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Atlantic Striped Bass

by

Gary Shepherd

Distribution, Biology and Management

The Atlantic striped bass, *Morone saxatilis*, is an anadromous species distributed along the Atlantic coast from northern Florida to the St. Lawrence estuary. It has been successfully introduced in numerous inland lakes and reservoirs and to the Pacific coast, where it now occurs from Mexico to British Columbia. The Atlantic coast (Figure 40.1) stocks, which originate in the Chesapeake Bay, Delaware River and Hudson River, undergo seasonal coastal migrations ranging from North Carolina to Nova Scotia, whereas stocks to the north or south remain within their natal rivers or estuaries. Recreational fishing on the coastal migratory stocks occurs year round, with peak activity occurring during the spring and fall migrations. Commercial fisheries are conducted seasonally, primarily with hook and line and gillnets.

Striped bass may attain lengths of up to 150 cm (59 in.) and weights of 25 to 35 kg (55 to 77 lb) (Collette and Klein-MacPhee 2002). Maximum age is in excess of 25 years and sexual maturity is attained between ages 2 to 4 for males and 5-8 for females (ASMFC 1990). Spawning occurs in the migratory stocks during April to June as fish migrate into fresh or brackish water. Water temperatures during spawning may range from 10° to 23° C; peak spawning activity is observed between 15° and 20° C (Hardy 1978). After spawning, most large females leave the estuaries and participate in coastal migrations. Males also leave the spawning grounds but may remain within the estuaries throughout the year. Striped bass are omnivorous, feeding on a variety of invertebrates and fish species (Walter et al. 2003), particularly clupeids such as menhaden and river herring.

Coastal migratory stocks of striped bass are managed under a fishery management plan developed by the Atlantic States Marine Fisheries Commission (ASMFC) under the authority of the Atlantic Striped Bass Conservation Act. During the mid-1980s, stringent management measures were adopted by states from North Carolina to Maine to rebuild the depleted Chesapeake striped bass stocks. Recruitment in Chesapeake Bay improved and moderate to strong year classes began to occur at regular intervals (Richards and Rago 1999). In 1995,

Atlantic striped bass were formally declared to be restored, and commercial and recreational management regulations were relaxed. Current management measures include size limits, seasonal closures, recreational daily bag limits and annual commercial catch quotas. Fisheries are limited to state waters due to the continued moratorium on fishing for striped bass within the EEZ.

The Fishery

Total recreational landings in 2004 were 2.5 million fish or 11,874mt, almost 20% above the average tonnage landed during 2001-2003 and twice as high as in 1995 when the stock was declared restored (Table 40.1, Figure 40.2). Recreational fisheries accounted for 72% by weight of the 2004 landings of the Atlantic stocks. Four states, Massachusetts, New Jersey, Maryland and Virginia, accounted for 70% of recreational striped bass landings between 2000 and 2004. The recreational fishery has generally been dominated by 7 to 9 year old fish ranging on length from 28 to 40 inches. This is in part due to size regulations as well as the strong Chesapeake Bay 1996 cohort which has contributed heavily to the coastal fisheries. Within Chesapeake Bay the size limit is 18" and the 2000 year class is the predominate cohort. The level of striped bass fishing effort, combined with size limits and a catch and release ethos, results in large numbers of discarded striped bass. Average hooking mortality has been estimated as 9% (Diodati and Richards 1996), which equates to over 1.3 million recreational discard mortalities in 2004.

Commercial fisheries occur in 8 of the 14 states/jurisdictions with striped bass fisheries. Total landings in 2004 were 3,290 mt, considerably below such landings of nearly 6,000 mt landed in 1973. Current size restrictions of 18" in Chesapeake Bay and 28" along the coast are higher than early 1970s when size limits ranged from 12" to 24". Since 2000, Maryland and Virginia have accounted for 56% of commercial landings (by weight) followed by Massachusetts with 14%. In 2004, 4 and 5 year old striped bass accounted for a third of the total commercial landings. Commercial discards in 2004 were estimated to be 10% of the total striped bass catch in number. Seasonal concentrations of migrating striped bass in the EEZ, an area currently closed to all striped bass fishing, tend to be more susceptible to incidental capture in commercial fisheries, which results in discarding.

Research Vessel Survey Indices

NEFSC spring research survey abundance indices for striped bass in the Middle Atlantic area have varied annually with the appearance of large cohorts entering coastal waters. The index increased in 1994, 1997 and 2001 due to large Chesapeake Bay year classes in 1993, 1996 and 2000. The index also increased in 2000 (Figure 40.3), due to the large 1999 year class in the Hudson River stock. Fishery independent indices of abundance for striped bass are also available from state surveys of juvenile and adult fish. Maryland Department of Environmental Protection (DEP) survey indices of striped bass show a steady increase in abundance since 2001. A haul-seine survey conducted by the state of New York along southern Long Island indicated increasing abundance since 2002. Juvenile surveys in the Hudson River, Delaware River and Chesapeake Bay exhibit moderate to strong year classes every 2 to 3 years. This pattern of successful year classes is similar to that which occurred in the 1960s when the Chesapeake stock was considered to be highly productive.

Assessment Results

Average fishing mortality (ages 8-11, unweighted) exceeded 0.3 prior to 1984 (Figure 40.4) when a moratorium was imposed in the Maryland portion of Chesapeake Bay. During the Maryland moratorium years (1984-1989), restrictive striped bass regulations or moratoriums were also enacted in other states and fishing mortality declined to about 0.15. From 1990, when the fishery re-opened, until 2003 fishing mortality averaged 0.23. In 2004 fishing mortality increased to 0.40, although estimates of F for ages 7-11 from tag recovery results show a smaller increase to 0.29. Spawning stock biomass of age 4 and older striped bass increased from about 1,300 mt in 1982 to 27,500 mt in 2002, but has since declined to 24,900 mt in 2004 (Figure 40.5). Overall, population numbers increased from 4.8 million fish in 1982 to 60.1 million fish in 1997 and have since fluctuated between 53.9 million and 66.6 million fish.

Since 1982, recruitment at age 1 from the three major coastal stocks combined has ranged from less than 1.5 million fish (1981 year class) to 22.3 million fish (2003 year class) (Figure 40.6). Over the 1982-1992 period, geometric mean recruitment for the 1981-1991 year classes was 4.6 million fish. In 1993, the Maryland juvenile striped bass index was the highest in the time series which began in 1957 and marked the beginning of a series of strong cohorts. The 1993 year class was estimated at 16.6 million fish at age 1 and was followed by the strong year classes of 1996, 2000, 2001 and 2003. The initial estimate of the 2004 year class at age 1 was 12.7 million, which is average strength for the period 1993-2003.

Biological Reference Points

Fishing mortality and spawning stock biomass biological reference points were calculated in 2003 as part of the development of Amendment 6 to the ASMFC Striped Bass FMP (ASMFC 2003). The spawning stock biomass target (17,509 mt) and threshold (14,016 mt) only pertain to female striped bass. The fishing mortality associated with F_{msy} is 0.41 and is considered the threshold level of mortality. The fishing mortality targeted by management is 0.30 (Table 40.2).

The relationship between spawning stock biomass and recruitment for Atlantic striped bass over the period covering the 1981-2004 year classes is illustrated in Figure 40.6. The spawning biomass threshold of 14,016 mt was determined based on the mature female biomass in 1995 when the stocks were considered restored. The target SSB of 17,509 mt is 125% of the 1995 spawning biomass. Spawning biomass in 2004 (24,900 mt) was 42% greater than the target SSB.

Summary

Atlantic striped bass spawning stock biomass increased since the 1980s when restoration efforts commenced and by 1995, SSB was high enough for the stock to be declared recovered. The spawning stock has continued to increase and in 2004 was well above the threshold and thus the stock complex is not overfished. Fully recruited fishing mortality (ages 8-11) has remained below the target F since 1984. Fishing mortality estimates from tag recapture models suggest 2004 estimate of fishing mortality from the catch at age model ($F = 0.40$) may be an over-estimate.

Assessment results indicate that the stocks of striped bass on the Atlantic coast are attaining their production potential and are generally being fished at or below their target fishing mortality. Concern expressed in public and scientific communities that the abundance of striped bass in Chesapeake Bay now exceeds the carrying capacity of this system. Continued work will be required to fully determine the optimal abundance of striped bass in the Bay.

Table 40.1 Recreational and commercial landings of Atlantic Striped Bass (thousand metric tons).

Category	1986-95 Average	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
U. S. Recreational	1.8	6.0	7.1	5.7	6.1	7.9	8.7	8.2	10.3	11.9	11.9
Commercial											
United States	0.5	1.2	2.7	2.9	3.0	3.0	3.1	2.7	3.2	3.3	3.0
Canada	-	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-
Total Nominal Catch	2.3	7.2	9.8	8.6	9.1	10.9	11.8	10.9	13.5	15.2	14.9

Table 40.2 Yield and SSB per Recruit and MSY Based Reference Points for Atlantic Striped bass.

Yield and SSB per Recruit-based Reference Points

SSB_{target}	=	17,509 mt
$SSB_{threshold}$	=	14,016 mt
F_{target}	=	0.30
$F_{threshold}$	=	0.41

For further information

ASMFC, 1990. Source document for the supplement to the Striped Bass Fisheries Management Plan- Amendment #4. Atlantic States Marine Fisheries Commission, Washington, D.C. Fisheries Management Report #16.

ASMFC, 2003. Amendment 6 to the Interstate Fishery Management Plan for Striped Bass. Atlantic States Marine Fisheries Commission, Washington, D.C. Fisheries Management Report # 41. 63 p.

Collette, B.B., and G. Klein-MacPhee (ed.). 2002. Bigelow and Schroeder’s Fishes of the Gulf of Maine. 3rd edition. Smithsonian Inst. Press. Washington, D.C. 748 p.

Diodati, P., and R.A. Richards, 1996. Mortality of striped bass hooked and released in salt water. Transactions of the American Fisheries Society 125: 300-307.

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- Richards, R.A., and P.J. Rago, 1999. A case history of effective fishery management: Chesapeake Bay striped bass. *North American Journal of Fisheries Management* 19: 356-375.
- Walter, J.F.III, A.S. Overton, K.H. Ferry and M.E. Mather. 2003. Atlantic coast feeding habits of striped bass: a synthesis supporting a coast-wide understanding of trophic biology. *Fisheries Management and Ecology* 10:349-360.

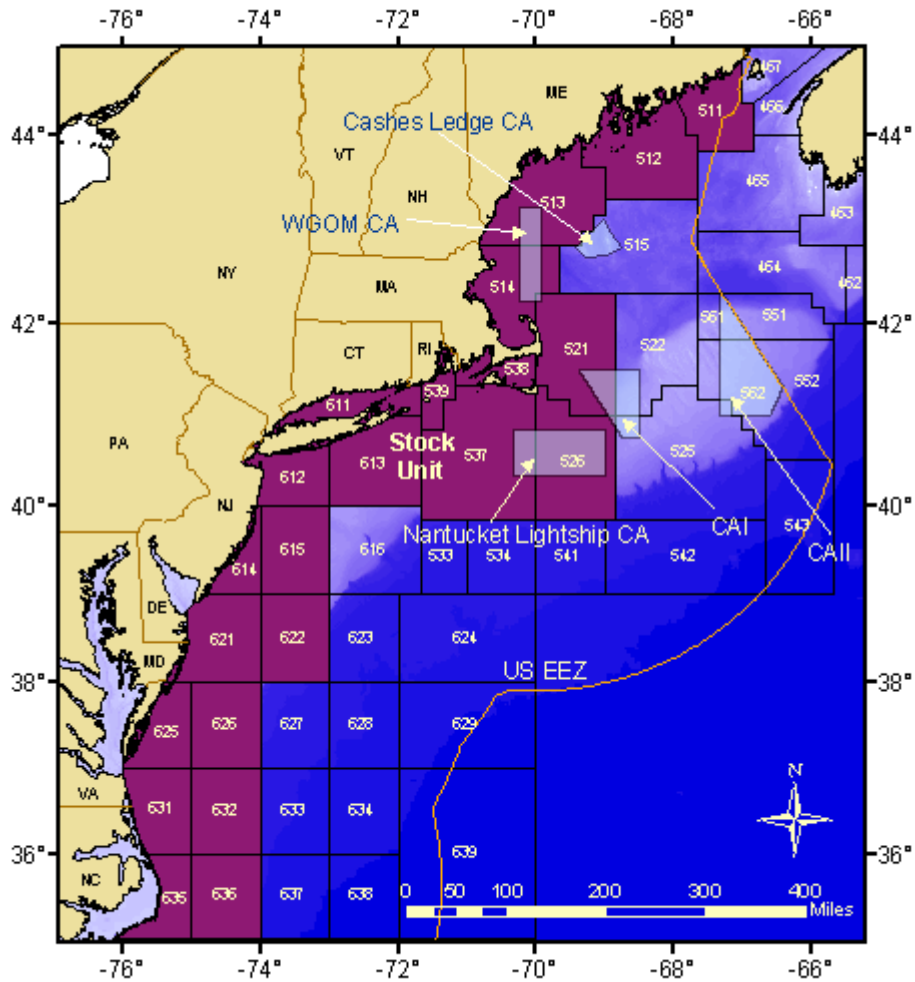


Figure 40.1. Statistical areas used to assess the combined striped bass stocks.

Atlantic Striped Bass Commercial and Recreational Landings

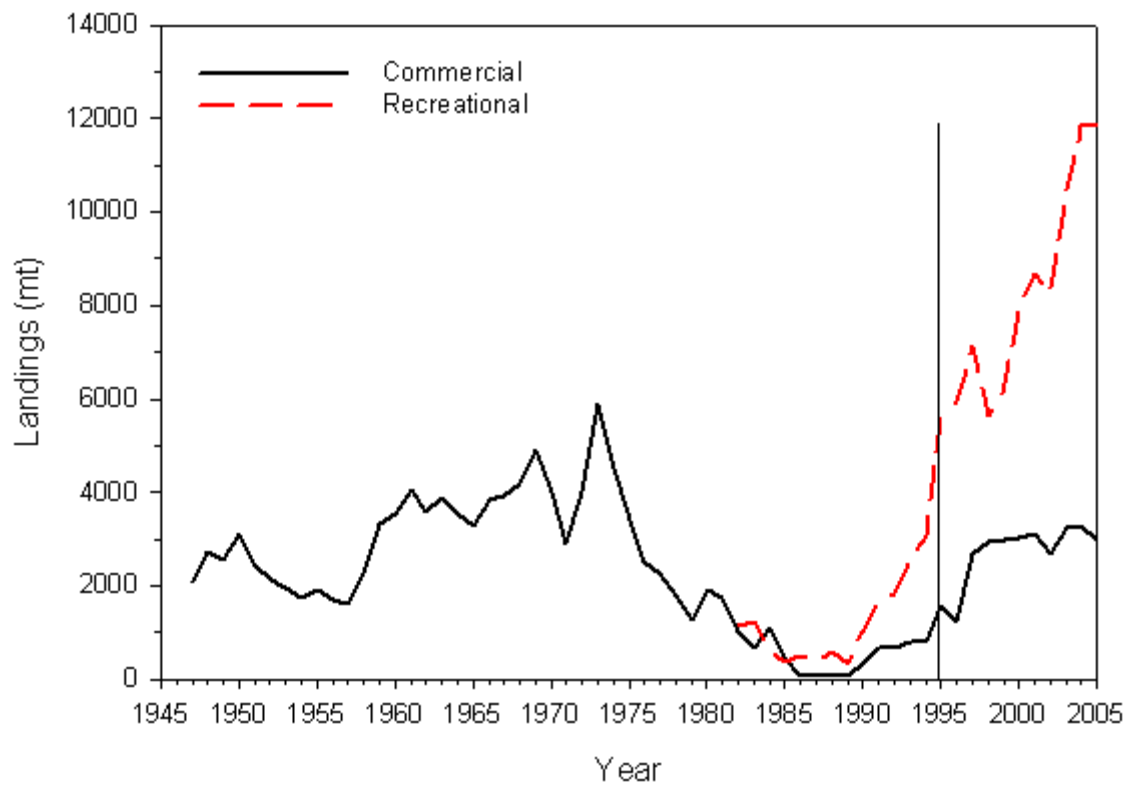


Figure 40.2. Commercial landings (1947-2005) and recreational landings (1982-2005) for Atlantic striped bass from Maine to Virginia (plus coastal North Carolina). The solid vertical line represents the year, 1995, when the coastal stock complex was declared restored.

Atlantic Striped Bass Mean Number per Tow

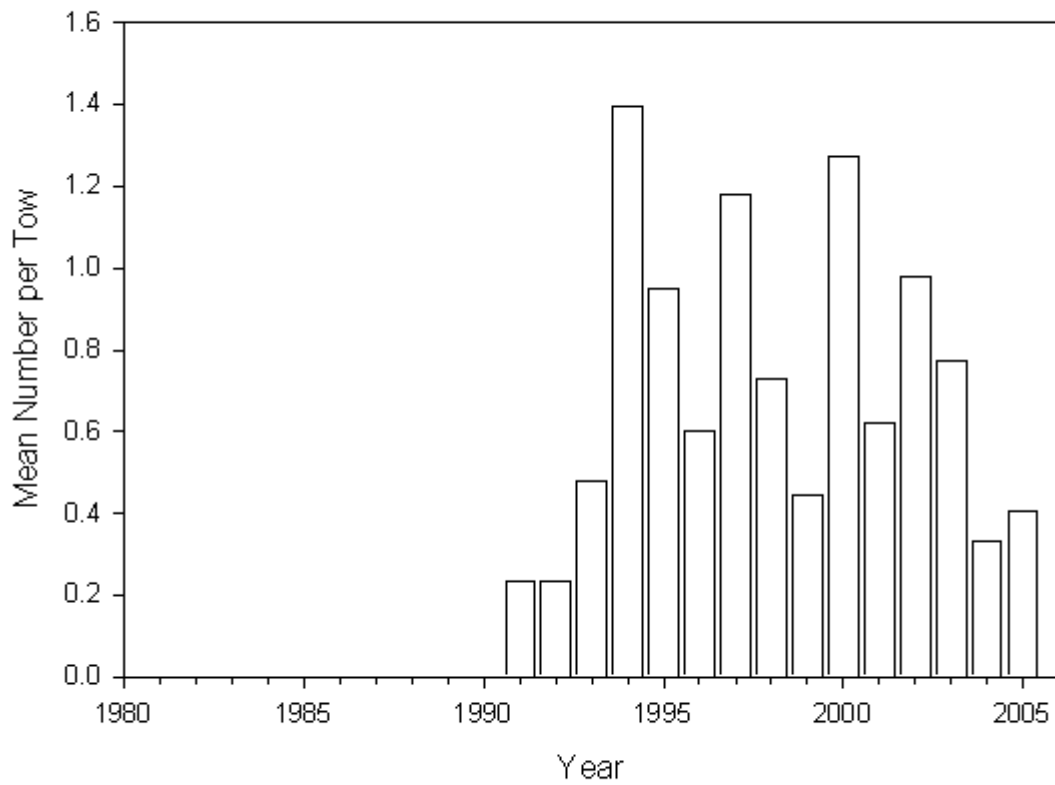


Figure 40.3. NEFSC indices (re-transformed mean number per tow) for Atlantic striped bass from spring bottom trawl survey between Massachusetts and North Carolina.

Atlantic Striped Bass Trends in Fishing Mortality

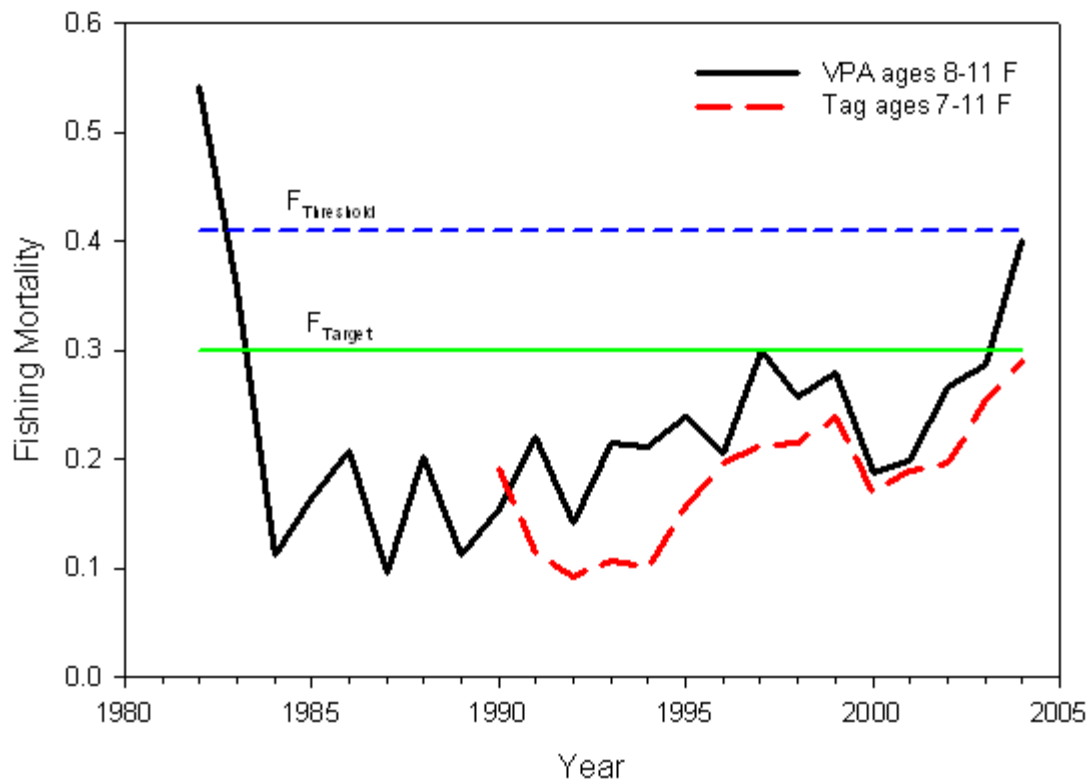


Figure 40.4. Trends in Atlantic striped bass fishing mortality from VPA and tagging models and current biological reference points.

Atlantic Striped Bass Trends in Female Spawning Stock Biomass

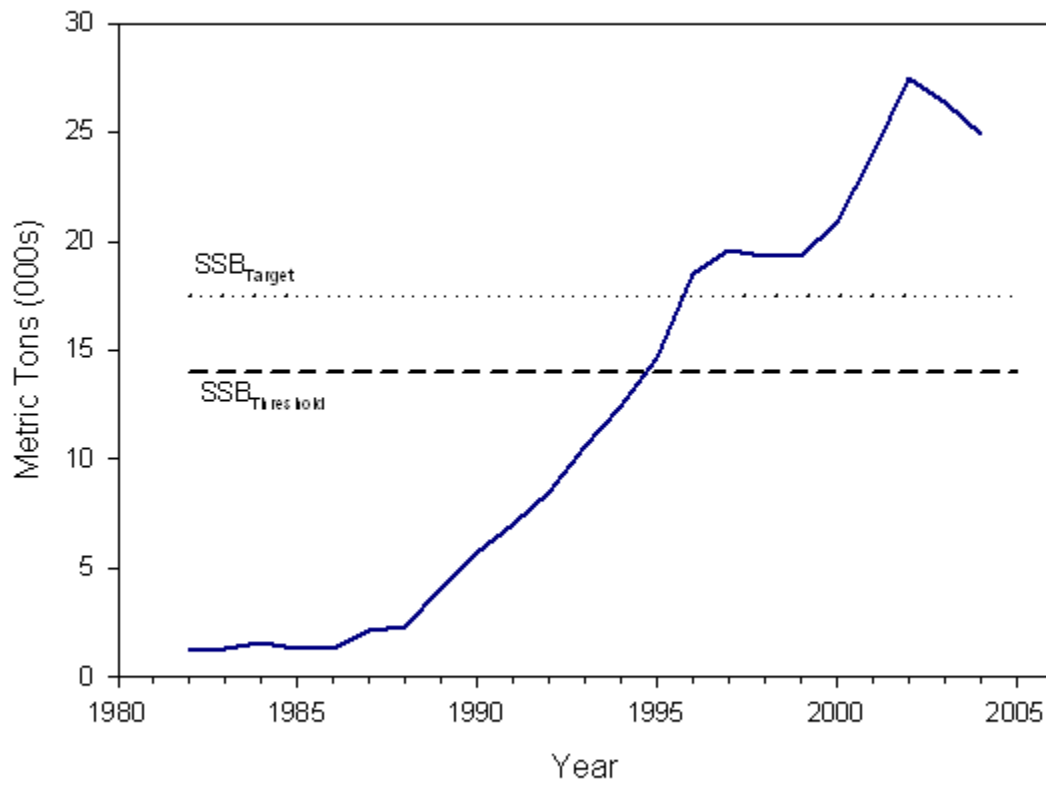


Figure 40.5. Trends in female Atlantic striped bass spawning stock biomass, 1982-2004, and biological reference points.

Atlantic Striped Bass

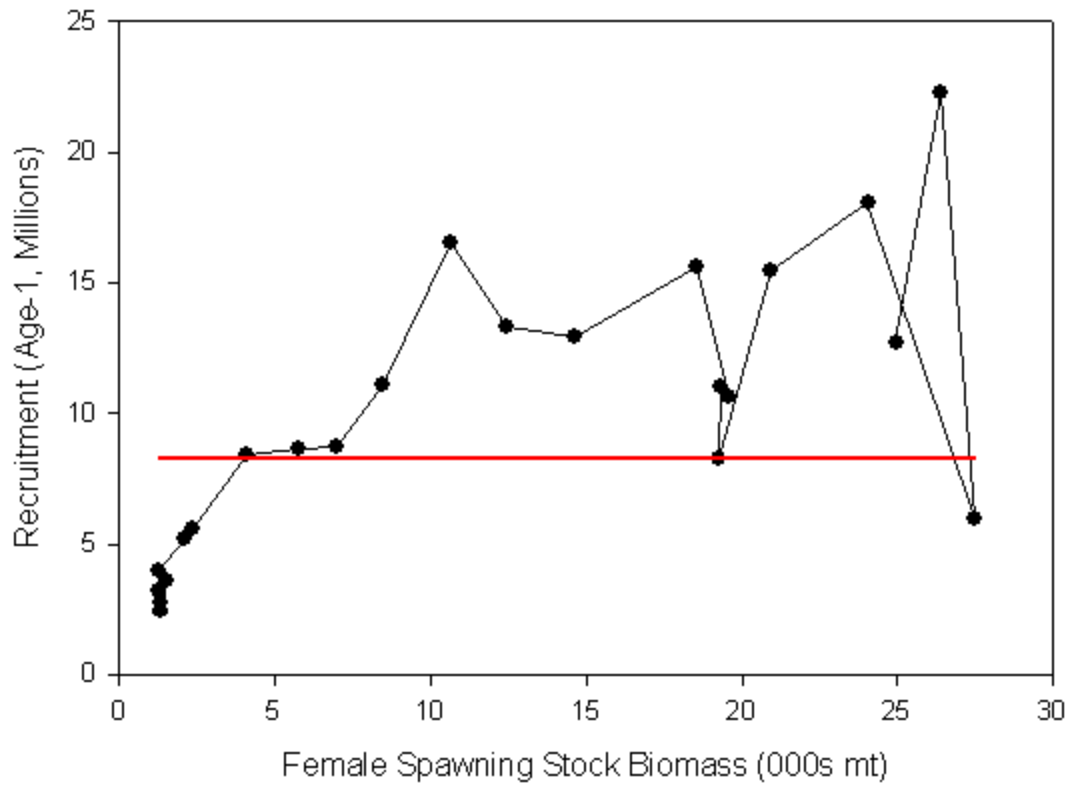


Figure 40.6. Female spawning stock biomass-recruitment scatterplot for Atlantic striped bass. The solid horizontal line represents the geometric mean recruitment during 1982-2005 (8.3 million fishes at age 1).