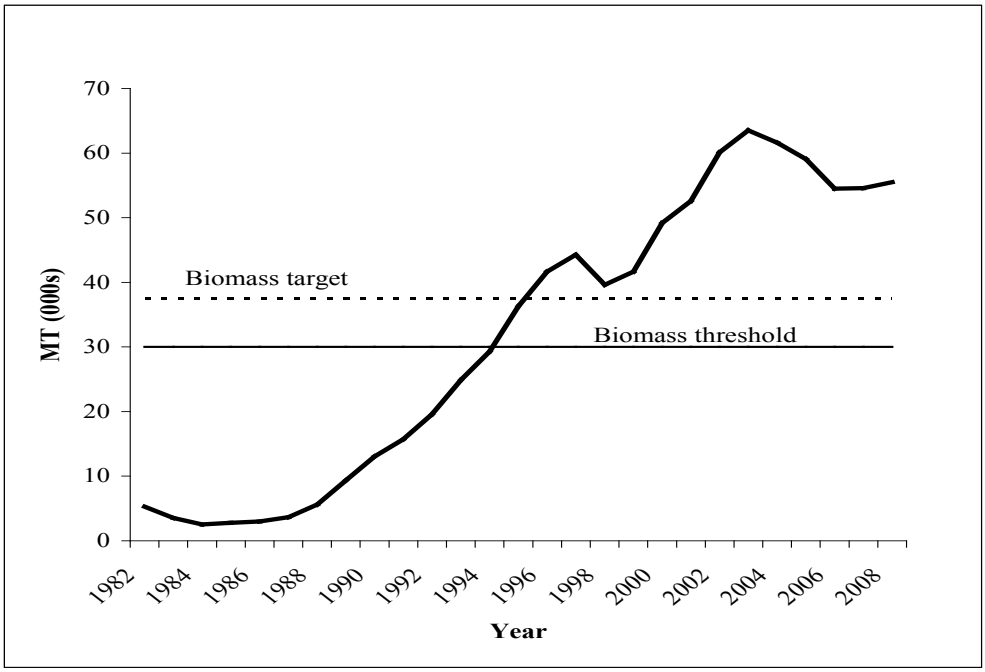


Figure 7. Trends in female spawning stock biomass, 1982 to 2008, from the 2009 catch at age model results.



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