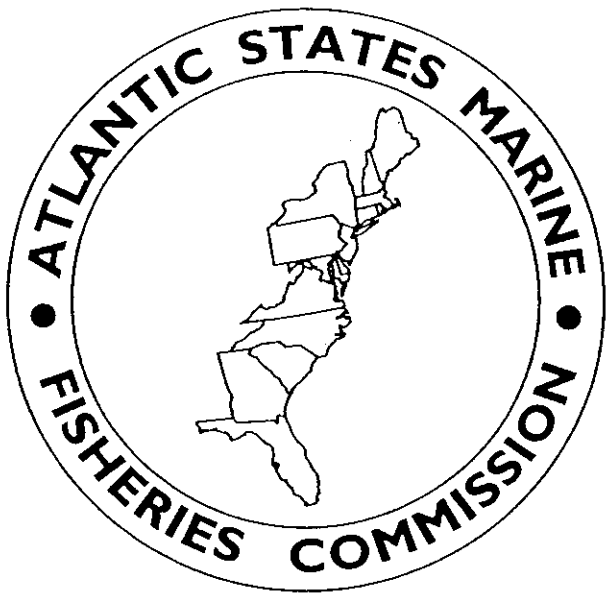
Fishery Management Report No. 25 of the
Atlantic States Marine Fisheries Commission



Fishery Management Plan for Tautog

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Atlantic States Marine Fisheries Commission
1444 Eye Street, N.W., 6th Floor
Washington, D.C. 20005

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The Fishery Management Plan for Tautog was developed by the Atlantic States Marine Fisheries Commission. The Plan Development Team (Team), chaired by John Carmichael, Fishery Management Plan Coordinator, ASMFC, consisted of: Dr. Barbara Dorf (TDN Environmental, Attelboro, Massachusetts), who served as the plan writer, Mr. David Simpson (Connecticut Department of Environmental Protection, Marine Fisheries Division), Mr. David Boyd (Virginia Marine Resources Commission), Dr. Frank Steimle (U. S. Fish and Wildlife Service), and Dr. Najih Lazar (ASMFC). The Team worked under the guidance of the Tautog Management Board (Chairman, Mr. David Borden, Rhode Island Department of Environmental Management), Advisory Panel, and Technical Committee (Chairman, Mr. David Simpson), and thanks these groups for the crucial guidance they provided.

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EXECUTIVE SUMMARY

Definition of Overfishing

The Plan defines overfishing as a rate of fishing exceeding the natural mortality rate (M = 0.15). This overfishing definition is consistent with the slow growth and long lifespan of this species. In addition, this conservative reference point is warranted given the uncertainty in stock structure and in the spawning biomass required to maintain at least average recruitment.

Goals and Objectives

Goals

To perpetuate and enhance stocks of tautog through interstate fishery management so as to allow a recreational and commercial harvest consistent with the long term maintenance of self-sustaining spawning stocks.

To maintain recent (i.e., 1982 - 1991) utilization patterns and proportions of catch taken by commercial and recreational harvesters.

To provide for the conservation, restoration and enhancement of tautog critical habitat for all life history stages.

To maintain a healthy age structure.

To conserve the tautog resource along the Atlantic coast to preserve ecological benefits such as biodiversity and reef community stability, while maintaining the social and economic benefits of commercial and recreational utilization.

Objectives

To establish criteria, standards, and procedures for plan implementation as well as determination of states' compliance with management plan provisions.

To allow harvest that maintains spawning stock biomass in a condition that provides for perpetuation of self-sustaining spawning stocks in each spawning area, based on maintaining young-of-the-year indices, SSB, size and age structure, or other measures of spawning success at or above historical levels as established in the plan.

To achieve compatible and equitable management measures among jurisdictions throughout the fishery management unit.

To enact management recommendations which apply to fish landed in each state, so that regulations apply to fish caught both inside and outside of state waters.

To promote cooperative interstate biological, social, and economic research, monitoring and law enforcement.

To encourage sufficient monitoring of the resource and collection of additional data, particularly in the southern portion of the species range, that are necessary for development of effective long-term

management strategies and evaluation of the management program. Effective stock assessment and population dynamics modeling require more information on the status of the resource and the biology/community ecology of tautog than is currently available, in particular to facilitate calculation of F and stock trends.

To identify critical habitats and environmental factors that support or limit long term maintenance and productivity of sustainable tautog populations.

To adopt and promote standards of environmental quality necessary to the long term maintenance and productivity of tautog throughout their range.

To develop strategies that reduce fishing mortality, restore size composition and the historical recreational/commercial split, consider ecological and socio-economic impacts and identify problems associated with the offshore fishery. Compatible regulations between the states and the EEZ are essential.

Specific State-by-State Plan Compliance Requirements

This plan will apply to all Atlantic coastal states from Massachusetts through North Carolina. The pattern of this FMP is to adopt a target fishing mortality rate (F) and then to establish regulatory programs for recreational and commercial fisheries that will meet this target.

To preserve spawning stock biomass and increase yield in the fishery, commercial and recreational fisheries will be constrained by a size limit. In order to achieve annual fishing mortality targets, recreational fisheries may be managed through a regime of possession limits and seasonal closures, and commercial fisheries will be managed through a Management Board approved plan developed by each state. This allows each state maximum flexibility to develop a plan that reflects the nature and relative importance of its tautog fisheries. If a state fails to meet the fishing mortality target for a given year, any overages will be subtracted from the following year's target.

The FMP specifies an interim target fishing mortality rate of F=0.24 for two years. At the end of the interim period, each state must reduce fishing mortality to the sustainable target of fishing mortality equal to natural mortality (M), which is equal to 0.15.

Recreational Fishery Management Measures:

A. *Size Limit*: The FMP specifies a 14 inch minimum size for recreational fisheries. This may be implemented by adopting 13 inches in 1997 and 14 inches in 1998.

B. *Fishing Mortality Reduction*: Recreational fisheries reductions to reach the interim target F rate may be achieved through possession limits, seasons, or a combination of both. The fishing mortality reductions associated with possession limits and seasonal closures and have been developed for each state based on 1991 – 1993 catch rates.

Commercial Fishery Management Measures:

A. *Size Limit*: The FMP specifies a 14 inch minimum size for commercial fisheries. This may be implemented by adopting 13 inches in 1997 and 14 inches in 1998.

B. *Fishing Mortality Reduction*: Commercial fisheries reductions to reach the interim target F rate are to be achieved through state-specific plans requiring Management Board approval. States are

given the flexibility to develop a commercial fishery management regime that will best meet their particular needs.

Timetable for Plan Implementation

Event	Implementation Date
FMP Approved	April 1996
13" minimum size	April 1997
14" minimum size	April 1998
Commercial plans submitted	October 1996
Effort controls (55% reduction in F)	
North of Delaware Bay	April 1997
Delaware Bay - North Carolina	April 1998
Maintain effort controls	1997-1998
Evaluate stock condition	Winter 1998-1999
Implement F=0.15	April 1999

Monitoring Program Needs

In order to develop an analytical assessment (VPA), significant additional data are required. Current (December 1, 1995) data availability is illustrated in the following table.

Data Type	MA	RI	CT	NY	NJ	DE	MD	VA	EEZ /NMFS
Commercial Landings	O	O	O	O	O	●	O	O	O
Commercial Discards	O	O	—	O	—	—	—	—	O
Commercial Length Frequency	—	—	—	—	—	—	—	—	—
Recreational Landings	●	●	●	●	●	●	●	●	●
Recreational Discards	●	●	●	●	●	●	●	●	●
Recreational Length Frequency	O	O	O	●	O	O	O	O	O
Juvenile index	—	●	O	●	—	—	—	—	—
Index at Age (survey)	—	O	O	O	—	—	—	—	—
Age at Length Keys	—	O	O	O	—	—	—	O	—
Survey Length Frequency (fishery independent)	●	●	●	●	●	—	—	—	O

● Good
O Fair
— Not available

An analytical assessment will require a doubling or tripling of length sampling in the MRFSS and initiation of length-frequency sampling in the commercial fishery. In addition, the development of more comprehensive age-length keys is required.

The analytical assessment (VPA) is needed to estimate stock size, recruitment and spawning biomass coupled with fishing mortality rates. In the absence of an analytical assessment, other age-based methods could be used to less precisely estimate fishing mortality. However, stock size, recruitment and spawning biomass cannot be estimated by these methods. Mark-recapture studies provide an alternative to age-based assessments for estimating stock size and fishing mortality rates. However, such estimates of stock size and fishing mortality are often considered to be less reliable than VPA.

In the absence of any of the above, fishing mortality cannot be estimated and other management reference points will have to be considered. Alternatively, an index-based assessment, and associated reference points, could be developed. Indices could be derived from either fishery independent or dependent sources, however, fishery dependent indices have historically proved misleading by failing to predict stock collapse.

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1. INTRODUCTION

1.1 BACKGROUND INFORMATION

1.1.1 Statement of the Problem

The primary rationale for the development of a tautog FMP is the vulnerability of tautog to overfishing. Additional concerns center around localized overfishing and a shift toward increasing commercial fishing pressure since the early 1990's. As stocks of other species decline and entry to other fisheries becomes more restricted, greater pressure may be placed on tautog stocks. Fisheries managers lack most of the biological and fisheries data necessary for effective management of the tautog resource. Estimates of recreational and commercial catches are poor. Information on migration and critical habitat utilization are lacking in most of the species range. Inadequate data are available on size and age distribution, natural and fishing mortality rates, and recruitment. Little information is available on critical habitat availability, current habitat status, or the capability of artificial habitats to expand species abundance. Most states in the species range have few regulations on harvest of tautog. Because of the uncertainties associated with all aspects of the tautog resource, an interstate cooperative effort is needed to effectively manage this species.

1.1.2 Benefits of Implementation

1.1.2.1 *Social and economic*

Throughout most of the species range, tautog provide a nearshore angling opportunity. Preserving this opportunity by maintaining healthy stocks allows people who lack the desire or means to participate in offshore fisheries a chance to experience recreational fishing. The localized nature of the fishery provides fishing opportunities when migratory species may be unavailable.

Primary economic effects are associated with fishery-based business sales, wages and other components of value added. In the recreational fishery, effects vary depending on angler expenditure per recreational fishing trip for such things as fuel, boat charter/rental, lodging, food, bait and tackle, SCUBA gear, licenses, etc. For the northern part of the species range, economic resources previously targeted at other recreational fisheries have been redirected at tautog. For the commercial fishery, the costs associated with processing and wholesale and retail marketing must be factored in. Social and economic data regarding tautog fisheries is lacking.

1.1.2.2 *Ecological*

Over the range of the species, tautog are an important component of reef ecosystems. Preservation of the tautog resource contributes to maintenance of biodiversity and stability of reef communities, including both vertebrate and invertebrate species, through tautog predation (Steimle and Shaheen, In Press).

1.2 DESCRIPTION OF THE RESOURCE

1.2.1 Species Life History Summary

The tautog, *Tautoga onitis*, is one of 500 - 600 species of the mostly tropical wrasse or Labrid family (Nelson 1984). They are distinguished by their large lips and are commonly referred to as: tog, blackfish, white chin, chinner, chub, black porgy or slippery bass. Only one other wrasse is commonly found north of Cape Hatteras: the cunner, *Tautogolabrus adspersus*. Tautog are stouter than cunner and

have a higher head profile, no scales on the gill cover, and grow to a much larger size (over 20 pounds for tautog; around 2 pounds for cunner; Bigelow and Schroeder 1953).

1.2.1.1. *Distribution*

Tautog are distributed along the northeast Atlantic coast of North America from the outer coast of Nova Scotia to Georgia (Parker et al. 1994). The best coastwide map currently comes from Auster (1989) (Figures 1 and 2). Tautog are most abundant from Cape Cod to the Chesapeake Bay. North of Cape Cod, they are usually found within 4 miles of shore in waters less than 60 feet deep. South of Cape Cod, they can be found up to 40 miles offshore and at depths up to 120 feet.

1.2.1.2. *Habitat Needs*

Post-larval tautog are found in association with structured habitats throughout their lives. These provide shelter during nightly dormant periods. When tautog are not feeding during the day, they can be found resting on sand or within shelter, lying quietly on their sides, often grouped together (Bigelow and Schroeder 1953). At night, they are so unresponsive that they can be touched by divers (Olla et al. 1974). Juveniles require places to feed and to hide from predators. They are typically found in submerged vegetation, shellfish beds, and other structures with crevices and holes that provide shelter. Larger fish require more complex structures for shelter, and locations where their food source of encrusting and bottom living organisms can be found. North of Long Island, New York, rocks and boulders left by glacial deposition can be found in abundance along the coastline, providing "reef" habitat for larger tautog. South of Long Island, there are few natural rocky habitats in coastal waters. Tautog in these southern areas commonly inhabit shellfish beds, coastal jetties, pilings, shipwrecks, and artificial reefs.

1.2.1.3. *Spawning*

Adult tautog generally migrate inshore in the spring from offshore wintering locations to spawn in late spring through early summer (Chenoweth 1963, Cooper 1966, Stolgitis 1970, Olla et al. 1974, Briggs 1977). Spawning usually occurs within estuaries or in nearshore marine waters (Feigenbaum et al. 1989, Sogard et al. 1992).

In Rhode Island, tagging studies showed that adults returned to the same spawning locations over a period of several years (Cooper 1966, Lynch 1991). Studies in New York waters suggested that adults from different populations may mix at spawning locations from year to year (Olla et al. 1980).

Some adults remain offshore throughout the year, particularly in the southern part of the range (Olla and Samet 1977, Eklund and Targett 1990, Adams 1993, Hostetter and Munroe 1993). Tautog collected on offshore hard bottom sites in Maryland and Virginia were found to be seasonally in spawning condition (Eklund and Targett 1990, Hostetter and Munroe 1993). Eggs and larvae collected in continental shelf waters from Georges Bank to North Carolina, with especially high concentrations off of southern New England and New York, suggest that tautog spawn in offshore as well as inshore locations (Sogard et al. 1992). Recent research shows evidence of tautog spawning 12 miles off the coast of Virginia in 60 feet of water (G. White, Virginia Institute of Marine Science, Gloucester Point, VA, personal communication).

1.2.1.4. *Life History Stages*

Tautog eggs are buoyant and around 0.04 inches in diameter. They are found in greatest numbers at the water surface. Hatching occurs around 2 days after spawning (Hildebrand and Schroeder 1928). The

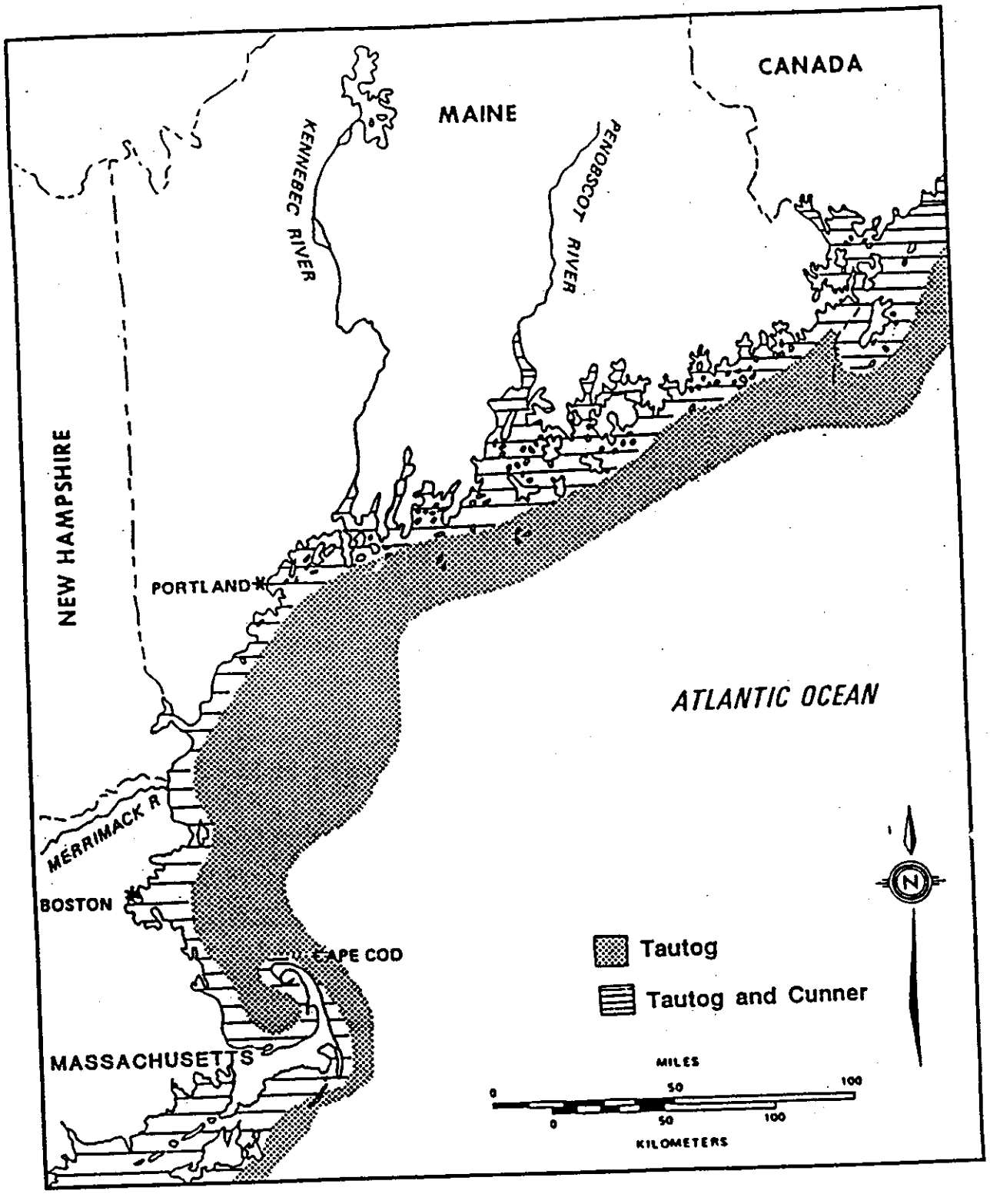


Figure 1. Distribution of tautog in the North Atlantic region. From Auster 1989.

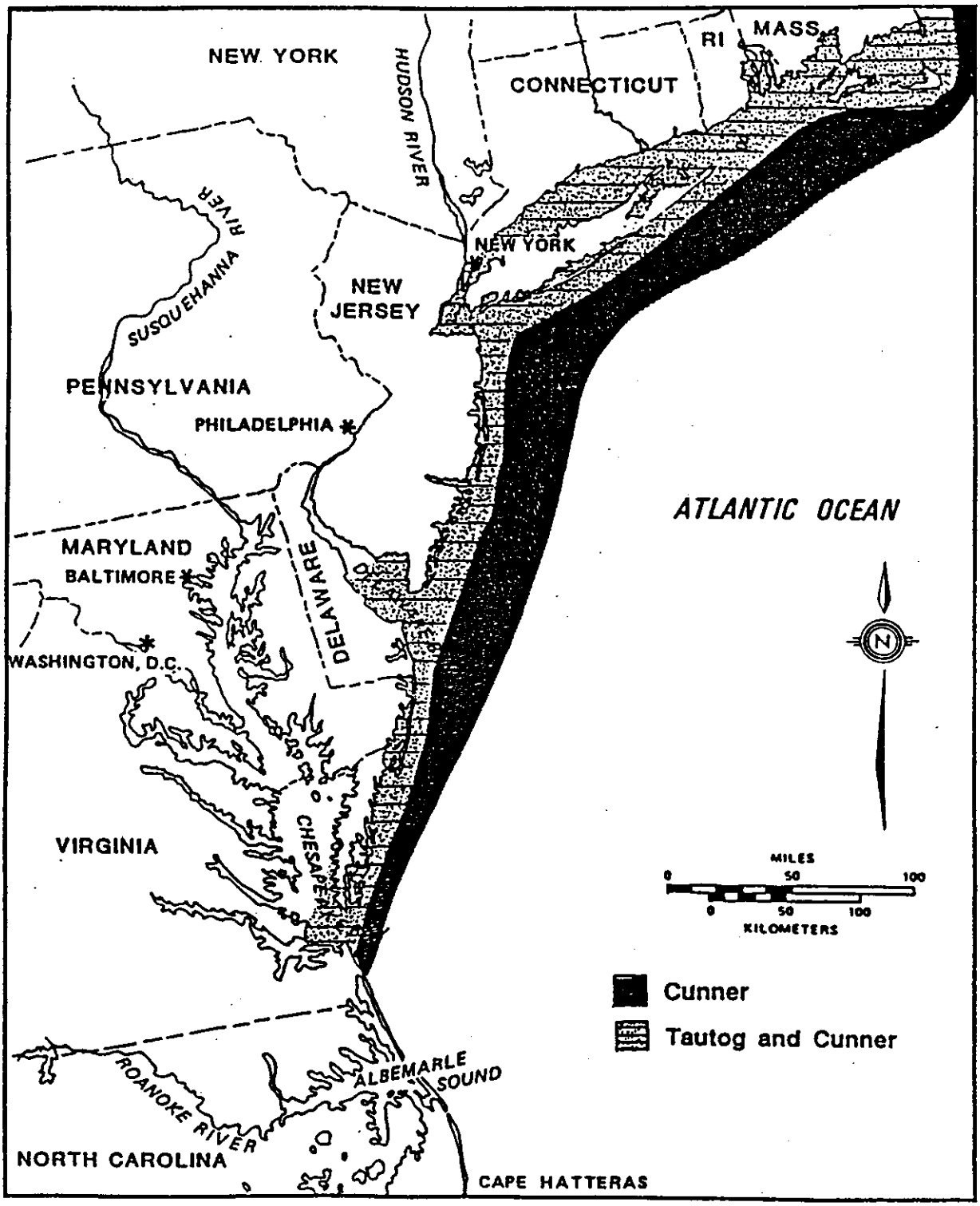


Figure 2. Distribution of tautog in the Mid-Atlantic Region. From Auster 1989.

larvae (0.09 inches at hatching) stay near the surface during the day and may go deeper at night (Malchoff 1993). After approximately 3 weeks, larvae undergo metamorphosis and settle out of the water column as juveniles (Sogard et al. 1992, Dorf 1994). High water temperatures such as those experienced in power plant cooling water systems may result in egg mortality or anatomical deformities in embryos (Smith et al. 1979).

As juveniles, tautog begin a bottom dwelling (demersal) existence continues for the remainder of their lives. Newly settled juveniles look similar to miniature adults and assume the color (bright emerald green to mottled or striped brown) of the habitat they occupy. They tend to stay in shallow waters less than 3 feet in depth and prefer vegetated areas to unvegetated regions. Vegetation can include sea grass and various types of macroalgae (Briggs and O'Connor 1971, Sogard et al. 1992). With growth, these young-of-the-year move to deeper waters but are not usually found deeper than around 25 feet (Cooper 1964).

Larger juveniles become associated with various reef-like habitats and hard surfaces as long as the main habitat requirement of shelter is met. Young tautog may establish homesites they stay within a few feet of during the day and return to at night when they become dormant (Olla et al. 1979). Juvenile tautog remain inshore during the winter (Cooper 1964, Stolgitis 1970, Olla et al. 1974). When water temperatures drop below 40°F some large juveniles may move to deeper, more protected locations. Juveniles remaining inshore in shallow water can be found in a variety of shelters including grass and macroalgal beds, shells, discarded soda cans and bottles, fish pots, crevices and even in bottom depressions covered with silt (Cooper 1964, Olla et al. 1978, Olla et al. 1980). By the end of their first year juveniles reach a length of around 2.4 inches in Rhode Island waters (Cooper 1967) and 5.5 inches in Virginia waters (Hostetter and Munroe 1993).

Tautog normally reach sexual maturity at 3 to 4 years of age (7 - 12 inches), although there are some sexually mature 2 year old fish (Chenoweth 1963, Olla and Samet 1977, Hostetter and Munroe 1993). Tautog in Rhode Island waters reached sexual maturity at a smaller size (7.5 - 7.9 inches; Cooper 1966) than in New York (8.5 - 9.5 inches; Briggs 1977) or Chesapeake Bay waters (10.7 - 11.4 inches; Hostetter and Munroe 1993). The difference in size is probably related to the length of time which the water remains warm and growth occurs (Hostetter and Munroe 1993).

Adults occupy habitats similar to those of large juveniles and can be found in a variety of complex, structured coastal locations. These can include: vegetation, rocks, natural and artificial reefs, pilings, jetties and groins, mussel and oyster beds, wrecks, and submerged trees, logs and timbers (Steimle and Shaheen, In Press). Adults stay relatively close to their preferred home site and, although they move away during the day to feed, they return to the same general location at night where they become dormant (Olla et al. 1974).

Mouths of estuaries as well as other inlets and artificial reefs may be extremely important habitats for tautog (Zawacki 1969, Briggs 1975), particularly south of Long Island where there are fewer natural rocky outcrops to provide shelter than in the more northern portion of the range. Localized populations form during the summer, in co-existence with large juveniles (Olla et al. 1974). Adults will leave a site if conditions become unsuitable (i.e., high water temperature, decline in mussel abundance) (Olla et al. 1979, Adams 1993).

The fall offshore migration is triggered when water temperatures drop below approximately 50°F in the late fall. Most adult tautog form schools and migrate offshore to deep water locations (80- 150 feet) with rugged bottom topography. When water temperatures are very low, adults become torpid (Cooper 1966, Briggs 1977). This may allow tautog, a member of a mostly tropical family, to survive cold winter conditions in northern regions (Curran 1992). Some adults overwinter inshore and some also remain

active throughout the year, particularly in the southern portion of the range (Auster 1989, Eklund and Targett 1991, Adams 1993, Hostetter and Munroe 1993).

Not all tautog migrate inshore in the spring. In Maryland and Virginia, populations of adults have been observed 12 - 40 miles offshore in 30 -225 feet of water throughout the year (Eklund and Targett 1990, Hostetter and Munroe 1993). Offshore distributions decline toward the northern part of the species range (Chesapeake Bay Program 1994). Tautog do not appear to make extensive long-shore migrations, although some fish from Long Island bays have been reported to overwinter in New Jersey coastal waters (Briggs 1977) .

1.2.1.5. *Reproduction.*

Optimum size for female egg production has been estimated at 14 - 16 inches. Tautog between 8 - 27 inches in total length (3 to 20+ years old) were observed to contain 5,000 to 637,500 mature eggs (Chenoweth 1963). In Maryland and Virginia, the ratio of reproductive organ weight to body weight (Gonadal-Somatic Index, GSI) reaches a peak between April and June (Eklund and Targett 1990, Hostetter and Munroe 1993). Spawning begins in the spring when water temperatures reach at least 48°F, reaches a peak in June, and continues throughout the summer (Bigelow and Schroeder 1953, Cooper 1964, Colton et al. 1979, Eklund and Targett 1990, Sogard et al. 1992, Hostetter and Munroe 1993).

Spawning occurs in heterosexual pairs or in groups of a single female with several males. In laboratory studies, the type of spawning depends on the number of mates available for the female, the male-dominance hierarchy, and the availability of shelter and food. Pair spawning is usually the dominant process (Olla and Samet 1977).

1.2.1.6 *Growth*

Larval growth rates have been estimated to be between 0.01 - 0.03 inches per day (Malchoff 1993, Dorf 1994).

During summer, young-of-the-year juveniles grow around 0.02 inches per day (Sogard et al. 1992, Dorf 1994). Size attained at the end of the first year increases from north to south. Since juvenile daily growth rates appear to be similar in all areas during the summer, size differences may be due to the longer duration of warmer water temperatures in southern portions of the species range (Sogard et al. 1992, Dorf 1994). Juvenile growth rates have been observed to be higher in vegetated than in unvegetated habitats. Among vegetated habitats, juvenile growth was higher in sea lettuce beds than in eelgrass beds in New Jersey (Sogard et al. 1992).

Adult male tautog grow faster in length than adult females (Cooper 1967, Simpson 1989, Hostetter and Munroe 1993). In Rhode Island waters, the mean length of a seven year old male was 14.1 inches, while a female was 13.2 inches (Cooper 1967). Faster adult male growth has also been documented in Long Island Sound (Simpson 1989) and Virginia waters (Hostetter and Munroe 1993). Adult growth is relatively slow and varies with the season. Slowest body growth rates occur during maturation of the gonads in the spring prior to spawning. Maximum body growth occurs after spawning during the summer and fall followed by a period of slow or no winter growth associated with reduced water temperatures and feeding activity during the torpid period (Hostetter and Munroe 1993). Mean adult growth rates are similar for tautog in northern and southern waters until the age of 13. After that age, growth rates decrease more rapidly in the northern part of the species range, with growth rates in Virginia being almost double those of tautog in Rhode Island waters (Hostetter and Munroe 1993). In Rhode Island, male annual growth rates were reduced to less than 0.5 inches per year after age 12 and to 0.08 - 0.16 inches per year after age 20. For females, annual growth decreased to less than 0.4 inches per year after

age 13 and to 0.12 - 0.16 inches per year after age 17 (Cooper 1967) Tautog are long lived fish with males living longer than 30 years and females around 25 years (Cooper 1966, Hostetter and Munroe 1993).

As stated above, many variables may affect the observed length of an individual tautog at a given age, and age-length keys show significant overlap of age groups by length. On average, Table 1 provides a reasonably accurate guide.

Table 1. Tautog length-at-age relationship.

Length (inches)	Age (years)
3	1
5.5	2
9	3
10.5	4
12.5	5
14	6
15.5	7
17	8
18	9
19	10
21	15
22	20

1.2.1.7 *Feeding*

Larval tautog probably feed on water column plankton although no specific data are available.

Juvenile tautog feed primarily on small benthic and pelagic invertebrates including: copepods, amphipods, isopods, ostracods, polychaetes, crabs and mussels (Olla et al. 1975, Festa 1979, Grover 1982, Sogard et al. 1992, Dorf 1994) . The composition of the juvenile diet changes with fish size. In Narragansett Bay, Rhode Island, small young-of-the-year (0.8 - 2.0 inches total length) primarily consumed amphipods and copepods. Juveniles 2.0 -2.7 inches in length consumed a variety of invertebrates. The largest young-of-the-year (2.7 - 3.9 inches) ate mainly small shrimp and crabs (Dorf 1994). Similar diets were reported in New Jersey (Festa 1979, Sogard et al. 1992) and Chesapeake Bay waters (Orth and Heck 1980). In New York waters, juveniles 4.1 - 8.1 inches in length fed primarily on blue mussels throughout the year (Olla et al. 1975). Larger juveniles (7.9 - 12.6 inches) in New Jersey were observed to feed on xanthid crabs (Festa 1979).

Adult tautog feed primarily on the blue mussel (*Mytilus edulis*) and other shellfish throughout the year. The diet can be extremely varied depending on location and availability. The following items have been found to be eaten by adult tautog: barnacles, various crabs, sand dollars, amphipods, isopods, shrimp, lobsters, periwinkles, scallops, soft shell clams and razor clams (Bigelow and Schroeder 1953, Olla et al. 1974, Steimle and Ogren 1982, Auster 1989).

Adults grasp mussels using their large canine teeth, tearing them from the surrounding surface by shaking their heads. Small mussels are swallowed whole, while larger, hard-shelled ones are crushed by the pharyngeal teeth prior to swallowing. Canine teeth are not used for crushing shells (Olla et al. 1974).

Tautog begin actively searching for food at dawn (Briggs 1969, Olla et al. 1975). When they leave their home sites they usually venture no further than 1,500 feet away, although there have been reports of tautog traveling as far away as 3.8 miles from their home shelter (Olla et al. 1974). Tautog have been observed to follow an incoming tide above low water levels to feed on concentrations of mussels in the intertidal, returning to deep water as the tide ebbs (Bigelow and Schroeder 1953). Most fish move to areas with large concentrations of mussels during the day and return to their home site at evening twilight (Olla et al. 1974). Tautog are visual predators and therefore, do not feed at night (Olla et al. 1974, Deacutis 1982). Food intake may be reduced due to high water temperatures (Olla et al. 1978), during low winter temperatures (Cooper 1966), and during spawning (Bridges and Fahay 1968).

The high dependence of tautog on blue mussels as the primary food in most areas creates an important trophic link of interest to tautog distribution, behavior, and perhaps, growth and survival. Periodic recruitment failure of mussels in tautog habitat can cause tautog to move to other feeding areas (Steimle and Shaheen, In Press). If they do not move, or the failure is widespread, tautog inhabiting the area may suffer some effects of an inadequate diet. Heavy consumption of mussels can cause a depletion of this food source before new prey recruitment occurs, especially if tautog are concentrated in an area for some climatological, water quality, or behavioral reason.

1.2.2 Stock Assessment Summary

The tautog assessment was reviewed through the NMFS 20th Northeast Regional Stock Assessment Workshop (SAW) in Spring 1995. The SAW process provides a peer reviewed, consensus summary of assessment information, and an advisory report on stock status. The following is a summary of the SAW Advisory Report.

1.2.2.1 *State of the Stock*

Tautog resources in the region from Massachusetts to New York are overexploited (Figure 3 a, b) and at a low biomass level (Figure. 4). There has been an apparent increase in fishing mortality, and fishing mortality appears to be well above any candidate biological reference point (F_{max}, $F_{0.1}$, F = M) for this long lived and slow growing species. Although fishing mortality estimates from state trawl surveys are too imprecise for annual monitoring purposes because of poor characterization of the age structure, overall indices have been more consistent. The Massachusetts, Rhode Island and Connecticut surveys al indicate higher stock sizes in the mid-1980's followed by general decline in recent years. In addition, the University of Rhode Island (URI) trawl survey, initiated in 1959, indicates that stock sizes were substantially larger early in the time series when Cooper (1967) estimated fishing mortality to be close to our definition of overfishing (F = M = 0.15). Under low fishing rates during the 1960's, biomass per tow in the URI survey averaged 40.1 kg. This declined to an average of 18.9 kg/tow during the 1980–1989 period when fishing rates in the area averaged 0.29 (Gibson 1994). During the 1990's, with the present coastwide average fishing mortality of F = 0.54, survey biomass has declined by more than half from levels observed the previous decade, to 8.6 kg/tow.

1.2.2.2 *Stock Identification and Distribution*

Tautog are distributed from Massachusetts to Georgia. For assessment purposes, the stock was divided into two sub-areas: Massachusetts to New York and New Jersey to Virginia.

1.2.2.3. *Catches*

Total recreational landings (Massachusetts to Virginia) fluctuated without trend from 1981 through 1985 averaging 2,521 mt. Landings increased to 7,700 mt in 1986 and averaged 4,100 mt in 1987–1988. Recreational landings have declined since the mid-1980's and reached a record low of 1,400 mt in 1994. Total commercial landings have generally declined since 1987 to recent low of 240 mt in 1993.

1.2.2.4. *Data and Assessment*

Many data sources were examined, including trends in fishery independent surveys, catch curves analyses, tagging data, an analytical assessment of 1982–1993 total landings using the ADAPT method, and catch at age data from New York, Connecticut, Rhode Island and Massachusetts. All catches (trawl surveys, recreational, and commercial) were aged using age-length keys from the Connecticut trawl survey. Age-length keys were augmented with Rhode Island age-length data from 1987–1993. Length frequencies of recreational discards (B2) were estimated from samples taken by the New York recreational survey, assuming a 25 percent discard mortality. Length frequencies of commercial catches were assumed similar to the annual MRFSS length frequencies for fish greater than or equal to 13 inches. Commercial discards were not estimated. . Natural mortality was assumed to be 0.15.

1.2.2.5 *Biological Reference Point*

Preliminary estimates of biological reference points, derived using the selectivity pattern from ages 1 - 8 from a separable VPA with an assumed flat-topped recruitment pattern after age 8 were: $F_{0.1} = 0.13$, $F_{30\%} = 0.24$ and $F_{max} = 0.28$ (Figure 3 a, b).

1.2.2.6 *Fishing Mortality*

Fishing mortality from survey catch curves for the region from Massachusetts to New York averaged 0.58 from 1988–1992. A Rhode Island tagging study estimated fishing mortality as 0.71 (95% CI from 0.48 to 0.95). Terminal year fully recruited fishing mortality from the VPA analysis was 0.71 with a CV of 55% (Fig. 5).

The status of the resource in the region from New Jersey to Virginia could not be fully evaluated by the SARC because of incomplete data. However, the Stock Assessment Subcommittee estimated fishing mortality for New Jersey using trawl survey data and the estimation procedure recommended by the SARC and used for analysis of trawl survey data from Massachusetts through Connecticut. This analysis indicated fishing mortality levels of F = 0.79 for the period 1988–1991, and F = 0.77 from 1991–1994.

1.2.2.7 *Recruitment*

Estimates are not available.

1.2.2.8 *Spawning Stock Biomass*

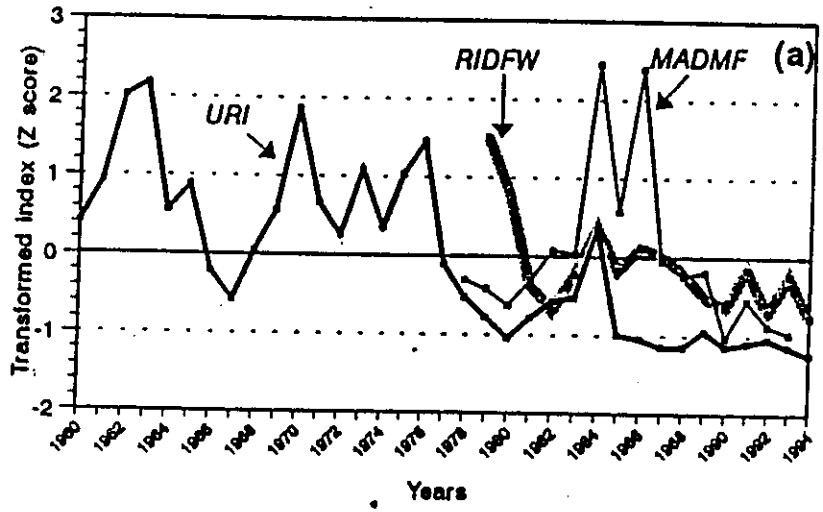
No reliable estimates are available, but state survey abundance indices indicate record low levels of abundance (Figure 4).

1.2.2.9 *Special Comments*

The SARC noted serious problems with the VPA results due to lack of data and inadequate age-length keys. The SARC concluded that these data problems and high level of uncertainty in the VPA results rendered estimates of stock size unreliable for drawing conclusions about the absolute level of spawning stock size and recruitment, and inappropriate for use in projections. The SARC agreed that a VPA estimated fishing mortality in the terminal year (with an estimate of its precision), taken together with mortality estimates from other sources, could be used to draw conclusions about the current levels of exploitation in the region from Massachusetts to New York.

The SARC recommended an immediate reduction of fishing mortality (F) to avoid a collapse of the fishery resource.

Figure 3 a,b. Transformed abundance indices from Massachusetts, Rhode Island, Connecticut, and New York trawl surveys.



URI=University of Rhode Island / MADMF=Massachusetts Division of Marine Fisheries
RIDFW=Rhode Island Division of Fish and Wildlife

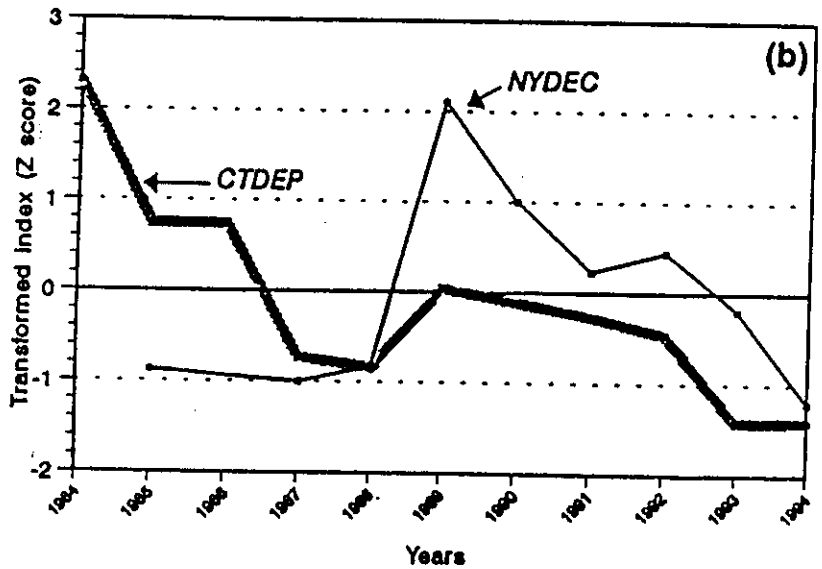


Figure 4. Yield and spawning stock biomass per recruit (M=0.15).

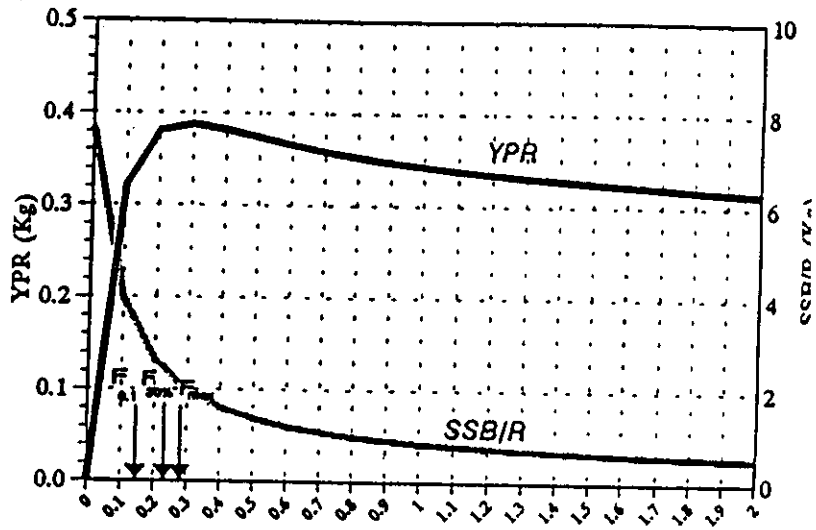
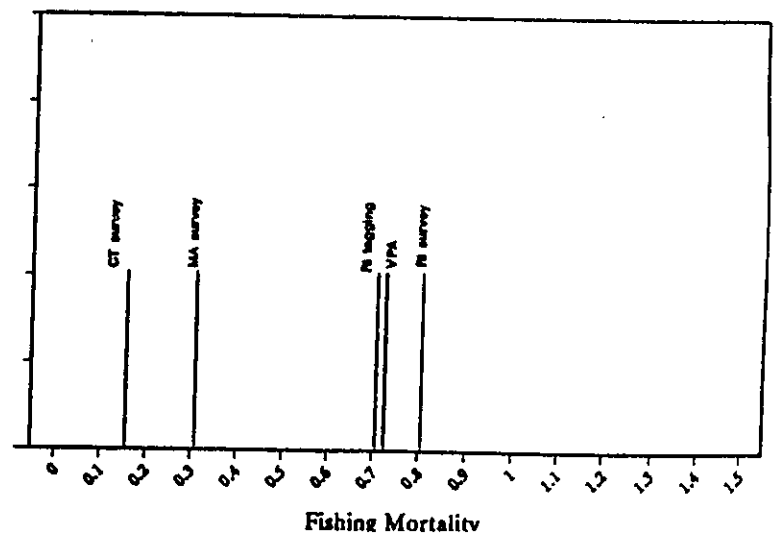


Figure 5. Point estimates of fishing mortality from VPA, RI tagging data, and catch curve analysis of MA, RI, and CT trawl surveys.



1.3. DESCRIPTION OF THE FISHERY

1.3.1 Recreational

1.3.1.1 *Annual Harvest*

Annual recreational harvest of tautog fluctuated without trend from 1981 to 1985, ranging from 4.1 million pounds in 1981 to 8.2 million pounds in 1982. Harvest peaked in 1986 at 16.9 million pounds. Harvests have been declining since 1986, reaching lows of 5.2 million pounds in 1990 and 1993 (Figure 6, Table 2).

Table 2. Commercial and recreational tautog landings from 1981-1993. Data from the Marine Recreational Fishery Statistical Survey (MRFSS) and National Marine Fisheries Service (NMFS) General Canvas.

Year	Commercial (1000 pounds)	Recreational (1000 pounds)	Total (1000 pounds)	% Commercial
1981	331	4,115	4,446	7.4
1982	417	8,271	8,688	4.8
1983	427	5,730	6,157	6.9
1984	674	5,382	6,056	11.1
1985	733	4,298	5,031	14.6
1986	939	16,903	17,842	5.3
1987	1,158	8,880	10,038	11.5
1988	1,071	9,297	10,368	10.3
1989	1,016	6,345	7,361	13.8
1990	874	5,154	6,028	14.5
1991	1,108	8,078	9,186	12.1
1992	1,011	7,661	8,672	11.7
1993	653	5,180	5,833	11.2

1.3.1.2 *State Harvest*

Recreational landings by state are shown in Tables 3 and 4.

New York and New Jersey dominate recreational landings, accounting for an average of 27 percent of the total in most years. Massachusetts, Rhode Island, Connecticut and Virginia share most of the remaining harvest. The recreational fishery is most active in the spring and early autumn, although fishermen in Virginia pursue tautog in winter as well.

Figure 6. Commercial and recreational tautog landings (1000 pounds) by year and state. Commercial light bars, recreational, dark bars. Data from the MRFSS and NMFS General Canvas.

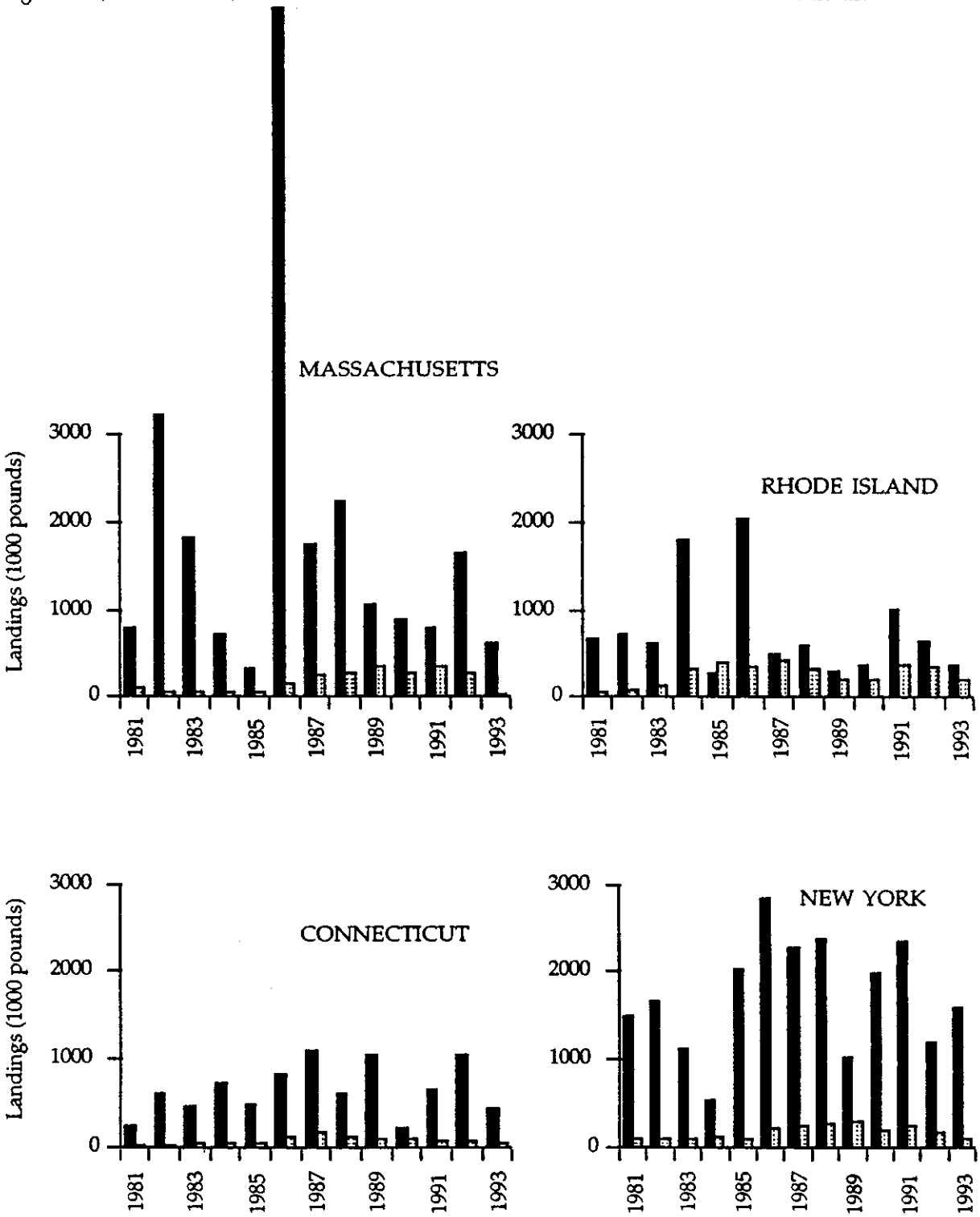
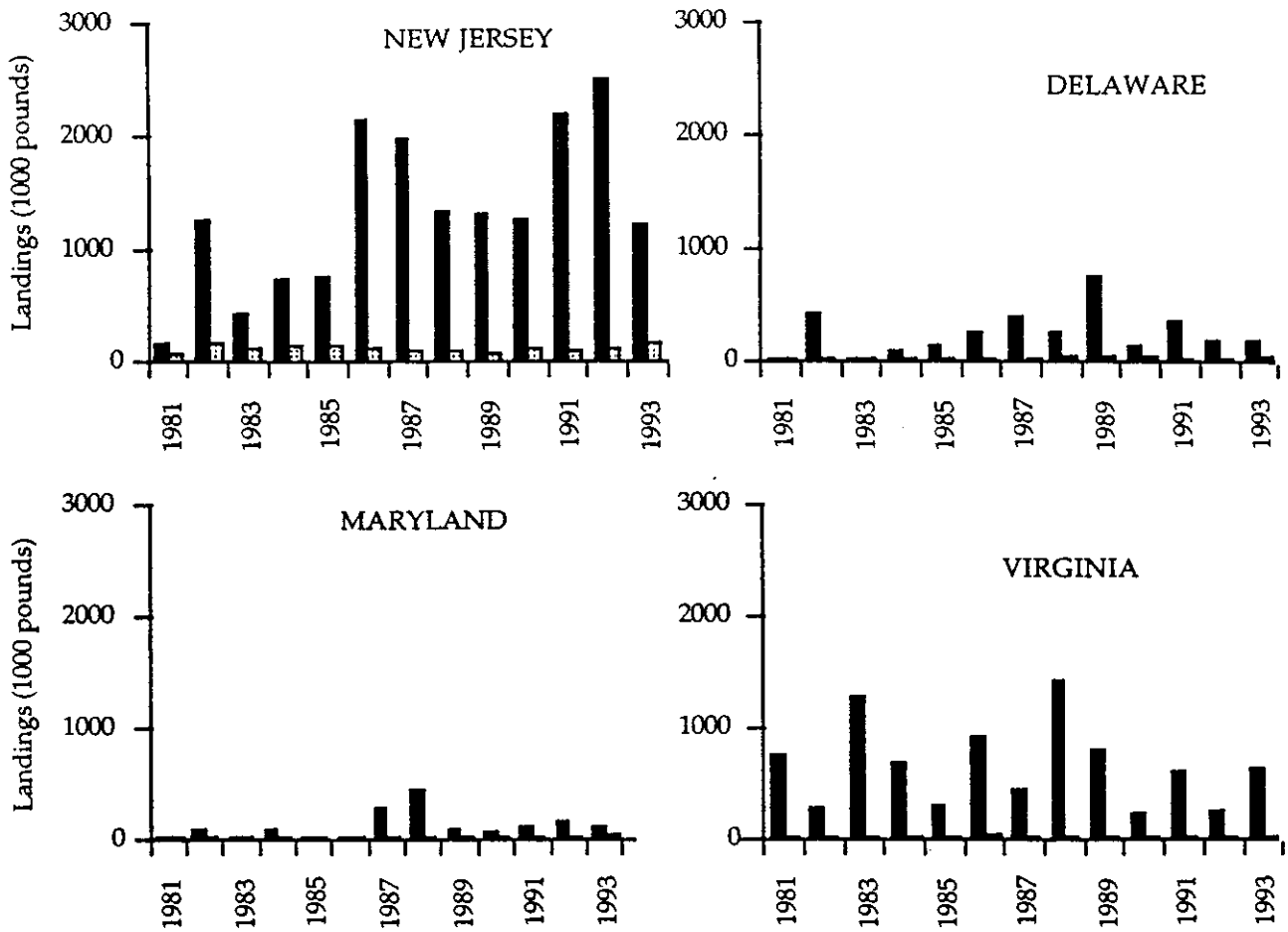


Figure 6 Continued.



Massachusetts recreational landings have fluctuated over time, reaching a peak in 1986 of 7.9 million pounds and a low in 1985 of 0.3 million pounds. The fishery in Massachusetts is most active south of Plymouth. Tautog ranks seventh among target species for recreational anglers in Massachusetts.

Recreational landings in Rhode Island also peaked in 1986 at 2 million pounds, declining to 0.4 million pounds in 1993.

Connecticut recreational landings increased from 0.2 million pounds in 1981 to a high in 1987 of 1.1 million pounds. Between 1988 and 1993, recreational catches varied between 0.2 million pounds in 1990 to 1 million pounds in 1989 and 1992.

Recreational landings in New York are some of the largest recorded, accounting for between 14 and 44 percent of tautog landings. Landings ranged from 0.5 million pounds in 1984 to 2.8 million pounds in 1986.

New Jersey recreational landings have fluctuated over time ranging from 0.2 million pounds in 1981 to the peak of 2.5 million pounds in 1992.

Table 3. Estimated numbers of tautog landed in recreational fisheries by year and state. Data from the MRFSS 1981 - 1993.

State	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Massachusetts	228,736	1,051,022	670,508	258,256	100,941	1,980,719	617,068	621,679	250,077	233,444	176,905	357,949	182,145
Rhode Island	233,508	214,938	245,796	490,128	115,404	671,592	130,729	207,799	116,506	153,433	291,946	193,786	115,616
Connecticut	100,308	231,187	200,676	287,470	182,318	333,396	312,430	234,198	303,782	75,871	191,137	319,221	149,879
New York	721,062	646,693	612,163	286,077	1,105,234	1,183,114	929,887	828,183	562,549	953,622	871,221	413,236	457,272
New Jersey	132,271	583,550	344,580	516,086	840,627	2,369,852	1,015,123	564,286	710,958	841,770	1,067,284	1,018,205	695,025
Delaware	3,457	137,328	4,350	28,388	62,001	141,290	99,706	94,491	249,928	61,526	128,985	68,769	74,492
Maryland	4,670	35,105	2,126	42,835	486	5,476	90,523	107,570	34,709	45,467	26,770	106,255	65,017
Virginia	236,768	71,599	579,795	207,192	91,957	322,905	126,783	368,320	284,477	111,998	168,068	100,952	255,390
North Carolina	3,072	15,062	36,549		8,252	12,660	3,698	4,462	11,354	3,428	6,804	5,249	4,576
TOTAL	1,663,852	2,986,485	2,696,543	2,116,432	2,507,219	7,021,003	3,325,948	3,030,988	2,524,339	2,480,559	2,929,120	2,583,622	1,999,413

Table 4. Recreational tautog landings in thousands of pounds by year and state. Includes type A + B1 data from the MRFSS 1981 - 1993.

State	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Massachusetts	791	3,227	1,837	734	328	7,863	1,751	2,256	1,076	895	799	1,669	634
Rhode Island	665	726	616	1,810	277	2,043	507	612	297	390	1,008	657	378
Connecticut	242	6.11	459	734	471	838	1,107	610	1,038	200	649	1,049	441
New York	1,496	1,675	1,125	542	2,035	2,833	2,288	2,380	1,018	1,980	2,353	1,200	1,578
New Jersey	161	1,241	415	717	742	2,133	2,131	1,332	1,289	1,257	2,189	2,486	1,206
Delaware	7	428	4	96	145	265	387	250	743	143	355	184	191
Maryland	10	91	7	79	1	10	266	447	78	60	106	160	111
Virginia	743	272	1,267	670	299	918	443	1,410	806	229	619	256	641
Total	4,115	8,271	5,730	5,382	4,298	16,903	8,880	9,297	6,345	5,154	8,078	7,661	5,180

Landings from Delaware and Maryland have been relatively low, peaking in 1987 at 0.4 million pounds in Delaware and in 1988 at 0.5 million pounds in Maryland.

Virginia recreational landings have been variable, ranging from 0.2 million pounds in 1990 to the high of 1.4 million pounds in 1988. Recreational landings from Virginia waters may be underestimated since the MRFSS does not collect data during January and February when tautog are one of the few recreational species available and pursued by anglers.

1.3.1.3 *Mode of Fishing*

Private/Rental boat fishing dominates the recreational tautog catch, averaging approximately 5.1 million pounds per year, or 70 percent of the total recreational landings (Figure 7, Table 5) The peak value for Private/Rental boat fishing occurred in 1986 (12.7 million pounds), and catches have declined to an average value for the last five years (1989–1993) of 4.7 million pounds.
Party/Charter boat and Shore-based fishing remained relatively constant from 1981–1993, averaging 1.4 million pounds (19 percent of total landings) for Party/Charter boat fishing and 0.8 million pounds (10.9 percent of total landings) for Shore-based fishing. Party/Charter boat fishing peaked in 1986 at 3.1 million pounds. Shore-based fishing reached a maximum of 1.4 million pounds in 1984 and dropped to a low of 0.4 million pounds in 1993.

1.3.1.4 *Area of Fishing*

Tautog fished from state waters (a combination of inland waters and oceanic waters less than 3 miles from shore) accounted for approximately 79 percent of the recreational harvest, or approximately 6 million pounds per year between 1981 and 1994 (Table 6). Landings from state waters peaked in 1986 at around 14.8 million pounds. Harvest from oceanic waters greater than 3 miles also peaked in 1986, at 3.4 million pounds.

Table 5. Recreational tautog landings in pounds by year and mode of fishing, all states combined. Data from the MRFSS 1981 - 1993.

Year	Shore	Party/Charter	Private/Rental
1981	1,074,084	979,111	2,061,358
1982	797,072	1,685,882	5,787,494
1983	1,055,260	772,422	3,901,770
1984	1,384,113	1,472,417	2,524,718
1985	843,494	1,053,896	2,400,587
1986	1,121,350	3,107,904	12,673,143
1987	593,002	1,861,108	6,426,334
1988	633,781	1,069,783	7,593,626
1989	638,668	1,038,059	4,670,077
1990	639,553	1,019,679	3,494,292
1991	700,546	1,797,346	5,578,987
1992	493,672	1,106,561	6,058,511
1993	396,032	1,286,748	3,498,027
Total	10,370,626	18,250,917	66,668,925

Figure 7. Recreational tautog landings in pounds by year and mode of fishing, all states combined. Data from the MRFSS 1981–1993.

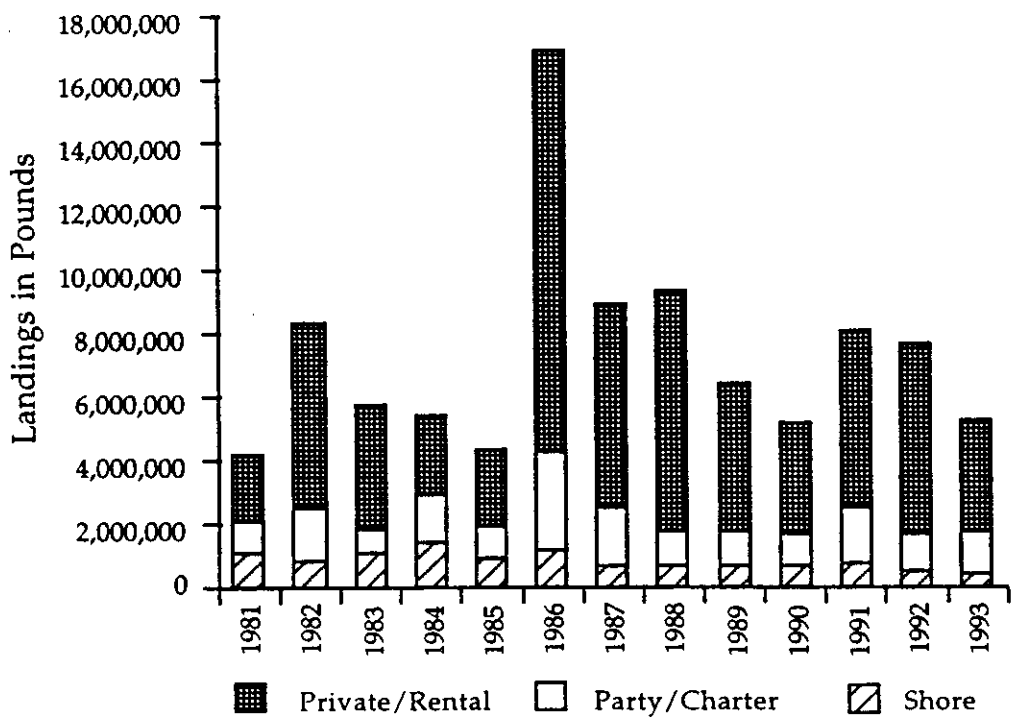


Table 6. Recreational tautog landings in thousands of pounds by area, all states combined. Data from the MRFSS 1981–1994.

Fishing Area	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Inland	1,673	2,718	1,804	1,760	2,877	5,733	3,142	5,748	4,318	3,201	3,953	3,825	3,409	1,964
≤ 3 miles	2,062	2,846	3,400	5,479	1,114	9,037	2,258	3,011	1,381	1,123	2,467	1,586	909	437
> 3 miles	424	3,381	1,150	354	1,149	3,380	3,126	3,171	1,272	1,163	1,272	1,683	977	673
TOTAL	4,159	8,945	6,354	7,593	5,140	18,150	8,526	11,930	6,971	5,487	7,692	7,094	5,295	3,074

1.3.2 Commercial

1.3.2.1 *Annual Harvest*

Commercial landings from Massachusetts through New Jersey represent an average of 99 percent of the coastwide total (Table 7). Since 1981, commercial tautog landings have averaged approximately 0.8 million pounds per year. Commercial landings increased steadily from 1981 to 1987, and have fluctuated since 1987. In 1991, landings were slightly below the 1987 peak of 1.1 million pounds. Since 1991, however, commercial catch has declined. The 1993 catch of 0.4 million pounds was the lowest since 1983.

1.3.2.2 *State Harvest*

In the northern portion of the species range, most commercial landings come from Massachusetts and Rhode Island, followed closely by New York. Commercial landings from Delaware through Virginia are much lower (Table 7).

Table 7. Weight of commercial tautog landings in thousand of pounds, by year and state. Data from unpublished NMFS General Canvas 1981–1993.

State	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Massachusetts	103	69	58	68	63	165	250	277	353	289	354	292	160
Rhode Island	70	86	143	335	403	363	421	329	215	211	372	360	202
Connecticut	21	21	34	33	50	104	159	112	100	82	54	66	44
New York	81	90	88	103	85	201	225	255	285	182	226	169	90
New Jersey	54	148	101	130	125	101	95	88	52	99	93	116	153
Delaware	0	0	1	1	3	0	1	1	0	1	1	0	0
Maryland	1	0	0	3	2	3	4	6	4	5	3	4	1
Virginia	1	3	2	1	2	2	3	3	7	5	5	4	3
Total	331	417	427	674	733	939	1,158	1,071	1,016	874	1,108	1,011	653

Table 8. Commercial tautog landings as percent catch by gear and year, 1979 – 1993. Data from unpublished NMFS General Canvas.

GEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Hook & Line	22.77	14.94	19.79	14.20	9.38	4.50	4.60	14.50	15.94	22.68	17.12	21.10	26.46	25.92	14.00
Trawl	38.45	42.09	32.08	28.60	34.57	48.68	52.43	54.25	46.90	42.73	41.08	32.68	26.45	30.97	35.27
Gillnet	4.29	9.90	17.02	12.53	22.44	17.89	17.15	13.39	16.94	15.79	8.96	11.35	17.54	19.56	11.55
Pots & Traps	17.06	16.65	12.32	32.87	20.98	17.61	15.35	12.58	15.01	15.44	29.58	31.95	19.27	16.17	27.34
Pound Net	17.25	16.42	17.77	11.34	12.49	10.89	9.43	4.64	5.03	3.34	3.25	2.77	4.16	3.57	3.60
Spear	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.09	3.78	7.10
Others	0.19	0.00	1.02	0.41	0.14	0.42	1.04	0.64	0.18	0.02	0.01	0.15	0.03	0.02	1.13
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

1.3.2.3 *Mode of Fishing*

Tautog have been harvested in both state and federal waters by a variety of commercial gears. Coastwide from 1979 to 1993, trawls accounted for the greatest proportion of tautog (39 percent)(Table 8). Other predominant gears include pots and traps (20 percent), hook and line (17 percent) and gill nets (10 percent).

Although otter trawls accounted for 27 to 54 percent of the landings coastwide (Table 8), the proportion of the commercial tautog landings attributed to hook and line has increased in recent years. In 1991, the amount of tautog landed commercially using hand lines was equal to that attributed to otter trawls (27 percent). In 1993, pots and traps accounted for the second largest proportion of the commercial catch (27 percent) after trawls (35 percent). Larger proportions of the catch using hook and line and pots and traps may be due to increased demand from the live fish market.

Trawls were the dominant commercial gear in Rhode Island, Connecticut and New York from 1979 to 1993 (Table 9). Hook and line accounted for the largest proportion of commercial landings in Massachusetts and Virginia. Pots and traps were the dominant gear in New Jersey, Delaware and Maryland.

1.3.2.4 *Area of Fishing*

Coastwide, from 1982 to 1991, an average of 70 percent of the tautog caught commercially came from state waters (Table 10).

In state waters for the period 1982 to 1991, most tautog were harvested in May and June with a secondary peak in October. In the Exclusive Economic Zone (EEZ, waters 3 - 200 miles offshore), average monthly landings peaked in May with greater amounts of tautog caught in two periods: April through June and November through January. Coastwide, in state and EEZ waters combined, commercial tautog landings peaked in May at approximately 135,000 pounds, with a secondary peak in November of 65,000 pounds.

Table 9. Commercial tautog landings as percent catch in pounds by gear and state, 1979 - 1993 combined. Data from unpublished NMFS General Canvas.

Gear	MA	RI	CT	NY	NJ	DE	MD	VA
Hook & Line	47.22	6.13	14.12	13.63	0.71	26.19	2.90	43.75
Trawl	21.54	43.78	79.36	53.19	18.59		2.80	24.51
Gillnet	6.79	37.40	1.56	2.79	1.38	14.29	2.13	12.94
Pots/ Traps	18.95	1.49	2.75	19.94	73.98	40.48	91.77	11.76
Pound Net	5.32	6.80	1.07	10.11	4.68			6.56
Spear		4.34			0.27			0.49
Others	0.17	0.06	1.14	0.34	0.38	19.05	0.40	
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 10. Total commercial tautog landings in thousands of pounds by area. Data from unpublished NMFS General Canvas, 1982 - 1991.

Fishing Area	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
State	318	353	407	392	736	908	787	732	526	724
EEZ (> 3 miles)	100	74	265	341	203	248	283	284	345	384
TOTAL	418	427	672	733	939	1,156	1,070	1,016	871	1,108

1.3.2.5 *Value of Landings*

The ex-vessel value of landings has generally increased between 1982 and 1991 with a peak nominal value recorded in 1991 of $588,000 (Table 11). This reflects the increase in the average price per pound received for tautog at the dock. Ex-vessel price increased from $ 0.21 per pound in 1982 to $ 0.56 per pound in 1990. The coastwide average price paid in 1991, $ 0.53, was only slightly below this peak. In 1991, the mean price per pound was $0.56 with the highest prices paid in New York, New Jersey, and Delaware (Table 12).

Table 11. Ex-vessel value of commercial tautog landings by year, Maine to Virginia combined. Prices adjusted with PPI (1982-100), data from unpublished NMFS General Canvas.

Year	Nominal Value ($ x 1000)	Nominal Mean Price	1990 Adjusted Mean Price
1982	76	0.18	0.21
1983	85	0.20	0.23
1984	132	0.20	0.22
1985	184	0.25	0.29
1986	342	0.36	0.43
1987	445	0.39	0.44
1988	542	0.51	0.55
1989	515	0.51	0.53
1990	783	0.55	0.56
1991	588	0.53	0.53

Table 12. Commercial tautog landings, value, and price by state for 1991. Data from unpublished NMFS General Canvas.

State	Weight of Fish (1000 pounds)	Ex-vessel Value ($ x 1000)	Price ($/pound)
Massachusetts	354	149	0.42
Rhode Island	371	185	0.5
Connecticut	54	27	0.5
New York	226	158	0.7
New Jersey	93	63	0.68
Delaware	1	0	0.72
Maryland	3	1	0.44
Virginia	5	2	0.52

1.3.3 Current Management Regulations

1.3.3.1 *Commercial*

Commercial regulations on tautog harvest vary greatly from state to state. Minimum size limits range from no minimum in Maine, New Hampshire, Maryland, and Virginia to 16 inches in Massachusetts, Rhode Island, and New York. The minimum size in New Jersey is 12 inches, and it is 14 inches in Connecticut. Delaware is the only state with seasonal minimum sizes (15 inches from April through June; 12 inches during the remainder of the year). Seasonal and area closures and gear restrictions are implemented in Massachusetts (trawls and gill nets), Rhode Island (trawls and fyke nets), New York (trawls) and New Jersey (fish pots and trawls), Delaware (trawls), and Virginia (trawls). Only three states have daily possession limits: Massachusetts and New York (50 fish) and Delaware (3 fish from April through June, 10 fish in all other months). Commercial permits to land and sell tautog are required in Massachusetts, Rhode Island, Connecticut and New York. Limited entry programs exist in Massachusetts (fish pots, gill nets and otter trawls), Maryland, and Virginia (2 year delayed entry). Reporting requirements exist in Massachusetts (gillnet only), Rhode Island (upon request), Connecticut (all gear types), Maryland, and Virginia (all gear types).

1.3.3.2 *Recreational*

Recreational regulations on tautog harvest are variable from state to state. Minimum size limits are identical to those described above for the commercial fisheries except for New York, which has a smaller recreational minimum size limit of 13 inches. Only four states have daily possession limits (number of fish): Massachusetts (8), Rhode Island (8), New York (10), and Delaware (3 from April through June, 10 in all other months).

Appendix 1 contains a state-by state summary of commercial and recreational harvest regulations for tautog as of January 1996.

1.3.4 Social and Economic Impacts

No information is available on social and economic impacts of the tautog fishery on regional income. The information desired would include effects on: business sales, wages and other components of value added, and on employment. In the recreational fishery, effects would vary depending on angler expenditure per recreational fishing trip for such items such as gasoline, boat charter/rental, lodging, food, fishing gear and bait, licenses, etc. In addition, for the northern part of the species range, economic resources previously targeted at other recreational fisheries have been redirected at tautog. For the commercial fishery, the costs associated with processing and wholesale and retail marketing must be factored in.

1.4 HABITAT CONSIDERATIONS

Because so little research has been done on the effects of pollution, contaminants, and other anthropogenic effects on tautog habitat and various life history stages of tautog themselves, development of specific recommendations relating to habitat is difficult. Tautog occupy a variety of habitat types depending on life history stage, time of year, and geographic location (see Section 1.2.1, "Species Life History Summary", and Steimle and Shaheen, In press). Each of these habitats and the tautog occupying them are subject to a variety of potential impacts that may influence tautog survival and growth as well as the condition and quality of the habitats. The relationships among potential impacts, habitats and tautog life history stages are summarized for both estuarine and coastal habitats in Figure 8 (adapted from Hoss and Thayer 1993) and will be discussed in greater detail in this section.

1.4.1 Habitat Description by Functional Classification

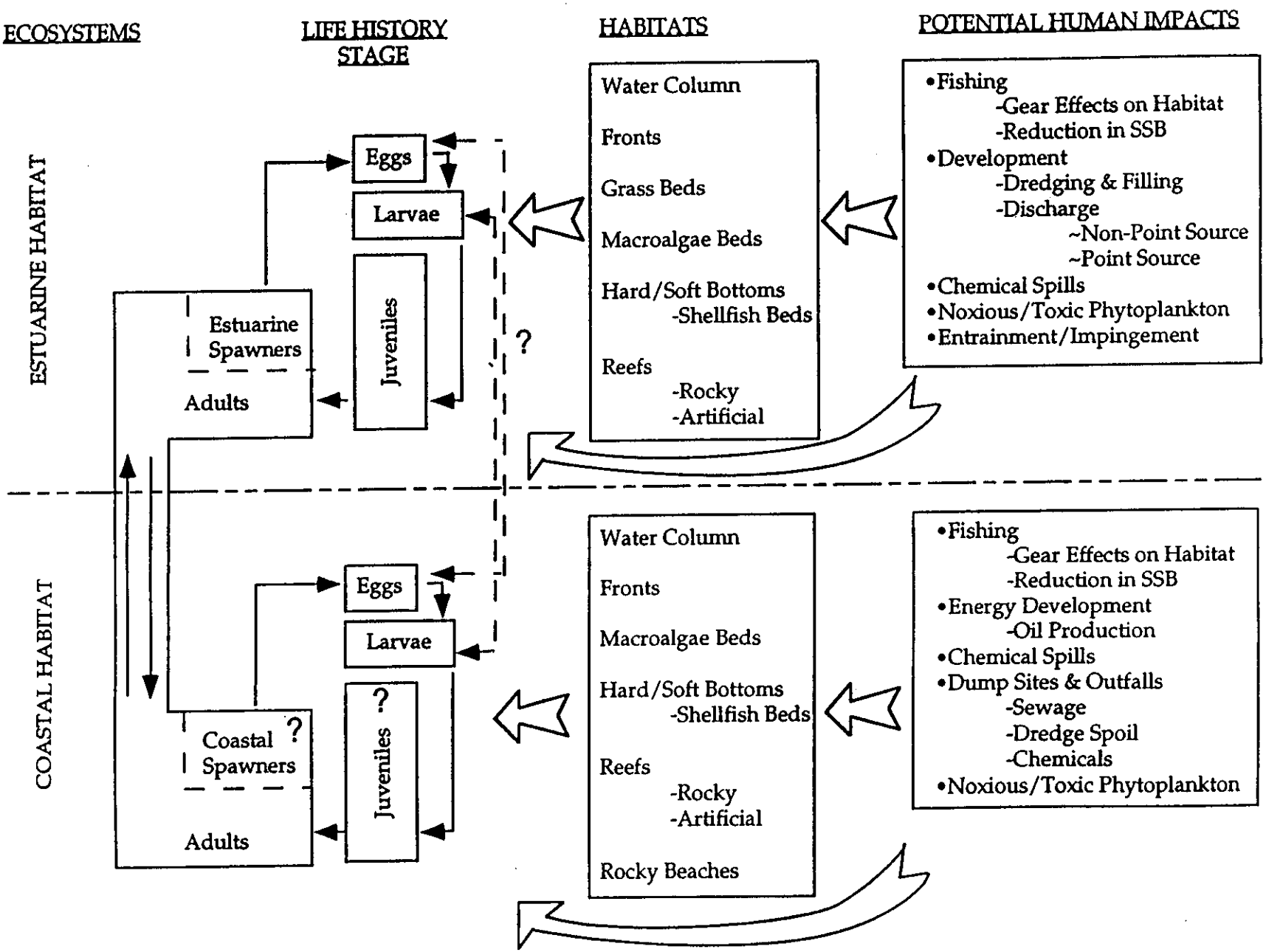
1.4.1.1 *Spawning*

After migrating inshore in the spring, spawning occurs primarily at or near the mouths of estuaries and nearshore marine waters (Sogard et al. 1992). The most extensive inshore/offshore migrations appear to occur in the northern portion of the species range, although little data are available for more southern areas. Tautog in spawning condition have been found on offshore hard bottom sites in Maryland and Virginia (Eklund and Targett 1990, Hostetter and Munroe 1993). Spawning activity may also occur in continental shelf waters based on eggs and larvae collected from Georges Bank to North Carolina and concentrated off of southern New England (Sogard et al. 1992).

1.4.1.2 *Eggs and Larvae*

Tautog eggs are buoyant and are found near the surface in large numbers in both estuaries and nearshore waters (Bourne and Govoni 1988, Monteleone 1992, Marine Research 1992, Sogard et al. 1992). Larvae are also found in estuaries and nearshore waters, staying near the surface during the day and sometimes going deeper at night (Malchoff 1993). Although no specific data are available, it is possible that eggs and larvae, because of their lack of (eggs), and relatively weak (larvae) swimming ability, may accumulate in marine frontal or other boundary features. Eggs and larvae are possibly transported onshore from offshore spawning sites, and seasonally high abundances of larvae and eggs offshore could be due to transport from estuarine and nearshore producer locations (Sogard et al. 1992). However, recent research indicates that tautog do spawn at offshore sites in Virginia (G. White, Virginia Institute of Marine Science, Gloucester, personal communication).

estuarine and coastal habitats. (adopted from Hoos and Thayer 1993). Solid lines indicate known movements. Dashed lines indicate possible, but unproven movements.



1.4.1.3 *Juvenile*

Juveniles settle to the bottom at around 3 weeks of age and tend to stay in waters less than 3 feet deep. They prefer vegetated over unvegetated areas (Briggs and O'Connor 1971, Sogard et al. 1992, Hostetter and Munroe 1993, Dorf and Powell In review), although a laboratory study indicates that some juveniles may prefer boulders to artificial vegetation (Dixon 1994). Vegetation can include sea grass and various types of macroalgae (Steimle and Shaheen, In press). With growth, young-of-the-year move gradually to deeper waters but are seldom found deeper than around 25 feet (Cooper 1964, Sogard and Able 1991). Juveniles have been known to move from their home sites during the summer if conditions become unsuitable due to loss of vegetative cover, high temperatures, or storm conditions (Olla et al. 1979, Dorf and Powell In review). Larger juveniles become associated with various reef-like habitats and hard surfaces (Olla et al. 1979) as long as the main habitat requirement of shelter is met.

Juvenile tautog remain inshore during the winter (Olla et al. 1974). When water temperatures drop below 40°F some large juveniles may move to deeper, more protected locations. Juveniles remaining inshore in shallow water can be found in a variety of shelters including grass and macroalgal beds, shells, discarded soda cans and bottles, fish pots, crevices and even in bottom depressions covered with silt (Cooper 1966, Olla et al. 1979). It is unknown if tautog larvae settle out of the water column in offshore locations or if small juvenile tautog are found in offshore habitats.

1.4.1.4 *Adult*

Adults occupy habitats similar to those of large juveniles and can be found in a variety of complex, structured coastal locations. These can include: vegetation, rocks, natural and artificial reefs, pilings, jetties and groins, mussel and oyster beds, wrecks, and submerged trees, logs and timbers (Steimle and Shaheen, In Press). Mouths of estuaries as well as other inlets and artificial reefs may be extremely important habitats for tautog (Zawacki 1969, Briggs 1975), particularly south of Long Island where there are fewer natural rocky outcrops to provide shelter than in the more northern portion of the range Localized populations form during the summer, in co-existence with large juveniles (Olla et al. 1974). Adults will leave a site if conditions become unsuitable (i.e., high water temperature, decline in musse abundance) (Olla et al. 1979, Adams 1993).

Most adult tautog form schools and migrate offshore to deep water locations (80- 150 feet) with rugged bottom when water temperatures drop below 52°F in the late fall, although this is known primarily from the northern portion of the species range. When water temperatures are low, adults become torpi (Cooper 1966, Briggs 1977). Some adults overwinter inshore (Auster 1989, Eklund and Targett 1991, Hostetter and Munroe 1993) and some also remain active throughout the year (Adams 1993).

1.4.2 Physical Habitat Characteristics

1.4.2.1 *Dissolved Oxygen (DO) levels*

No information is available on the effects of low DO levels on eggs or larval tautog. Juvenile tautog ar considered to be "hypoxia-tolerant" ($LC_{50} \leq 1.6$ mg L^{-1}) based on laboratory studies (D. Miller, EPA, Narragansett, Rhode Island, 1995, personal communication).

No laboratory information is available on effects of hypoxia on adult tautog (but see Howell and Simpson 1994). Tautog are capable of leaving low oxygen areas (Ogren and Chess 1969), although som adult mortality has been reported in association with major anoxic events (Perlmutter 1952, Azarovitz et al. 1979).

1.4.2.2 *Temperature*

High water temperatures (such as those that can result from passing through a power plant cooling water system) can result in egg mortality (Smith et al. 1979) as well as larval mortality or deformity (Olla and Samet 1978). At higher water temperatures larval metabolic rate and yolk usage increases. The resulting larvae may be smaller and at a competitive disadvantage with larger larvae, or other planktivores, when first required to feed on plankton (Laurence 1973). This may slow growth and reduce success in reaching the protected habitats required for settlement.

Adults seek shelter during the day at high water temperatures, and reduce their feeding and aggressive activities (Olla and Studholme 1975, Olla et al. 1978, Olla et al. 1980). Extended periods of high water temperatures may cause large adults to move to cooler water (Adams 1993).

When temperatures decrease in the fall and winter, juveniles remaining inshore become torpid, occupying shelters throughout the winter (Cooper 1966, Olla et al. 1974).

Water temperature (approximately 50 °F) serves as the primary trigger for adult tautog seasonal migrations (Olla et al. 1980). At very low water temperatures, adult tautog become torpid (Cooper 1966, Olla et al. 1974). Some adults remain active throughout the year, particularly in the more southerly portion of the species range (Eklund and Targett 1991, Adams 1993, Hostetter and Munroe 1993).

1.4.2.3 *Salinity*

Although reported from brackish water, tautog have not been collected in freshwater (Bigelow and Schroeder 1953).

1.4.3 Differences in Habitat Characteristics With Distribution

In the northern portion of the species range, there are more natural rocky areas which provide the rocky reef habitat required by adult tautog. South of Long Island Sound, relatively few of these habitats occur naturally and tautog can be found in shellfish beds, jetties, shipwrecks and artificial reefs. Habitat scarcity may serve to constrain tautog population size both by limiting the encrusting prey upon which tautog feed (Chee 1977), as well as limiting availability of shelter sites.

Tautog tend to be found further offshore in the southern portion of the species range and have been reported up to 40 miles offshore and in up to 225 feet of water in southern Virginia (Hostetter and Munroe 1993).

Migration patterns may differ throughout the species range. Not all tautog migrate inshore in the spring, as occurs in the more northern states. Populations of adults have been observed offshore throughout the year in Maryland and Virginia on hard bottom and artificial reef substrates (Eklund and Targett 1990, Hostetter and Munroe 1993).

1.4.4 Linkage Between Habitat Protection and Species Production

Although habitat and fishery production are linked, there are no available quantitative data and, for some locations, qualitative information, on linkages between habitat and tautog production, or on the effects of habitat loss or degradation on tautog productivity. The size and quality of tautog populations are probably highly dependent on the quantity and quality (shelter and food) of their habitat.

Estimates of tautog population sizes are currently unreliable and the amount and specific locations of essential spawning and nursery habitats are unknown. Understanding tautog-habitat interactions is necessary for effective conservation and management of the tautog resource.

1.4.4.1 *Identification and Distribution of Essential Habitats*

If we accept the definition of habitat as the place where an organism is naturally found in abundance (Odum 1971), then we may further refine this to a definition of essential habitat. "Essential habitat" refers to the habitats that are known to be required for the successful reproduction and survival of the managed species. Essential habitats for tautog are described above and include spawning grounds, nursery areas, feeding areas, shelter areas, and migration routes. All are essential to tautog at different stages of their life cycle.

Tautog are distributed in coastal and estuarine waters from Nova Scotia, Canada to Georgia, although they are most abundant from Cape Cod to Cape Hatteras. The best coastwide species distribution maps currently available come from (Auster 1989) and include the distribution for cunner, a closely related species (Figures 1 and 2).

1.4.4.2 *Present Condition of Habitats and Essential Habitats*

Besides over exploitation, which primarily affects adult tautog, other sources of mortality can reduce abundance. Very little information is available on disease effects, although finrot has been reported in some locations (see Steimle and Shaheen, In Press). Tautog occur near areas immediately associated with human activity (shallow estuarine areas, rocky and artificial reefs, and submerged stormwater and sewage outfall pipes, etc.) which has resulted in past and current changes in habitat availability and quality. Development of nearshore areas through such activities as dredging of material for channel maintenance, marina construction and other shoreline development resulting in pollutant discharges will impact tautog populations at all life history stages. Shipwreck salvage or reduction in reef height and complexity (shelter sites) may reduce their value as adult tautog habitat. Use of "rock-hopper" roller trawling gear over wrecks, low profile reefs and mussel beds also threatens the quality of these habitats. Declining oyster beds is yet another threat to the estuarine habitat needs of juvenile tautog and other species with similar needs (Chesapeake Bay Program 1994).

Loss or destruction of vegetated bottom areas eliminates juvenile nursery areas. Increased turbidity and siltation due to dredging activities may inhibit feeding in larvae, degrade submerged aquatic vegetation beds used as nursery habitat, as well as damage adult spawning areas. Contaminants, disturbed in the dredging process, and brought into the water column could affect egg, larval and juvenile survival directly, or indirectly, through their food sources.

Entrainment of eggs and larvae in power plant intakes may result in physical damage to early life history stages and heated effluent from these and other industrial outfalls may also result in thermal stress. Discharge of treated sewage effluent and industrial wastes may have direct effects on fish as well as indirect effects on habitat and potential food sources through eutrophication. Results could include alterations of community composition (animal and vegetation) due to nutrient enrichment, and resulting anoxic and hypoxic environments.

Contaminants in the environment can affect tautog directly through contact and indirectly through ingestion of contaminated food. Reductions in growth and reproductive success, as well as direct mortality, are possible effects due to metals, oil, or other chemicals, which often remain in natural environments for long periods of time without degradation to less harmful forms. Biological sources of

contamination could include direct contact with or ingestion of food associated with noxious or toxic phytoplankton blooms.

No information is available on direct pollution effects in tautog, however chromium, copper, and nickel levels in New Jersey coastal adult tautog liver tissue decreased significantly with increasing body length (Mears and Eisler 1977). Hall et al. (1978) found low to average levels of 15 metals in tautog muscle tissue (unknown collection site). Recently, the National Marine Fisheries Service (1995) found metal concentrations (silver, cadmium, chromium, copper, nickel, lead, zinc, arsenic and mercury), as well as PCB, PAH and pesticide concentrations below FDA action concentrations in adult tautog collected from Manasquan Inlet, New Jersey. In a laboratory study, Deacutis (1982) found that adult tautog showed little tendency to avoid oil contaminated feeding locations and would readily consume fuel oil contaminated bivalve meat.

Greatest direct contaminant effects could occur with eggs and larvae, but because tautog feed on bottom-dwelling organisms, juveniles and adults could experience trophic transfer, resulting in indirect effects and long-term build up of contaminants in edible flesh. Possible long-term effects on humans eating tautog are unknown.

Prevention of habitat loss throughout the species range should be a high priority for restoration of the tautog resource.

1.5 IMPACTS OF THE FISHERY MANAGEMENT PROGRAM

1.5.1 Biological and Environmental Impacts

Management of tautog stocks will stabilize or rehabilitate their roles in reef communities. Maintenance of tautog stocks will also prevent drastic, and perhaps irreversible, changes in the structure of reef fish/epifauna communities, such as those occurring now on Georges Bank, with skates replacing groundfish (Steimle and Shaheen, In Press).

1.5.2 Social Impacts

Preservation and enhancement of the tautog fishery resource will allow continued participation in a recreational inshore coastal fishery using easily accessible resources such as jetties and small vessels.

1.5.3 Other Resource Management Efforts

1.5.3.1 *Artificial Reef Development/Management*

Artificial reefs are commonly created and used to "sustain" and "enhance" tautog (and other reef fish) populations and fisheries. These fishery management tools are popular with state managers, the public, and the news media. As there exist many questions on how the various uses of artificial reefs can affect maintenance of sustainable populations and fisheries, reef planning and use must be discussed relative to the overall management goals and objectives of the tautog FMP (and other reef resources). Important questions persist as to what degree artificial reefs enhance biological production (survival, growth, etc.), and if this production will keep up with the attraction or aggregation role of reefs for fishery exploitation. Some reef habitats that can be readily monitored by enforcement personnel (e.g. from shore) should be considered as refuges.

Reef management activities undertaken through framework provisions contained in Section 4.3 of this FMP are to be in accordance with the reef management objectives of the jurisdiction involved. Further, any such activities are to be promulgated with appropriate public input.

1.5.3.2 *Bycatch in Trap or Pot Fisheries*

Little information is available on the proportion of tautog collected as bycatch in trap fisheries in the northern portion of the species range. Tautog did not form a large portion of the catch in a Mid-Atlantic Bight black sea bass (*Centropristis striata*) trap fishery study conducted in Maryland and northern Virginia over hard bottom reef areas consisting of low profile rocky, gravel and shell material (Eklund and Targett 1990, 1991). Tautog were the third most abundant species collected (0.4 percent), after the target species, *C. striata* (97.5 percent) and spotted hake (*Urophycis regia*, 0.9 percent). Catches varied over time, with tautog most abundant in early May, probably coincident with their spring inshore spawning migration, since their gonadosomatic index was also highest at this time (Eklund and Targett 1990).

Tautog were the second most abundant species (23%) after scup (30%) of the finfish bycatch in lobster pots during New York State Department of Environmental Conservation's (NYSDEC) 1994 monitoring of New York's lobster fishery (Graulich 1995). While tautog made up only 1% of the total lobster pot catch (with respect to lobsters and finfish only) from all areas sampled, estimates of catch per unit effort varied noticeably between areas. Bycatch (as number of tautog per pot per year) was greatest in the ocean (2.3), least in eastern Long Island Sound (0.13), and was 1.5 in western Long Island Sound. This bycatch become significant when multiplied by the number of traps. A survey of resident commercial lobstermen provided a self-reported estimate of 160,572 traps in use in New York waters and in the EEZ during 1994 (P. T. Briggs, NYSDEC, East Setauket, personal communication). Further, lobstermen in some areas target tautog when lobstering slows down by using longer sets without bait (K. Graulich, NYSDEC, East Setauket, personal communication). Unpublished data from NYSDEC's lobster fishery monitoring in 1993 and 1994 shows that the mean length of tautog (N=956) caught in lobster pots was 10.3 inches (pots sampled had escape vents of either 1 15/16 inches rectangular or 2.5 inches circular). Eighty percent of these fish were under the proposed coastwide minimum size limit of 14 inches, seventy-two percent were under 12 inches, and eighty-seven percent were under 16 inches.

1.5.3.3 *Land/Seabed Use Permitting*

This plan does not impact land or seabed use permitting.

1.5.4 Economic Impacts

In all Fishery Management Plans, potential adverse impacts to the commercial and recreational fishing industry and the cost of enforcement must be evaluated in terms of the resulting value gained. The benefits of the proposed management measures, though not fully quantifiable at this time, are likely to be greatly in excess of any costs. This plan is designed to manage tautog stocks at a sustainable level and to prevent stock collapse. Therefore, any economic losses that may result from proposed fishing effort reductions will be recovered by allowing a valuable fishery to continue for future generations.

1.5.4.1 *Recreational Fishery*

The management measures of this plan will preserve a recreational fishing opportunity and all of the associated economic benefits that would be lost if stocks were allowed to collapse. The coastwide minimum size should benefit enforcement efforts in areas of closely overlapping jurisdictions.

Enforcement costs are dependent upon the specific measures a state may choose to adopt, but should not impose a significant burden beyond current activities.

1.5.4.2 *Commercial Fishery*

The management measures of this plan will preserve a commercial fishery and all of the associated economic benefits that would be lost if stocks were allowed to collapse. The coastwide minimum size should benefit enforcement efforts in areas of closely overlapping jurisdictions and in cases of interstate commerce. Specific enforcement costs of other commercial management measures should be considered as each state develops a commercial management proposal.

1.6 LOCATION OF TECHNICAL DOCUMENTATION FOR FMP

Technical documentation of this Fishery Management Plan will be contained in a separate Source Document to the Tautog Fishery Management Plan. The Source Document will be made available through the ASMFC and will contain the following information:

1. Review of Resource Life History and Biological Relationships

Steimle, F. W., and P. A. Shaheen. In Press. Tautog, *Tautoga onitis*: life history and habitat requirements. Northeast Fisheries Science Center, NOAA Technical Report NMFS-F/NEC.

2. Stock Assessment Document

Lazar, N. 1995. Consensus Summary of the Coastal/Pelagic Subcommittee; Assessment of the Tautog Stock. Atlantic States Marine Fisheries Commission 20th SAW/SARC Working Paper F1.

3. Review of Fishery

Reviews of the tautog fishery in each state with an interest in tautog will be contained in the Source Document.

4. Review of Public Comment

Summaries of the Public Information Document Meetings and Public Hearings on the Tautog Fishery Management Plan will be contained in the Source Document.

2. GOALS AND OBJECTIVES

GOALS:

To perpetuate and enhance stocks of tautog through interstate fishery management so as to allow a recreational and commercial harvest consistent with the long term maintenance of self-sustaining spawning stocks.

To maintain recent (i.e., 1982 - 1991) utilization patterns and proportions of catch taken by commercial and recreational harvesters.

To provide for the conservation, restoration and enhancement of tautog critical habitat for all life history stages.

To maintain a healthy age structure.

To conserve the tautog resource along the Atlantic coast to preserve ecological benefits such as biodiversity and reef community stability, while maintaining the social and economic benefits of commercial and recreational utilization.

OBJECTIVES:

To establish criteria, standards, and procedures for plan implementation as well as determination of states' compliance with management plan provisions.

To allow harvest that maintains spawning stock biomass in a condition that provides for perpetuation of self-sustaining spawning stocks in each spawning area, based on maintaining young-of-the-year indices, SSB, size/age structure, or other measures of spawning success at or above historical levels as established in the plan.

To achieve compatible and equitable management measures among jurisdictions throughout the fishery management unit.

To enact management recommendations which apply to fish landed in each state, so that regulations apply to fish caught both inside and outside of state waters.

To promote cooperative interstate biological, social and economic research, monitoring and law enforcement.

To encourage sufficient monitoring of the resource and collection of additional data, particularly in the southern portion of the species range, that are necessary for development of effective long-term management strategies and evaluation of the management program. Effective stock assessment and population dynamics modeling require more information on the status of the resource and the biology/community ecology of tautog than is currently available, in particular to facilitate calculation of F and stock trends.

To identify critical habitats and environmental factors that support or limit long term maintenance and productivity of sustainable tautog populations.

To adopt and promote standards of environmental quality necessary to the long term maintenance and productivity of tautog throughout their range.

To develop strategies that reduce fishing mortality, restore size composition and the historical recreational/commercial split, consider ecological and socio-economic impacts and identify problems associated with the offshore fishery. Compatible regulations between the states and the EEZ are essential.

2.1 SPECIFICATION OF THE MANAGEMENT UNIT

The management unit consists of all states from Massachusetts through North Carolina. Although there are apparent regional differences in tautog fishery and habitat characteristics, at present there is no biological basis for establishing Northern and Southern management units.

2.2 DEFINITION OF OVERFISHING

The Plan defines overfishing as a rate of fishing exceeding the natural mortality rate (M = 0.15). This overfishing definition is consistent with the slow growth and long lifespan (greater than 30 years) of this species. In addition, this conservative reference point is warranted given the uncertainty in stock structure and in the spawning biomass required to maintain at least average recruitment.

2.3 STOCK REBUILDING PROGRAM

2.3.1 Stock Rebuilding Targets

To enhance tautog stocks, the Plan establishes a target fishing rate equal to that of natural mortality (F = M = 0.15) and a uniform 14 inch minimum size. The target fishing rate will reduce exploitation of the older, fully recruited fish, while the minimum size will protect the younger fish and allow them to spawn at least once. In the initial phase, the plan targets an interim fishing rate of F = 0.24. At the end of this period, stock status and abundance will be evaluated, and the steps needed to reduce fishing mortality to the F=0.15 target will be identified. Additional stock rebuilding targets may be identified during the evaluation.

2.3.2 Maintenance of Stock Structure

The proposed minimum size allows young fish to reach maturity and enhance stock levels through reproduction, thereby preventing growth overfishing. Reducing fishing mortality on larger fish will rebuild and maintain tautog stock biomass and a healthy age structure (20+ age classes). Although the minimum size will result in a reduction of landings during the first year of implementation, it does not reduce fishing mortality on the older ages, and will not maintain the broad age structure required to enhance and maintain spawning biomass levels needed to prevent recruitment failure. As the fish grow beyond the minimum size and recruit into the fishery, they become vulnerable to fishing effort, and any spawning biomass conserved is quickly reclaimed by the fishery. The positive aspects of minimum size regulations relate to a modest increase in yield to the fishery (reducing growth overfishing) and more significant increases in spawning stock biomass. An additional benefit to establishing a minimum size is the immediate enhancement in stock biomass.

The second management measure is a target fishing mortality level of F = 0.15. To reach this goal, the Plan recommends taking an initial reduction for two years to a target of F = 0.24. Although the specific landings reductions in each state may vary, on a coastwide average, this step requires a 55 percent reduction in fishing mortality. Reducing fishing mortality on larger fish through effort controls is necessary to increase yield to the fishery and to rebuild and maintain tautog stock biomass and age structure. Under the Plan, states are allowed the flexibility to develop a management scheme that will meet the needs of their particular fishery and produce the necessary reductions.

3. MANAGEMENT PROGRAM SPECIFICATIONS

3.1 ASSESSING ANNUAL RECRUITMENT, SPAWNING STOCK BIOMASS, AND FISHING MORTALITY

The Plan recommends that when sufficient data become available, an analytical assessment should be developed on either a regional or coastwide basis, to evaluate stock condition and re-evaluate biological reference points. This would provide the best estimate of stock size, recruitment and fishing mortality. The years 1991 - 1993 will be used as benchmark years to demonstrate percent reductions in fishing mortality on a coastwide basis for recreational and commercial fisheries. This particular time series was chosen because it represents relatively recent history in the tautog fishery. At the same time, these years represent a period when a less severe regulatory climate existed. This time series will assure that no regulatory penalties will be imposed on states that currently have a more severe regulatory structure in place.

An age structure based assessment, or VPA, cannot presently be performed for tautog due to inadequate data. Currently no length or age samples are collected in the commercial fishery, while length samples only, are collected in the recreational fishery (Table 13).

Table 13. Data availability by state.

Data Type	MA	RI	CT	NY	NJ	DE	MD	VA	EEZ /NMFS
Commercial Landings	O	O	O	O	O	●	O	O	O
Commercial Discards	O	O	—	O	—	—	—	—	O
Commercial Length Frequency	—	—	—	—	—	—	—	—	—
Recreational Landings	●	●	●	●	●	●	●	●	●
Recreational Discards	●	●	●	●	●	●	●	●	●
Recreational Length Frequency	O	O	O	●	O	O	O	O	O
Juvenile index	—	●	O	●	—	—	—	—	—
Index at Age (survey)	—	O	O	O	—	—	—	—	—
Age at Length Keys	—	O	O	O	—	—	—	O	—
Survey Length Frequency (fishery independent)	●	●	●	●	●	—	—	—	O

● Good
O Fair
— Not available

Depressed stock abundance in recent years has resulted in even fewer tautog being available in fishery independent surveys for aging. As a consequence, annual VPA derived stock biomass and fishing mortality (F) estimates, familiar through use in management of other species such as summer flounder,

are not available for monitoring tautog status. In addition, reliance on survey based fishing mortality estimates, particularly at reduced stock sizes, is also impractical.

An analytical assessment will require a doubling or tripling of length sampling in the MRFSS and initiation of length-frequency sampling in the commercial fishery. In addition, the development of more comprehensive age-length keys is required. To develop accurate age-length keys, it is necessary to collect at least 10 fish per 10 cm size class. For a state specific key, this translates to roughly 500 fish per state. Alternatively, states could pool their data on a regional basis, thus requiring only 150-200 fish per state. Potential regional groupings are Massachusetts - Connecticut, New York and New Jersey, and Delaware - Virginia.

The analytical assessment (VPA) is needed to estimate stock size, recruitment and spawning biomass coupled with fishing mortality rates. In the absence of an analytical assessment, other age-based methods could be used to less precisely estimate fishing mortality. However, stock size, recruitment and spawning biomass cannot be estimated by these methods. Mark-recapture studies provide an alternative to age-based assessments for estimating stock size and fishing mortality rates. However, such estimates of stock size and fishing mortality are often considered to be less reliable than VPA.

In the absence of any of the above, fishing mortality cannot be estimated and other management reference points will have to be considered. Alternatively, an index-based assessment, and associated reference points, could be developed. Indices could be derived from either fishery independent or dependent sources, however, fishery dependent indices have historically proved misleading by failing to predict stock collapse.

3.2 SUMMARY OF MONITORING REQUIREMENTS

3.2.1 VPA

A VPA requires: commercial and recreational landings, discards and length-frequencies, annual age at length keys, length-weight relationships, natural mortality rates, discard mortality rates and indices at age. Length-frequency samples and age key data should be sufficient to characterize the structure of the stock. For age keys, approximately 5 fish per centimeter per state per year (approximately 200 fish per state) are needed to develop a regional key. Ten fish per centimeter (approximately 500 fish) are needed to develop state specific keys.

3.2.2 Catch Curve Analyses

A catch curve analysis requires annual length at age keys and length-frequency data from either fishery independent or dependent sources.

3.2.3 Length Based Methods

Length based methods require adequate length-frequency data and Von Bertalanffy growth parameters.

3.2.4 Mark-Recapture Methods

Mark-recapture studies require substantial tagging and recovery effort, as well as estimates of tag-induced mortality, tag loss rates and reporting rates. Extremely large sample sizes would be required to estimate mortality for a regional fishery.

3.2.5 Index-Based Assessment

An index-based assessment, and associated reference points, could be developed. Indices could be derived from either fishery independent or dependent sources, however, fishery dependent indices have historically proved misleading by failing to predict stock collapse. In addition, this would require development of new management reference points.

3.3 STOCKING

Declines in tautog populations and its importance in commercial and recreational fisheries suggest a potential for stock enhancement through stocking of hatchery-raised tautog in selected areas. Tautog are structure-oriented and non-migratory, traits that make them an attractive species for potential use in a stock enhancement program. Additionally, the tautog is hardy, adaptable to captive rearing, can be spawned both naturally and artificially (Perry 1994), and juveniles can be reared in high densities. Tautog culture is still in the early stages of development, so it is not yet known if stocking is feasible at a level that would benefit stock abundance.

The intent of stocking would be to increase available tautog resources over time through the introduction of artificially produced young fish. The management benefits would include stabilization of population numbers and enhancement of poor year classes. If other management measures are not successful, stocking could help rebuild the population. While there are no plans to stock tautog at this time, the Plan recognizes this potential management tool.

3.4 HABITAT/SANCTUARY CREATION

The intent of a Special Management Zone (SMZ), which usually restricts types of allowable fishing gear, would be to enhance management of tautog on or around artificial reefs through increased habitat availability, while optimizing fishing opportunities that would not otherwise exist. Artificial reefs consist of various types of accidentally or deliberately human generated structures such as concrete blocks, tires, bulkheads, riprap, pilings (concrete, wood or metal), shellfish culture areas, wrecks and others, that serve to enhance or attract fish. For tautog, artificial reefs may be more important as shelter sites than feeding areas (Steimle and Ogren 1982).

On request from a state, reef sites in the EEZ are to be impacted consistent with the reef management objectives of the state concerned. Regulations pursuant to reef management are to be promulgated with appropriate public input.

3.5 PREVENTION OF TARGETED FISHERY DEVELOPMENT

The majority of recreational and commercial landings result from existing directed fisheries. Commercial management plans developed by each state should be designed to prevent development of excessive additional fisheries for tautog in areas that cannot support additional effort.

3.6 BYCATCH REDUCTION

The paucity of information on non-targeted or undersized tautog bycatch in lobster or net fisheries prevents development of specific bycatch reduction measures and targets. To reduce ghost fishing by lost traps, degradable fastener provisions are contained in this Plan. Escape panels for pots and traps should be considered to reduce harvest of undersize fish. Additional research may be necessary to determine appropriate panel sizes.

4. MANAGEMENT PROGRAM IMPLEMENTATION

States must implement regulations to reduce fishing mortality (both recreational and commercial) to the interim target fishing mortality rate of F=0.24 for two years. The years 1991 -1993 are to be used as the benchmark period for determining fishing mortality reductions.

At the end of the interim period, each state must reduce fishing mortality to the target of fishing mortality equal to natural mortality (M), which is equal to 0.15. The condition of the fishery will be evaluated prior to implementation of the target, and fishing mortality reductions associated with various management options will be updated.

If a state can provide evidence of fishing mortality rates below what is indicated in the plan, that state is only required to implement restrictions that will be sufficient to reach the target fishing mortality level. Any state utilizing this option must monitor its fisheries to assure that fishing mortality rates do not exceed the target.

Compatible regulations between adjacent states are desirable to prevent the shift of fishing effort to areas with more liberal regulations, or to areas with an open season, if seasonal closures are implemented.

Any state that exceeds its commercial or recreational targets in a given year will have the overage deducted from the following years catches.

4.1 RECREATIONAL FISHERIES MANAGEMENT MEASURES

4.1.1 Size Limit

The FMP specifies a 14" minimum size for recreational fisheries. This may be implemented by adopting 13" in 1997 and 14" in 1998.

4.1.2 Fishing Mortality Reduction

Recreational fisheries reductions to reach the interim target F rate may be achieved through possession limits, seasons, or a combination of both. The fishing mortality reductions associated with possession limits and seasonal closures and have been developed for each state based on 1991 – 1993 catch rates (Tables 14 and 15; no discard mortality value is assumed in calculating the reductions in these tables).

Based on the coastwide average fishing mortality rate of F=0.58, a 55% reduction in fishing mortality is needed to reach the F=0.24 target. However, for states that exhibit a lower current fishing mortality rate, the plan only requires the appropriate level of reduction that will reach the target F rate.

Table 14. Percent reductions in tautog recreational fisheries at different possession limits by state. No discard mortality assumption is included.

Possession Limit/State	CT	DE	MD	MA	NJ	NY	RI	VA
1	72.75	83.06	78.35	85.61	74.93	80.30	85.18	78.89
2	58.95	70.82	63.23	75.64	60.87	66.83	73.90	64.41
3	48.15	60.89	53.36	68.35	50.94	56.68	64.72	54.62
4	39.79	52.49	44.98	62.92	43.79	48.41	56.84	47.73
5	32.39	45.17	38.96	58.28	37.85	41.85	50.09	41.27
6	25.97	38.87	32.54	54.54	33.34	36.36	44.53	35.91
7	22.10	33.42	28.41	51.15	29.73	31.87	39.84	32.05
8	18.95	28.87	25.08	47.98	26.30	27.89	35.67	28.77
9	16.71	24.79	21.99	45.07	23.44	24.49	32.22	25.75
10	14.82	21.19	18.98	42.47	20.73	21.39	29.24	22.79
11	13.17	18.72	17.18	40.36	18.47	18.94	26.60	20.17
12	11.75	16.42	14.88	38.36	16.36	16.63	24.11	17.69

Note: Percent reductions in Table 14 are based on an assumption of no seasonal closure. See * below.

Table 15. Percent reduction in tautog recreational landings for bi-monthly seasonal closures (percent landings from MRFSS by state and wave, no discard mortality assumption).

Wave	CT	DE	MD	MA	NJ	NY	RI	VA	Mean
Jan-Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar-Apr	1.01	7.61	16.86	1.83	3.91	1.98	2.04	18.46	6.71
May-June	35.50	13.95	17.61	23.32	19.24	28.69	19.45	17.20	21.87
July-Aug	19.61	8.23	5.54	29.61	7.40	4.33	20.17	6.04	12.62
Sep-Oct	31.25	51.77	59.47	32.81	54.90	46.23	38.97	35.88	43.91
Nov-Dec	12.63	18.44	0.51	12.44	14.55	18.77	19.37	22.42	14.89

Note: Percent reductions in Table 15 are based on an assumption of no possession limit. See* below.

* The values in Tables 14 and 15 are not additive. Therefore, if both possession limits and seasonal closures are used, the total reduction is not the sum of the values from each table. To determine the total reduction, it is necessary to account for the effects of one measure on the other. This can be done using the following formula:

Total reduction = X + {(1-X)*Y};
X = the percent reduction value from the seasonal closure table,
Y = the percent reduction value from the possession limit table.

4.2 COMMERCIAL FISHERIES MANAGEMENT MEASURES

4.2.1 Size Limit

The FMP specifies a 14" minimum size for commercial fisheries. This may be implemented by adopting 13" in 1997 and 14" in 1998.

4.2.2 Fishing Mortality Reduction

Commercial fisheries reductions to reach the interim target F rate are to be achieved through state specific plans requiring Management Board approval. States are given the flexibility to develop a commercial fishery management regime that will best meet their particular needs. The fishing mortality reductions for commercial seasonal closures are given in Table 16.

Based on the coastwide average fishing mortality rate of F=0.58, a 55% reduction in fishing mortality is needed to reach the F=0.24 target. However, for states that exhibit a lower current fishing mortality rate, the plan only requires the appropriate level of reduction that will reach the target F rate.

The relative burden of the conservation program and management measures will vary from state to state relative to the importance of the fishery in that state as compared to its importance in other states throughout the species range.

The Tautog Technical Committee will review each state's plan and forward a recommendation to the Tautog Management Board. The Management Board is responsible for final approval of the plan.

Table 16. Potential percent reduction in commercial landings for monthly seasonal closures (from percent commercial landings by month and state, 1991–1993).

Month	CT	DE	MD	MA	NJ	NY	RI	VA	Mean
1	<1		5.67	0.47	1.49	3.33	3.14	10.92	4.17
2	<1		2.00	0.06	0.61	1.94	0.41	3.18	1.37
3	<1		1.90	0.14	1.24	3.18	0.32	5.03	1.97
4	0.9		17.67	11.89	4.60	5.92	10.83	11.14	10.34
5	27.5		20.18	41.61	11.64	12.65	24.61	12.74	20.57
6	44.0		6.98	17.40	17.03	14.04	15.44	7.77	13.11
7	17.4		4.36	6.24	12.31	13.44	7.72	6.45	8.42
8	1.9		5.04	3.10	9.31	11.32	3.74	6.65	6.53
9	5.2		4.20	2.90	10.31	8.22	3.38	2.83	5.31
10	1.6		6.02	8.74	13.32	8.49	8.95	13.96	9.91
11	0.5		9.29	5.39	12.69	9.99	11.82	12.38	10.26
12	0.4		16.71	2.06	5.45	7.47	9.62	6.94	8.04

4.3 ADDITIONAL MANAGEMENT MEASURES

4.3.1 *De Minimis* Fishery Guidelines

Any state covered under this FMP which proves that it accounts for less than or equal to 1 percent of the coastwide commercial landings may apply for *de minimis* status. If *de minimis* status is granted, that state will be required to follow plan provisions concerning minimum size. Commercial landings exceeding 1 percent of the coastwide commercial landings will trigger monitoring requirements as discussed in Section 5 of this FMP.

4.3.2 Recommendations to the Secretary of Commerce for management in the Exclusive Economic Zone

Compatibility of state and Exclusive Economic Zone (EEZ) regulations are essential for effective management of the tautog fishery. Non-compatibility presents concerns of a possible shift of the fishery into the EEZ upon Plan implementation. Once the tautog FMP is adopted, the Secretary of Commerce and the NMFS should move as soon as possible to adopt compatible regulations for tautog fisheries in the EEZ (3 - 20 miles from the United States coast).

The plan recommends that the Secretary of Commerce implement minimum size of possession regulations for tautog in the EEZ that are in accordance with state minimum size requirements contained in the plan. It is the intention under the Atlantic Coastal Fisheries Conservation and Management Act to have EEZ fisheries regulated consistent with state possession and landing laws, and that the more stringent of state or federal law will apply regardless of whether fish are caught in the EEZ or in state waters.

4.3.3 Pot and Trap Degradable Fasteners

Tautog pots and traps are required to have hinges and fasteners on one panel or door made of one of the following degradable materials:

a. Untreated hemp, jute, or cotton string of 3/16" (4.8 mm) or smaller;

b. Magnesium alloy, timed float releases (pop-up devices) or similar magnesium alloy fasteners;

c. Ungalvanized or uncoated iron wire of 0.094" (2.39 mm) or smaller.

4.4 ADAPTIVE MANAGEMENT

The Management Board may vary the requirements specified in this FMP as a part of adaptive management as necessary to achieve the goals and objectives specified in the Executive Summary. Because specific measures for achieving fishing mortality rates are to be determined by each state, each state may change those regulations, providing such changes are made in accordance with procedures established in this plan. This section establishes a framework for adaptive management and identifies measures that may change.

4.4.1 Circumstances Under Which Change May Occur

– If a state can demonstrate that its current fishing mortality level is less than that identified in the Plan, that state is only required to reduce its fishing mortality by an amount that will bring it into compliance with targeted fishing levels.

– A state may change its specific commercial and recreational management measures if it determines that such changes will better meet the needs of it fisheries while still meeting the objectives of this FMP.

– The Management Board may make changes to specific elements contained in the plan if necessary to meet the objectives and goals specified.

4.4.2 Measures Subject to Change

Management measures that may be modified under this adaptive management framework include changes in regulatory measures such as size limits, possession limits, seasonal closures, and area closures; alteration of EEZ recommendations; creation of Special Management Zones; and modification of individual state commercial management program requirements.

The condition of the stock will be evaluated at the end of the interim management period. At this time, alternative biological references may be selected, the overfishing definition may change, and the compliance date for the next fishing mortality reduction may be modified as appropriate.

As additional biological data becomes available, assumptions and references associated with the assessment may be changed to reflect appropriate values. Discard mortality rates associated with recreational fishing will be examined and could change.

The Management Board may make changes to the state implementation schedule in accordance with adaptive management provisions.

4.4.3 Procedural Steps to Effect Change

The Plan Review Team (PRT) will monitor the status of the fishery and the resource and report on that status to the Management Board on or about July 1. In preparing its report, the PRT may consult with the Technical Committee, Stock Assessment Subcommittee, and Advisory Panel. The report will contain recommendations concerning proposed adaptive management revisions to the management program.

The Management Board will review the report of the PRT, and may consult further with the Technical Committee, Stock Assessment Subcommittee, and the Advisory Panel. The Management Board may direct the PRT to prepare an addendum if changes are necessary. The addendum will state the need for the changes and include a schedule for the states to implement its provisions.

The PRT will prepare the draft addendum, and distribute it to the states, Technical Committee, and the Advisory Panel for review and comment. A public hearing will be held in any state that requests one. The PRT will also request comment from federal agencies and the public at large. After a 30-day review period, the PRT will summarize the comments and prepare a final version of the addendum for the Management Board.

The Management Board will review the final version of the addendum prepared by the PRT, and consider the public comments received and the recommendations of the Technical Committee, the Stock Assessment Subcommittee, and the Advisory Panel. The Management Board will decide whether to adopt or revise the addendum.

Upon adoption of an addendum implementing adaptive management, states will prepare plans to carry out the addendum and submit them to the Management Board for approval according to the schedule contained in the addendum.

4.4.4 Emergency Procedures

The Tautog Management Board may authorize or require emergency action that is not covered by, or is an exception or change to, any provision in this FMP. These actions are based on unanticipated changes in the ecosystem, tautog stocks, or the tautog fishery, that result in significant risks to public health, tautog conservation, or attainment of tautog fishery management objectives. Procedures for implementation are addressed in the ASMFC Interstate Fisheries Management Program Charter, Section 6(c)(10) (ASMFC 1995).

4.5 HABITAT CONSERVATION AND RESTORATION

Habitat conservation may be defined as protection of resource environmental quality while allowing wise use of the same resource (Edwards et al. 1992). Existing fishery habitat, for all life history stages, should be protected and preserved, rather than relying on habitat restoration programs that can be extremely expensive, difficult to fund, and only partially successful. Little can be done to prevent natural damage to habitats due to storms or other acts of nature. Therefore, the greatest benefits can be achieved through controlling human activities that damage habitat. Because coastal development will continue, however, it must be directed so that marine resources are still protected. Consideration should be given to switching from a single species approach to an ecosystem management approach that allows conservation of specific species and habitat types as well as whole biological communities with all of their biological components and diversity.

Information on biological, economic and social aspects of habitat conservation and restoration are necessary for informed decision making, but are often unavailable. Public outreach and awareness of habitat issues can be increased through readily available information on fishery habitat issues and through proactive educational programs. This outreach should target two general audiences: first, those specifically involved in activities that may lead to habitat degradation, such as marinas, dredgers and other industries; second, the general public for education concerning tautog life history, fisheries, and management. Greater awareness of the importance of habitat to all life history stages of tautog could increase compliance with regulatory requirements designed to conserve and restore habitat. In addition to fishery habitat loss, pollution and environmental degradation can have other indirect effects. Private property values may decline as a result of decreased aesthetic value and decreased recreational opportunities resulting from declines in water quality. Hotels and marinas are impacted by chemical and oil spills through decreased demand for degraded areas. Business losses to recreation-associated industries occur as a result of decreasing demand for boat design and construction, campers, sports equipment and recreational gear.

4.5.1 Preservation of Existing Habitat

Agencies having regulatory or review authority over habitat types identified as critical to tautog should consider protection of such habitats to benefit the management efforts of this Plan. Management of existing habitat on a sustainable basis requires a thorough knowledge of essential habitat types, their distribution, and their use by all life history stages of tautog. Currently, additional research is needed to determine the extent and condition of essential tautog habitats on a coastwide basis. Once the locations and abundance of essential tautog habitats are determined, control of how these habitats are used can begin. Marine refuges and special fishery management zones (SMZ) that limit fishing access and gear types are one potential method of habitat management.

4.5.2 Avoidance of Incompatible Activities

Each state should establish windows of compatibility for activities known, or suspected, to adversely affect tautog habitat and notify appropriate agencies in writing. Projects involving water withdrawal should be evaluated to ensure that impacts will not adversely affect tautog stocks. In addition, industrial facilities should be located such that entrainment of eggs and larvae in cooling water systems and mortality from thermal effects and physical disturbances are minimized. Any activities that physically alter habitat, such as dredging, bulk-heading and channel construction, could reduce tautog production. The impact of such activities on tautog spawning and nursery areas should be considered. As a preventative measure, buffer zones could be established around important nursery areas.

4.5.3 Fisheries Practices

Certain gear types may disrupt tautog habitat, however, insufficient information is available to quantify effects at this time. Any fishing gear having an unacceptable impact on tautog habitat should be prohibited within essential habitats.

4.5.4 Habitat Restoration, Improvement, and Enhancement

Habitat restoration involves restoring the usefulness of habitats adversely impacted by human activity or natural events. Determining the need for restoration of tautog habitat requires definition of critical or essential habitat types for all life history stages and quantification of the amount of habitat required to support the desired tautog abundance. Restoration should be considered where well-known, historically "productive" tautog habitat has been degraded or lost. This degradation or loss can be from gradual encroachment by shoreline and coastal development, waste disposal practices, uncontrolled soil erosion, siltation, or accidental spills of toxic substances.

Restoration could be directed specifically toward tautog habitat or it could occur as a component of other efforts. South of Cape Cod, restoration of lobster habitat should also consider the needs of tautog because habitat usage by the two species overlaps. Response plans for accidental toxic spills in coastal waters should focus on tautog as well as shellfish resources, because tautog are localized and depend on specific habitats and associated food sources that are susceptible to chemical contamination.

Habitat improvement requires making tautog habitat better than it is presently. Tautog habitat could be improved by minimizing sewage discharges and increasing wastewater treatment levels near nursery areas. Existing industrial facilities should be retro-fitted with the best available technology to minimize facility-induced mortality of eggs and larvae. Larval stage assessments should be incorporated into the entrainment studies required of industrial facilities that withdraw coolant water from shallow water marine habitats. Non-point source toxic contamination of groundwater and nearshore coastal habitats can be reduced by redirecting storm water runoff into catch basins.

Habitat enhancement requires the creation or expansion of essential habitat where little or none presently exists. Creation of artificial reef habitats and breakwaters could mitigate habitat losses. Both intentional reef construction and accidental creation through shipwrecks may be expanding tautog habitat in open, sandy coastal areas where tautog would not normally be found.

4.6 MANAGEMENT INSTITUTIONS

4.6.1 Atlantic States Marine Fisheries Commission and ISFMP Policy Board

The Atlantic States Marine Fisheries Commission (ASMFC) and the Interstate Fisheries Management Program (ISFMP) Policy Board (Policy Board) are responsible for the oversight and management of the Commission's fisheries management activities. The Commission must approve all fishery management plans and amendments thereto, including this Plan; and must also make all final determinations concerning state compliance or noncompliance. The Policy Board reviews recommendations of the various Management Boards and, if it concurs, forwards them to the Commission for action.

The Commission's Interstate Fisheries Management Program Charter specifies the membership, function, and operational guidelines of the Management Board, Plan Review Team, and Technical Committee.

4.6.2 Tautog Management Board

The Tautog Management board is established by the Policy Board and is generally responsible for carrying out all activities under this Plan. It establishes and oversees the activities of the Plan Review Team, the Technical Committee, and the Stock Assessment Subcommittee; and requests the establishment of the Commission's Tautog Advisory Panel. Among other things, the Management Board makes changes to the management program under adaptive management and approves state programs and alternative state programs implementing the Plan. The Management Board reviews the status of each state's compliance with the FMP at least annually, and if it determines that a state is out of compliance reports that determination to the Policy Board under the terms of the ISFMP Charter (ASMFC 1995).

4.6.3 Tautog Plan Development/Plan Review Team

The Tautog Plan Development Team (PRT) and the Plan Review Team (PRT) are composed of a small group of staff whose responsibility is to provide the staff support necessary to carry out and document the decisions of the Management Board. Both are chaired by an ASMFC Fishery Management Plan Coordinator. The PDT is responsible for preparing the documentation necessary for development of the Tautog FMP and any future amendments to the FMP. The PRT is directly responsible to the Management Board for providing information and documentation concerning the implementation, review, monitoring, and enforcement of the Tautog FMP.

4.6.4 Technical Committee

The Tautog Technical Committee will consist of one representative from each jurisdiction and federal agency with an interest in the tautog fishery, and any other representatives deemed appropriate, in accordance with the ISFMP Charter (ASMFC 1995). Its role is to act as a liaison to the individual state agencies, provide information crucial to the management process, review management programs, and prepare biologically based recommendations concerning the management program. The Technical Committee will report to the Management Board through either the Chair or the Plan Review Team.

4.6.5 Stock Assessment Subcommittee

The Tautog Stock Assessment Subcommittee will consist of those scientists with expertise in the assessment of tautog populations. It's role is to assess tautog populations and provide scientific advice concerning the implications of proposed or potential management alternatives and to respond to any

other scientific questions of the Management Board. The Stock Assessment Subcommittee will report to the Management Board and the Technical Committee.

4.6.6 Advisory Panel

The Tautog Advisory Panel is established according to the Commission's Advisory Committee Charter (ASMFC 1993). Members of the Advisory Panel are citizens who represent a cross-section of commercial and recreational fishing interests and others who are concerned about tautog conservation and management. The Advisory Panel provides the Management board with advice directly concerning the Commissions tautog management program. Normally, the Advisory Panels meetings will be held at and in conjunction with selected Management Board meetings.

4.6.7 Secretaries of Commerce and the Interior

Under the Atlantic Coastal Fisheries Conservation and Management Act, if the Commission determines that a state is out of compliance with this Plan it reports that finding to the Secretaries of Commerce and Interior. The Secretaries are then required by federal law to impose a moratorium on fishing for tautog in that state's waters until that state comes back into compliance. In addition, the Commission has accorded the NMFS and the USFWS voting status on the Policy Board and the Tautog Management Board; and the federal agencies may participate on the Plan Review Team, the Technical Committee and the Stock Assessment Subcommittee.

5. COMPLIANCE

This section presents a detailed statement of each specific regulatory, monitoring, and research requirement that each state must implement in order to comply with the FMP. The relative burden of the Plan's conservation program and management measures may vary from state to state relative to the importance of the fishery in that state as compared to other states throughout the range. The states of Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina are required to comply with the provisions of this Plan.

5.1 MANDATORY COMPLIANCE ELEMENTS FOR STATES

5.1.1 Mandatory Elements of State Programs

A state will be found out of compliance if:

- it's regulatory and management programs for tautog have not been approved by the Management Board;

- it fails to meet any implementation schedule established for this FMP or any addendum prepared under adaptive management;

- it has failed to implement a change to it's program when determined necessary by the Management Board; or,

- it fails to adequately enforce any aspect of it's regulatory and management programs.

5.1.1.1 *Regulatory Requirements*

All state programs must include a regime of restrictions on recreational and commercial fisheries consistent with the requirements of Section 4.

5.1.1.2 *Monitoring Requirements*

The Plan identifies a number of monitoring options (refer to Section 3.1), but does not contain specific monitoring requirements.

5.1.1.3 *Research Requirements*

This Plan does not identify any mandatory research requirements.

5.1.2 Compliance Reporting Contents and Schedules

Each state must submit an annual report concerning its tautog fisheries and management program on or before May 1 each year, beginning May 1 1996. The report shall cover:

- the previous calendar year's fishery and management program including activity and results of monitoring, regulations that were in effect, and harvest information that is available, including estimates of non-harvest losses; and

- the planned management program for the current calendar year summarizing regulations that will be in effect and monitoring programs that will be performed, highlighting any changes from the previous year.

5.2 PROCEDURES FOR DETERMINING COMPLIANCE

Detailed procedures regarding compliance determinations are contained in the ISFMP Charter, Section 7 (ASMFC 1995).

The Plan Review Team will review implementation and compliance for the Tautog FMP annually. Additional reviews may be conducted at any time at the request of the Management Board, Policy Board, or the ASMFC. The PRT will prepare a written report for the Management Board summarizing the status of the resource and the fishery, and the status of compliance on a state-by-state basis.

The Management Board will review the written report of the PRT within 60 days. If a state's program fails to meet the requirements of the FMP, the Management Board may recommend to the Policy Board that the State be found out of compliance. The rationale for such a recommendation will address the required measures of the Tautog FMP that the State has not implemented or enforced, a statement of how that failure jeopardizes the tautog resource, and the actions a State must take in order to comply with the Tautog FMP.

The Policy Board will review any recommendation of noncompliance within 30 days. If it concurs in the recommendation, it will recommend at that time to the ASMFC that a State be found out of compliance.

The Commission will consider any Tautog FMP noncompliance recommendation from the Policy Board within 30 days. Any State subject to a recommendation of noncompliance will be given an opportunity to present written and/or oral testimony concerning whether it should be found out of compliance. If the Commission agrees with the recommendation to the Policy Board, it may determine that a State is not in compliance with the Tautog FMP and specify the actions the State must take to come into compliance.

Any State that has been determined to be out of compliance may request that the Commission rescind its noncompliance findings, provided the State has revised its tautog conservation measures.

5.3 RECOMMENDED (NON-MANDATORY) MANAGEMENT MEASURES

States with higher minimum size limits and more conservative possession limits than the proposed coastwide minimums should maintain these higher size limits to conserve local stocks. Proper catch and release procedures and closures around artificial reefs should be encouraged by individual states.

5.4 ANALYSIS OF ENFORCEABILITY OF PROPOSED MEASURES

All states are responsible for adequately enforcing the measures contained in this FMP. As many states currently have minimum size limits for tautog, enforcing the coastwide minimum size limit should be feasible. Additionally, the existence of a coastwide minimum size for both commercial and recreational fisheries should aid enforcement efforts. The enforceability of other management measures is dependent upon the particular management program a state adopts. When developing a management strategy, each state should evaluate the enforceability of the various management options that are being considered.

5.5 IMPLEMENTATION SCHEDULE

States must implement this FMP according to the following schedule:

October 1, 1996:	States must submit state programs to implement commercial restrictions to the Technical Committee, which will review the plans and forward a report to the Management Board for consideration and possible approval of each state program. To assure plan compliance, states are also encouraged to submit proposed recreational fishery regulations.
April 1, 1997:	States must implement a 13" minimum size of possession for commercial and recreational fisheries. Commercial and recreational effort controls to reach the interim target F=0.24 are required north of Delaware Bay.
April 1, 1998:	States must implement a 14" minimum size of possession for commercial and recreational fisheries. Commercial and recreational effort controls to reach the interim target F=0.24 are required from Delaware Bay (inclusive) to North Carolina. States north of Delaware Bay are required to maintain effort controls.
April 1, 1999:	Measures to reduce fishing mortality to a level at or below the overfishing definition are required from Massachusetts through North Carolina.

6. MANAGEMENT RESEARCH NEEDS

Additional research, particularly in the southern portion of the species range, is necessary for development of effective long-term management strategies. Requirements may be broadly divided into two categories: biology/community ecology and habitat. Effective stock assessment and population dynamics modeling require more information on the biology/community ecology of tautog than is currently available, in particular to facilitate calculation of F and stock trends. Habitat studies and determination of critical habitat areas are necessary for evaluation of anthropogenic impacts such as coastal development on tautog populations as well as to evaluate the possibility of population enhancement through the creation of artificial habitat.

The greatest data needs are in states in the southern portion of the species range (south of New Jersey), but continuing and long term data collection are necessary for VPA's as well as to evaluate biological reference points and stock abundance. Suggested topics include research to:

1. Establish state-by-state long-term surveys to gather information on tautog abundance and length-frequency. Both fishery-dependent and fishery-independent information is needed.

2. Initiate and continue annual aging studies, by state or region.

3. Collect effort data for determining CPUE.

4. Determine mortality for fish hooked and released.

5. Determine pot and trap escape vent dimensions needed to release tautog over a range of sizes.

6. Define the specific spawning and pre-spawning aggregating areas used by all major local populations and the criteria or times of use. It is critical to protect these sites from degradation and populations in these areas against excessive exploitation during use.

7. Define the specific wintering areas of juveniles and adults for major local populations and criteria or times of use. It is critical to protect these sites from degradation and populations in these areas against excessive exploitation during use.

8. Define the specific migration routes used by tautog to get to and from spawning and wintering areas. It is critical to protect these sites from degradation and populations in these areas against excessive exploitation during use.

9. Define local and regional movement patterns and site fidelity in the southern part of the species range. This information may provide insights into questions of aggregation vs. recruitment to artificial reef locations.

10. Define the source of offshore eggs and larvae (*in situ* or washed out coastal spawning). Unusual weather can be a critical factor in recruitment and varies with source of eggs.

11. Explore possible regional and local genetic differences (stock differentiation) and relate these to recruitment, growth, and exploitation rates. These differences can help support appropriate region-specific management strategies.

12. Confirm that tautog, like cunner, hibernate in the winter, and in what areas, for how long, and are there special habitat requirements during these times. This information will aid in understanding behavior variability and harvest availability.

13. Define the susceptibility of juveniles to coastal/anthropogenic contamination and resulting effects. This information will aid in assessment and management of habitat/population damage.

14. Define the role of prey type and availability in local juvenile/adult population dynamics. This information can explain differences in local abundance, movements, growth, fecundity, etc.

15. Define larval diets and prey availability requirements. This information can be used as determinants of recruitment success.

16. Define the status (condition and extent) of optimum or suitable juvenile habitats and trends in specific areas important to the species. It is critical to protect these habitats or to stimulate restoration or enhancement, if required.

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8. APPENDICES

8.1 CURRENT HARVEST REGULATIONS

Commercial and recreational regulations by state as of January 1996.

1. Commercial Regulations on Tautog Harvest.

State	Size limit	Season	Possession Limit	Gear Restrictions
Maine	None	All Year	None	None
New Hampshire	None	All Year	None	None
Massachusetts	16"	Some area and seasonal closures apply for trawl and gill net fisheries	50	a) Fish Pots-limits relative to scup fishery b) Trawls-cod end minimum mesh
Rhode Island	16"	Seasonal and area closures for trawl and fyke net fisheries	None	a) Fish Pots-limits relative to scup fishery b) Trawls-cod end minimum mesh
Connecticut	12"	All Year	None	Numerous area closures, night
New York	16"	Some trawling season closures, other gears all year	50	Some area closures for trawling
New Jersey	12"	All Year	None	No trawling within 2 miles, fish potting area restrictions
Delaware	12"	Jul 1 - Mar 31	10	None
	15"	Apr, May, Jun	3	
Maryland	None	All Year	None	None
Virginia	None	All Year	None	Limited/delayed entry; no trawling in state waters

2. Recreational Regulations on Tautog Harvest.

State	Size Limit	Season	Catch Limit
Maine	None	All Year	None
New Hampshire	None	All Year	None
Massachusetts	16"	All Year	8
Rhode Island	16"	All Year	8
Connecticut	12"	All Year	None
New York	13"	All Year	10
New Jersey	12"	All Year	None
Delaware	12"	Jul 1 - Mar 31	10
	15"	Apr, May, Jun	3
Maryland	None	All Year	None
Virginia	None	All Year	None

8.2 DEFINITIONS.

Definitions were taken from the ASMFC Interstate Fisheries Management Program Charter (1995) and Wallace et al. (1994).

ADAPTIVE MANAGEMENT - An iterative process which includes evaluation of the response of the managed fishery and stock to specific management measures and adjusting such measures based on that evaluation.

ADVISORY PANEL (AP) - A group of interested and knowledgeable persons convened under the ASMFC's Advisory Committee Charter to assist in development of an FMP or amendment.

BYCATCH - That portion of a catch taken in addition to the targeted species because of non-selectivity of gear to either species or size differences; may include non-directed, threatened, or endangered and protected species.

CATCH CURVE - A breakdown of different age groups of fish, showing the decrease in numbers of fish caught as the fish become older and less numerous or less available. Catch curves are often used to estimate total mortality.

CATCH PER UNIT OF EFFORT (CPUE) - The number of fish caught by an amount of effort. Typically, effort is a combination of gear type, gear size, and length of time gear is used. Catch per unit of effort is often used as a measurement of relative abundance for a particular fish.

COHORT - A group of fish spawned during a given period, usually within a year.

CONSERVATION EQUIVALENCY - Actions taken by a state which differ from the specific requirements of the FMP, but which achieve the same quantified level of conservation for the resource under management. For example, various combinations of size limits, gear restrictions, and season length can be demonstrated to achieve the same targeted level of fishing mortality. Conservation equivalency will be determined by the appropriate Management Board.

EXCLUSIVE ECONOMIC ZONE (EEZ) - All the waters from the seaward boundary of coastal states out to 200 nautical miles. This was formerly called the Fishery Conservation Zone.

FISHING MORTALITY (F) - A measurement of the rate of removal of fish from a population by fishing. Fishing mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year. Instantaneous is that percentage of fish dying at any one time.

GROWTH OVERFISHING - When fishing pressure on small fish is too heavy to allow the fishery to produce its maximum poundage. Growth overfishing, by itself, does not affect the ability of a fish population to replace itself.

MARINE RECREATIONAL FISHERY STATISTICS SURVEY (MRFSS) - An annual survey by the National Marine Fisheries Service (NMFS) to estimate the number, catch, and effort of recreational fishers.

MARK-RECAPTURE - The tagging and releasing of fish to be recaptured later in their life cycles. These studies are used to study fish movement, migration, mortality, and growth, and to estimate population size.

MAXIMUM SUSTAINABLE YIELD (MSY) - The largest average catch that can be taken continuously (sustained) from a stock under average environmental conditions.

NATURAL MORTALITY (M) - A measurement of the rate of removal of fish from a population from natural causes. Natural mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year. Instantaneous is the percentage of fish dying at any one time.

NATIONAL MARINE FISHERIES SERVICE (NMFS) - A federal agency--with scientists, research vessels, and a data collection system--responsible for managing the nation's saltwater fish. It oversees the actions of the Fishery Councils under the Fishery Conservation and Management Act.

RECRUITMENT - A measure of the number of fish that enter a class during some time period, such as the spawning class or fishing-size class.

RECRUITMENT OVERFISHING - When fishing pressure is too heavy to allow a fish population to replace itself.

SPAWNING STOCK BIOMASS (SSB) - The total weight of the fish in a stock that are old enough to spawn.

SPAWNING STOCK BIOMASS PER RECRUIT (SSBR) - The spawning stock biomass divided by the number of recruits to the stock or how much spawning biomass an average recruit would be expected to produce.

TOTAL MORTALITY (Z) - A measurement of the rate of removal of fish from a population by both fishing (F) and natural causes (M). Total mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year. Instantaneous is the percentage of fish dying at any one time.

YIELD PER RECRUIT (YPR) - A model that estimates yield (production from a fishery in terms of numbers or weight), but more often as a percentage of the maximum yield, for various combinations of natural mortality, fishing mortality and time exposed to the fishery.

VIRTUAL POPULATION ANALYSIS (VPA) - A type of analysis that uses the number of fish caught at various ages or lengths and an estimate of natural mortality to estimate fishing mortality in a cohort. It also provides an estimate of the number of fish in a cohort at various ages.