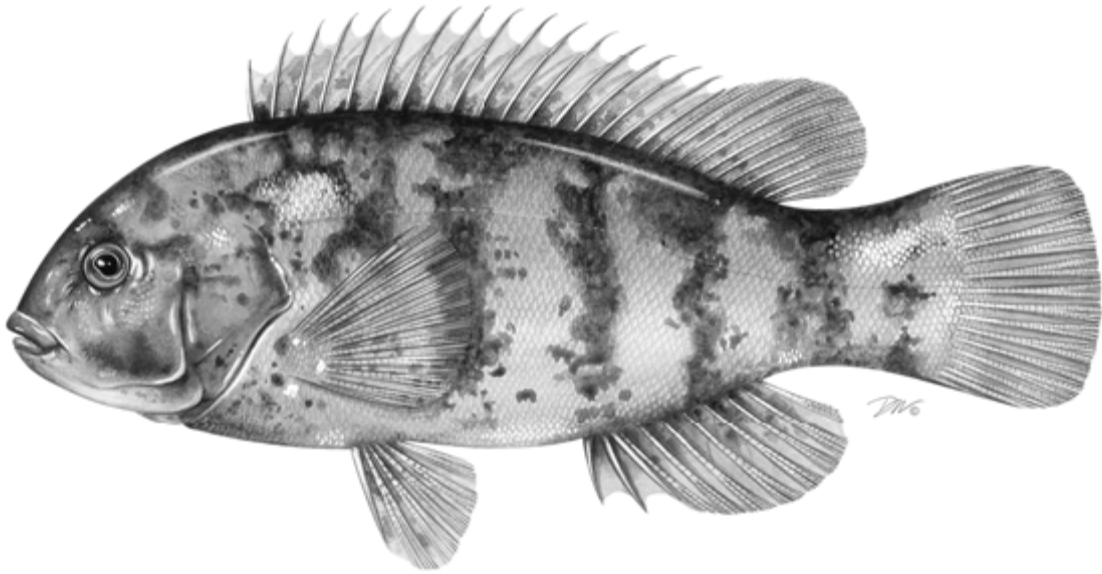# 2011 Tautog
Assessment Update Summary

ASMFC Stock Assessment Subcommittee (SAS)
Paul Caruso (MA DMF)
Jason McNamee (RI DFW)
Jeff Brust (NJ DEP)
Genny Nesslage (ASMFC)
Rich Wong (DE DFW)

TAUTOG COASTWIDE ASSESSMENT SUMMARY FOR 2011

State of Stock: The coastwide tautog stock is overfished and overfishing is occurring relative to the biological reference points established in Addendum IV to the Fishery Management Plan for Tautog (ASMFC 2007). Fishing mortality (F) calculated from the average of the currently fully recruited ages (8-10) ranged between about 0.15 and 0.65 from 1982-2008. The fishing mortality rate was estimated to be 0.45 in 2009. The average F over the past 3 years is F=0.38, both estimates are above the target fishing mortality reference point $F_{target} = 0.20$ (Figure 2).

Spawning stock biomass (SSB) decreased from a high of 35,000 MT in the early 1980s to a low of 8,000 MT in 1999. SSB was estimated to be 10,553 MT in 2009, below both the $SSB_{target} = 26,800$ MT and $SSB_{threshold} = 20,100$ MT (Figure 1).

The arithmetic average age 1 recruitment from 1982 to 2009 is 4,343,786 fish. The 1982 year class is the largest in the historical assessment time series, at 8,185,000 fish; the 2006 year class is the smallest at 2,443,000 fish. The 2008 year class is estimated to be about 5,937,000 fish, 37% above the average. (Figure 3).

The tautog coastwide stock assessment has historically exhibited a retrospective pattern of overestimation of F and both over and underestimation of SSB; the causes of these patterns have not been determined. Over the last 7 years, the annual retrospective error in fishing mortality has ranged from 0.1% in the 2006 terminal year to 17% in 2005, on average for the last 5 years running about 8% (Figure 5). Over the last 6 years, the annual retrospective error in SSB has ranged from -6% in the 2007 terminal year to +12% in 2006 (Figure 6).

Year	2004	2005	2006	2007	2008	2009	Max	Min	Mean
Commercial landings*	83,496	71,249	87,977	85,123	83,029	54,972	87,977	54,972	77,641
Recreational landings*	1,125,858	604,046	1,042,121	1,259,601	929,073	778,342	1,259,601	604,046	956,507
Recreational discards (losses)*	54,841	43,139	70,838	86,312	61,929	59,836	86,312	43,139	62,816
Catch used in assessment*	1,264,195	718,434	1,200,936	1,431,036	1,074,031	893,150	1,431,036	718,434	1,096,964
Spawning stock biomass (mt)	10,943	10,357	10,829	11,043	11,237	10,553	11,043	10,357	11,006
Recruitment (age 1, 000s fish)	3,935	4,193	2,443	2,927	7,116	5,973	7,116	2,443	4,431
F (ages 8-10)	0.29	0.12	0.39	0.42	0.27	0.45	0.45	0.12	0.32

Table 1. Catch and Status Table. * indicates number of fish.

Stock Distribution and Identification: The Atlantic States Marine Fisheries Commission (ASMFC) Fishery Management Plan for Tautog (FMP) defines the distribution of tautog to be from Georgia to Nova Scotia with the greatest numbers occurring from Cape Cod, MA to the Chesapeake Bay region. The conclusions of tagging studies (Cooper 1966; Lynch 1991; Olla et al 1980) of tautog movement and migration patterns indicate onshore offshore movements, some mixing of stocks, but no large scale coastwide stock migration patterns. These findings are consistent with the coast wide approach of the stock assessment but also allow for some degree of regionalization and/or specificity because the amount of stock mixing appears to be small around the periphery of the potential stock regions (ASMFC 1996).

Catch: Total catch peaked in 1986 at 14,846 MT. Following this high harvest event, landings declined markedly, reaching 983 MT in 1998. The principal gear used in commercial fishing for tautog is rod and reel, with some floating fish trap, fish pot, and otter trawl harvest occurring as well. Reported 2009 landings in the commercial fishery were 54,972 fish. There is no mandated commercial quota, though some states have enacted local quotas to constrain harvest. Commercial discard losses are unknown, assumed to be minimal, and are not accounted for in the assessment. Estimated 2009 landings in the recreational fishery were 778,342 fish, accounting for roughly 93% of all catch. Recreational discard losses have recently accounted for 7% of the total recreational catch, assuming a discard mortality rate of 2.5%. Total commercial and recreational landings in 2009 were 833,314 fish, and total losses were estimated at 893,150 fish (Figure 4).

Data and Assessment: The assessment model for tautog is a virtual population analysis (ADAPT VPA) (NFT 2008). The value for natural mortality is a constant value of $M = 0.15$. The fishery catch is modeled as total harvest including total discard losses. Indices of recruitment and stock abundance from the Massachusetts spring trawl survey, the Rhode Island trawl survey, Connecticut trawl survey, and New Jersey trawl surveys were used in the ADAPT model calibration. Age 1 indices from a local trawl survey conducted by the state of New York are also used in the input. This 2010 update assessment uses the same input fishery, survey data, and model configuration as the 2005 peer reviewed benchmark assessment (ASMFC 2006); updated with catch data through 2009 and 2010 fishery independent indices.

Biological Reference Points: Biological reference points were revised in 2006 via Addendum IV (ASMFC 2007), and the F_{target} changed from $F_{40\%SSB} = 0.28$ to $F=0.20$. The SSB reference point is estimated as the average of the first 10 years (1982 - 1991) of the assessment time series and the threshold is set at 75% of this value. The SSB_{target} is 26,800 MT, and the biomass threshold is 20,100 MT.

Fishing Mortality: Fishing mortality calculated from the average of the currently fully recruited ages (8-10), catch weighted values, ranged between 0.12 and 0.45 during 2004 - 2009. The fishing mortality rate has been above $F_{target} = 0.20$, since 2005 (Figure 2). The tautog stock assessment has historically exhibited a slight retrospective pattern of overestimation of F; the causes of this pattern have not been determined (Figure 5). Over the last 5 years, the annual retrospective error in fishing mortality has ranged from 0.1% in the 2006 terminal year to 17% in 2005, 8% on average for the last 5 years.

Spawning Stock Biomass: Spawning stock biomass (SSB) decreased from an average of 33,455 MT in the early 1980s to about 7,885 MT in 1999. It has remained at a low level since this date. SSB was estimated to be 10,553 MT in 2009, about 39% of the SSB reference point = 26,800 MT (Figure 1). The assessment has historically exhibited a slight retrospective pattern of both overestimation and underestimation of SSB; the causes of this pattern have not been determined (Figure 6). Over the last 5 years, the annual retrospective error in SSB has ranged from -6% in the 2007 terminal year to +12% in 2006.

Recruitment: The arithmetic average age 1 recruitment from 1982 to 2009 is 4,431,000 fish. The 1981 year class is the largest in the historical assessment time series, estimated at 8,185,000 fish as age 1; the 2005 year class is the smallest estimated at 2,443,000 fish as age 1. The 2008 year class is estimated as 5, 973,000 fish at age 1, 39% above the average. (Figure 3). A recent pattern of underestimation in recruitment is evident (Figure 7). Over the last 5 years, the annual retrospective error in recruitment has ranged from -104% for the 2007 year class to +6% for the 2004 year class.

General comments from the stock assessment subcommittee (SAS): The SAS wishes to provide the following comments to the Tautog Management Board:

- The SAS recommends that the update is appropriate for current management use given the need to address recent harvest levels relative to management goals and the lack of stock rebuilding.
- The SAS remains concerned about the differences in stock dynamics over the entire range of the species versus the use of a coast wide model.
- The SAS has concerns regarding the lack of fishery independent indices south of New Jersey.
- There is some lack of confidence in trawl surveys to provide the only fishery independent indices of abundance for a structure oriented species. Alternate survey gear types should be explored.
- Mean weight data needs updating.
- Residual patterns in fishery independent indices suggest changes in catchability over time. The current modeling approach is unable to capture this.
- Other statistical modeling approaches could more adequately explore some of the issues indicated by the residual patterns.
- The validity of the underlying recreational catch data and its influence on the model outputs and reference point calculations is unknown.
- There is relatively little information concerning incoming recruits as there are no age 0 indices in the model inputs.
- There is concern that the discard length frequency distribution is biased to single mode (party and charter)
- There is concern about the lack of commercial discard estimates and length frequency distribution
- The age data continues to improve over earlier tautog assessments.
- The model fit is good and consistent
- The retrospective pattern is minor.

Sources of Information

ASMFC. 1996. Fishery management plan for tautog. Fishery Management Report No. 25. 69 pp.

ASMFC. 2006. Tautog Stock Assessment Report for Peer Review. Stock Assessment Report No. 06-02. 184 pp.

ASMFC. 2007. Addendum V to the interstate fishery management plan for tautog. 5 pp.

Cooper, RA. 1966. Migration and population estimation of the tautog, Tautoga onitis (Linnaeus), from Rhode Island. Transactions of the American Fisheries Society 95: 239-247.

Lynch, TR. 1991. Marine Finfish Investigation, Sport Fish Population Survey in Rhode Island Marine Waters – Tautog studies, January 1, 1990 – December 31, 1990. Rhode Island Division of Fish and Wildlife Performance Report Project: F-54-R-1, Study I-I.

NOAA Fisheries Toolbox (NFT) 2008. Virtual Population Analysis Model (ADAPT), version 3.0.3. [Internet address: http://nft.nefsc.noaa.gov].

Olla, BL, Studholme, AL, Bejda, AJ, Samet, C, Martin, AD. 1980. Role of temperature in triggering migratory behavior of the adult tautog Tautoga onitis under laboratory conditions. Marine Biology 59: 23-30.

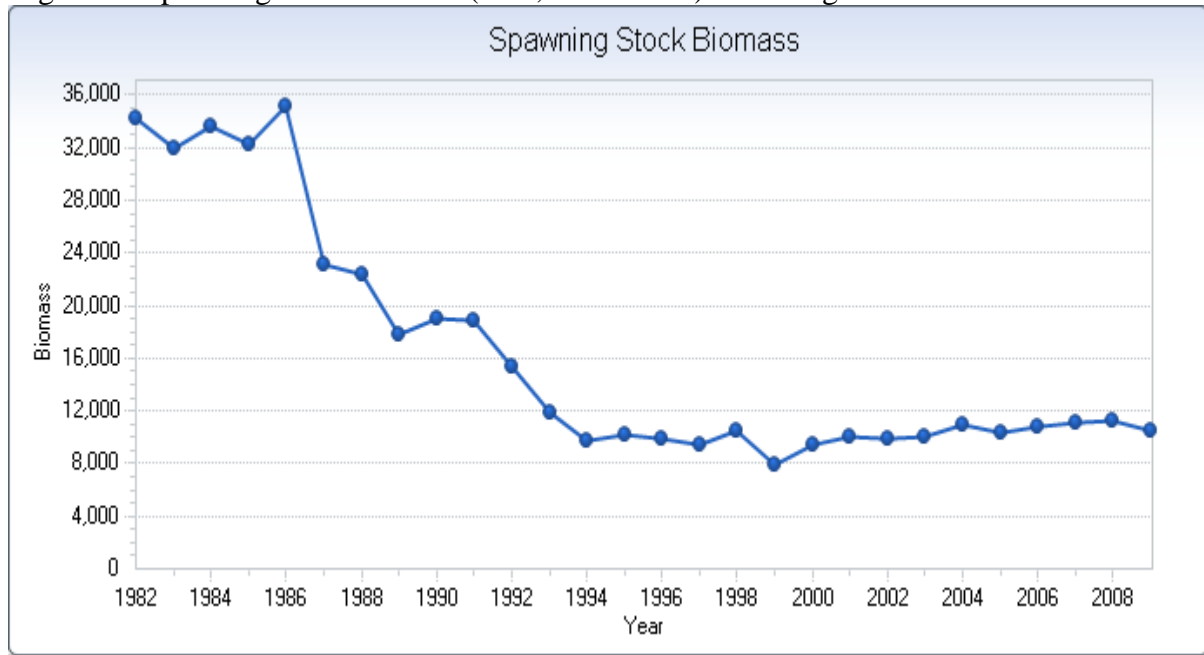Figure 1. Spawning stock biomass (SSB, metric tons) for tautog.

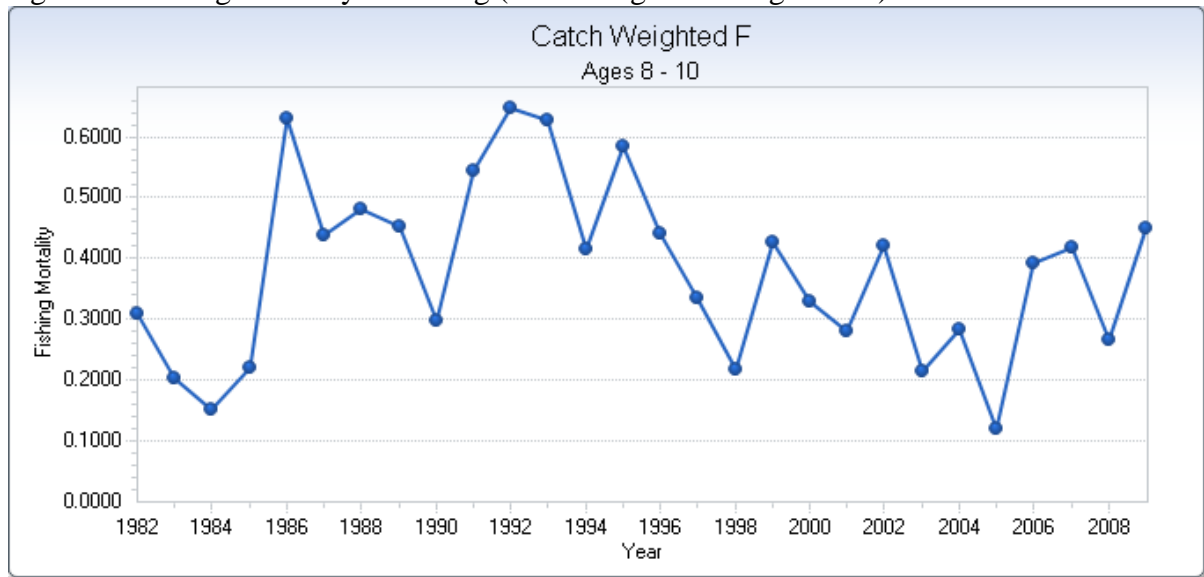Figure 2. Fishing mortality for tautog (catch weighted for ages 8-10).

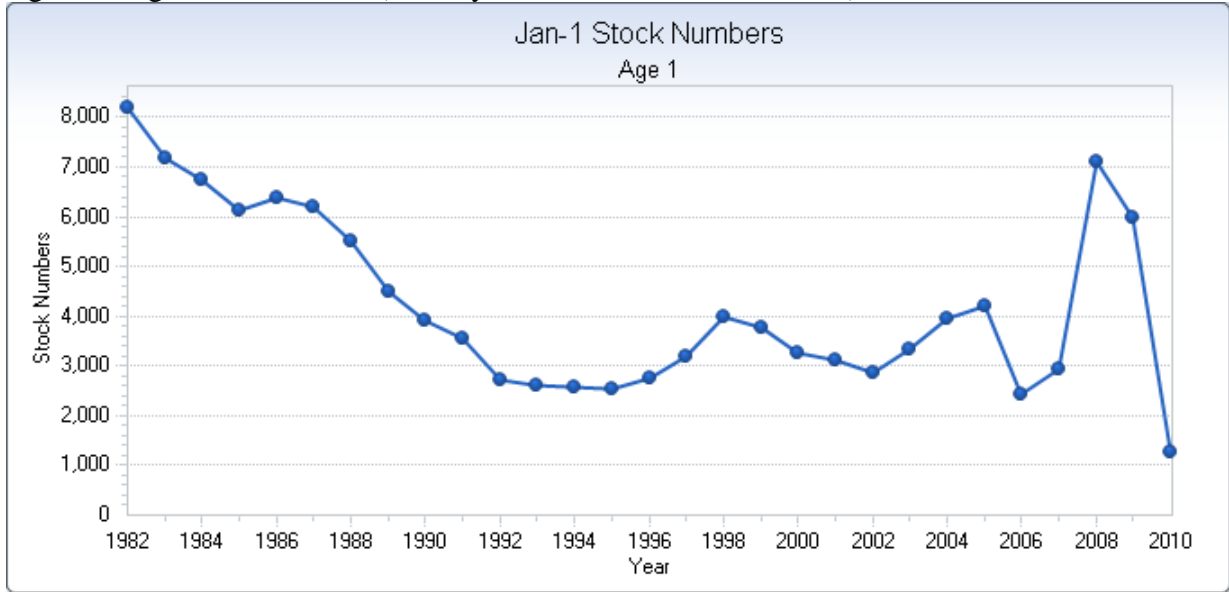Figure 3. Age 1 Recruitment (January 1 stock numbers; 000's fish).

Figure 4. Total catch (landings and discards, numbers of fish) and fishing mortality rate (F, ages 8 - 10) for tautog.
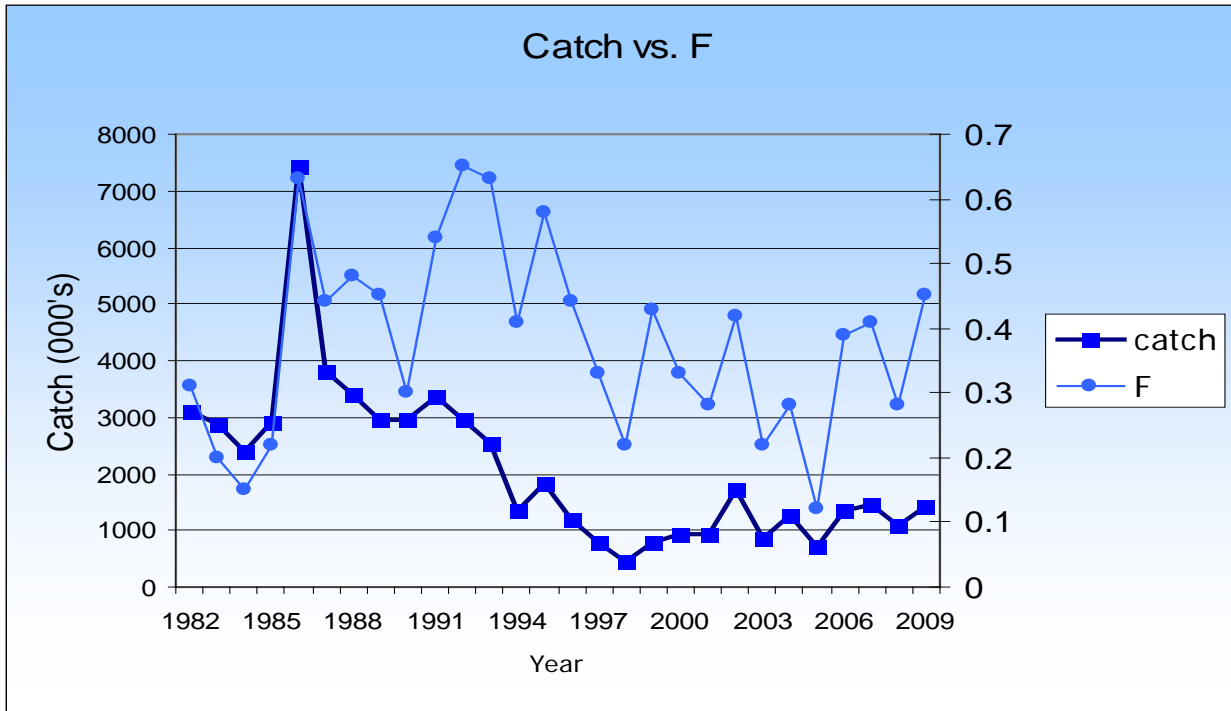

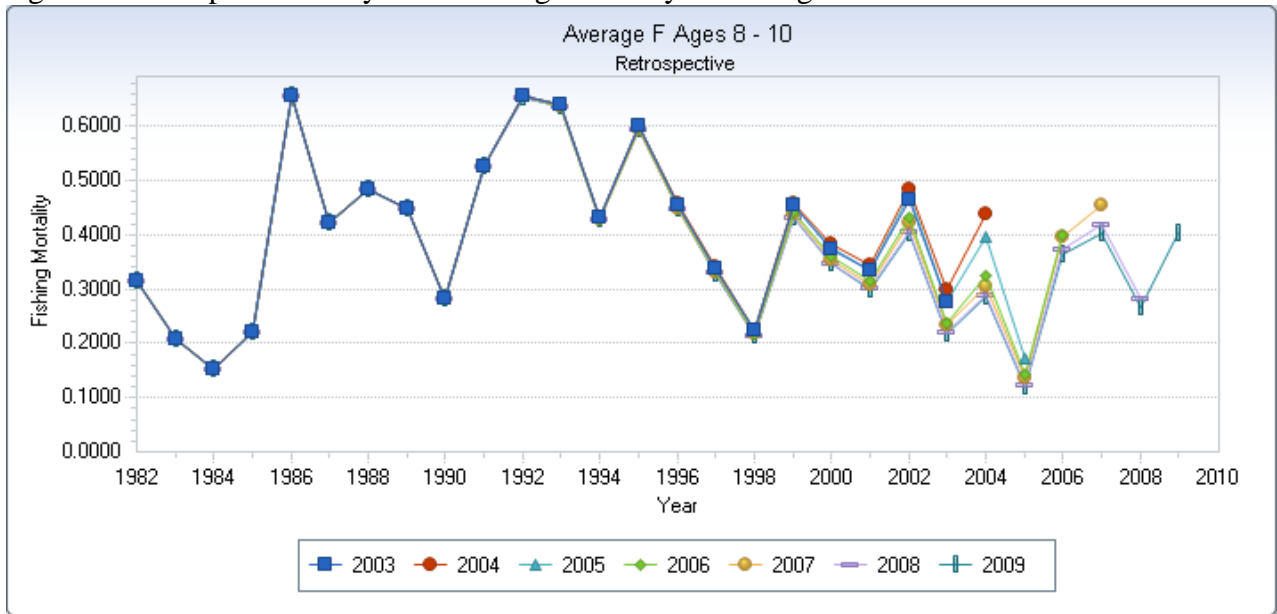Figure 5. Retrospective analysis of Fishing Mortality for tautog.

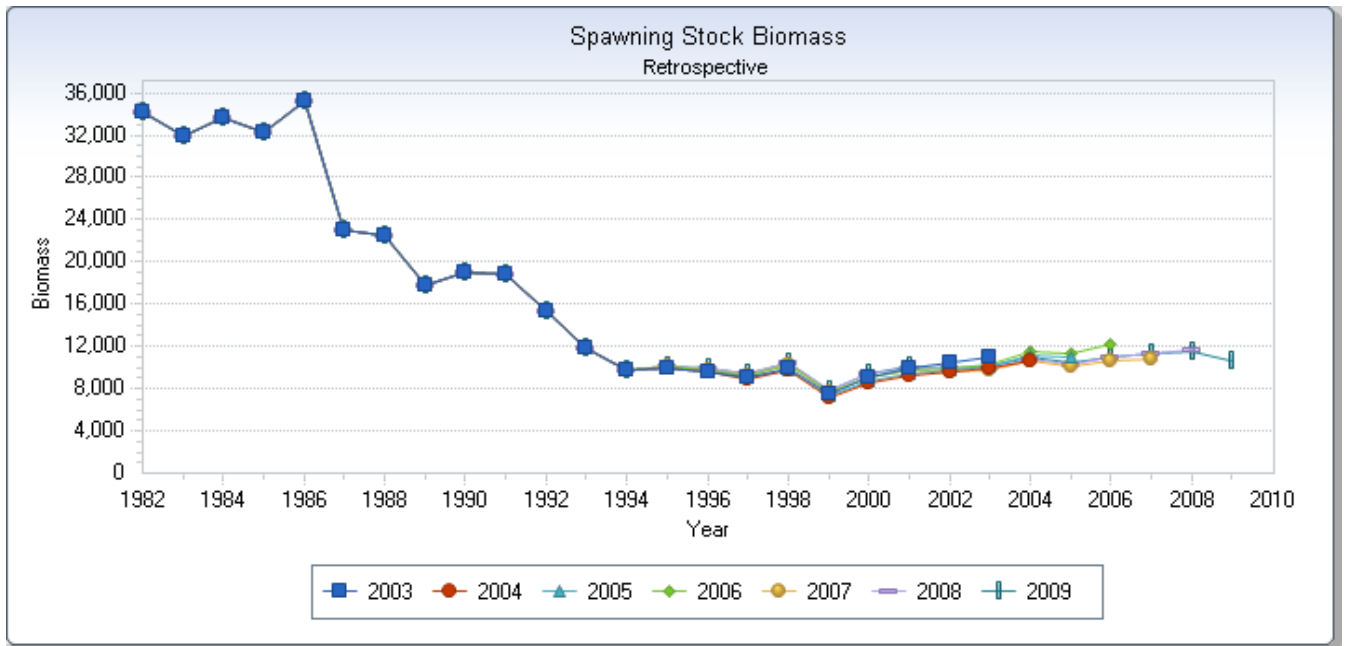Figure 6. Retrospective analysis of Spawning Stock Biomass (metric tons) for tautog.

Figure 7. Retrospective analysis of Recruitment (Stock Numbers; 000s age 1) for tautog.