FISHERY MANAGEMENT PLANS
BACKGROUND

Chesapeake Bay Fishery Management Plans (FMPs) are prepared under the directive of the *1987 Chesapeake Bay Agreement* and serve as a framework for conserving and wisely using fishery resources. Bay fisheries are traditionally managed separately by Pennsylvania, Maryland, Virginia, the Potomac River Fisheries Commission, and the District of Columbia. A Chesapeake Bay FMP provides a format for undertaking compatible, coordinated management measures among the jurisdictions. In addition, it creates a forum to specifically address problems that are unique to Chesapeake Bay. This is particularly important concerning habitat issues. The goal of Chesapeake Bay FMPs is to protect the reproductive capability of a resource while allowing optimal harvest. The ecological, economic and sociological factors affecting the resource must be considered in the process. Objectives include: quantifying biologically appropriate levels of harvest; identifying habitat requirements and recommending protection and restoration measures; monitoring the status of the resource, including fishery-dependent and independent surveys; and defining and enforcing management recommendations.

Development of a FMP is a dynamic, ongoing process. It begins with initial input by the FMP Workgroup under the Living Resources Subcommittee (LRSc) of the Chesapeake Bay Program (CBP). The FMP Workgroup consists of resource managers, scientists, stakeholders, and conservationists. They evaluate the biological, economic and social aspects of a particular resource; define problems and/or potential problems; and recommend strategies and actions to address the problems. Throughout development, FMPs undergo scientific and public review. The FMPs are adopted when signed by the Chesapeake Executive Council, the policy-making body of the CBP. Upon adoption, the appropriate management agencies begin implementing the recommended actions. In some cases, regulatory and legislative action must be initiated to fully implement a management action. In other cases, additional funding and staffing may be required. Progress of FMP implementation and status of the stock and fishery are updated annually for each FMP species. As the status of a stock changes and management strategies change accordingly, amendments and revisions may be recommended by the FMP Workgroup.

Many important finfish species found in Chesapeake Bay also migrate along the Atlantic coast. These fish stocks can be subject to fishing pressure by recreational and commercial fishermen from other coastal states. The federal Atlantic Coastal Fisheries Cooperative Management Act of 1993 gave the Atlantic States Marine Fisheries Commission (ASMFC) authority to specify conservation and management actions needed by the States. The ASMFC is concerned with fishery resources within state jurisdictions (0-3 miles offshore). The federal Magnuson Fishery Conservation and Management Act of 1976 provided exclusive management authority over fishery resources (except for tuna) within a fishery conservation zone of 3 to 200 miles offshore (the Exclusive Economic Zone, EEZ). The Mid-Atlantic Fisheries Management Council (MAFMC) is composed of representatives from New York, New Jersey, Pennsylvania, Delaware, Maryland, and Virginia and is responsible for developing management and conservation measures in the EEZ. Both the ASMFC and the MAFMC prepare and adopt FMPs that specify compliance requirements by the states, but include a range of management options to meet the requirements. The states have the primary role in determining what options are best for their region and how the options will be implemented. The Chesapeake Bay FMPs for coastal migratory species follow the guidelines established by the ASMFC and the MAFMC and outline how the Bay jurisdictions will comply with coastal management recommendations.

1998
CHESAPEAKE BAY AND ATLANTIC COAST
TAUTOG
FISHERY MANAGEMENT PLAN

Prepared by the
Fishery Management Plan Workgroup
Living Resources Subcommittee
Chesapeake Bay Program

December 1998

Printed by the U. S. Environmental Protection Agency
for the Chesapeake Bay Program

CHESAPEAKE EXECUTIVE COUNCIL

Chesapeake Bay Program

ADOPTION STATEMENT
TAUTOG FISHERY MANAGEMENT PLAN

We, the undersigned, adopt the *1998 Chesapeake Bay and Atlantic Coast Tautog Management Plan.* We agree to accept the Plan as a guide to conserving and protecting the tautog resource for long-term ecological, economic and social benefits. We further agree to work together to implement, by the dates set forth in the Plan, the management actions recommended to address the potential for overfishing, stock assessment and research needs, and habitat degradation.

We recognize the need to commit long-term, stable, financial support and human resources to the task of managing the tautog stock and addressing important research needs. In addition, we direct the Living Resources Subcommittee to periodically review and update the plan and report on progress made towards achieving the plan's management recommendations.

Date December 8, 1998

CHESAPEAKE EXECUTIVE COUNCIL

FOR THE STATE OF MARYLAND

FOR COMMONWEALTH OF PENNSYLVANIA

FOR THE COMMONWEALTH OF VIRGINIA

FOR THE DISTRICT OF COLUMBIA

FOR THE CHESAPEAKE BAY COMMISSION

FOR THE UNITED STATES OF AMERICA

FISHERY MANAGEMENT PLAN GUIDELINES

The ultimate, long-term goal of the Chesapeake Bay Program is the protection, restoration and maintenance of the health of the living resources of the Bay. Many commercially valuable aquatic species once inhabited the Bay in great numbers and, although it may not be practical in all cases to reach these historic levels of abundance, the success of the program must ultimately be measured by the health and abundance of the Bay's living resources.

The reasons for the decline of the Bay's living resources are complex, involving many interrelated factors. Degraded water quality, species overharvest, lost habitat, disease and competition from non-native species have all played a significant role in the decline. It therefore follows that the Bay program, to be successful in restoring the Bay's living resources, must assume a bold leadership role in reversing all of the causes of decline.

The program has made progress in reducing nutrient and toxic pollution and addressing habitat restoration and the first time introduction of non-indigenous aquatic species. The Bay Program has developed a number of species specific fisheries management plans over the past 10 years. The Chesapeake Bay Program has adopted the following statement of philosophy and set of over-arching principles to assure a leadership role in ending species overharvest and protecting essential habitat, both in the Bay proper and in the Atlantic Ocean, where many of the Bay species spend at least a portion of their life cycle.

It is the policy of the Chesapeake Bay Program to advocate the elimination of overharvest of all finfish and shellfish which spend any or all of their life cycle in the Bay in order to assure the long-term sustainability of both the commercial and recreational fisheries for future generations. In order to achieve this objective, the Chesapeake Bay Program adopts the following set of guidelines for developing and revising Chesapeake Bay fishery management plans.

Chesapeake Bay Program FMP's should:

1. Be risk averse (i.e., preventative of a crisis instead of reactive to one).
2. Utilize the best scientific information.
3. Establish sustainable targets for a species and:
    a. define and adopt a level of harvest that will quickly attain the established target and maintain that target.
    b. define, protect and restore the habitat needed to support that target.
4. Assure renewability of the stock (i.e., long term health and maintaining spawning stock biomass).
5. Identify, protect and restore critical fish and shellfish habitat for all life stages of the species and individual stocks of the species.
6. Identify, coordinate and advocate necessary management actions needed between the jurisdictions, including regulations and legislative actions.
7. Strive to manage a fishery and/or species by maintaining essential food web relationships, through multispecies management.
8. Consider the long term socio-economic health of a fishery.
9. Take a more conservative approach than Atlantic States Marine Fisheries Commission (ASMFC) and Mid-Atlantic Fishery Management Council (MAFMC) when all signatories of the Chesapeake Bay Program agree such action is necessary.
10. Minimize 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).
11. Provide the background and justification for joint positions of Chesapeake Bay Program partners on Chesapeake Bay issues under consideration by the ASMFC and MAFMC.

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EXECUTIVE SUMMARY

The goal of the Chesapeake Bay and Atlantic Coast Tautog Fishery Management plan (FMP) is to "enhance and perpetuate tautog stocks and their habitat in the Chesapeake Bay and its tributaries, and throughout its Atlantic coast range, so as to maintain the ecological role of the stock while generating optimum long-term social and economic benefits from their recreational and commercial harvest and utilization over time."

The tautog stock supports an important recreational fishery along the Atlantic coast. The tautog resource is especially important within the lower portion of the Chesapeake Bay, as it allows anglers access to the species year-round when other species may not be present. Recreational tautog landings comprise approximately 85-90% of the total landings, as the species preference for structural habitat makes commercial utilization difficult. While an active fishery exists in the federal Exclusive Economic Zone (EEZ, 3-200 miles offshore), the Chesapeake Bay serves as an important nursery and feeding ground for young tautog.

Concerns of localized overfishing and a shift toward increasing commercial fishing pressure since the early 1990s, have led to the development of a federal fishery management plan for the species (ASMFC 1996). The plan defines overfishing as a rate of fishing that exceeds the natural mortality rate (M=0.15). Due to the slow growth and long lifespan of tautog, as well as the lack of data on the stock structure and spawning biomass, this conservative reference point is warranted. A recent coastwide average fishing mortality of F=0.58 (u=41%; ASMFC 1996) identifies the tautog resource as overexploited, chiefly in the region from Massachusetts to New York. The Virginia tautog fishing mortality has been estimated at F=0.36 (u=28%; White pers. comm. 1998), while Maryland is estimated at F=0.38 (u=29%; ASMFC Tautog Management Board 1998).

To begin immediate reduction in exploitation levels, to rebuild the spawning stock and to promote uniform management between federal and state agencies, the Bay jurisdictions will promulgate several fishery management measures for the species. The Bay jurisdictions will reduce exploitation and improve protection of the spawning stock in the Chesapeake Bay and Atlantic *by complying with ASMFC recommendations*;

1) implement a minimum size limit of 14"

2) require all tautog pots to have escape vents as well as biodegradable hinges and fasteners.

3) reduce F to target levels through a combination of seasons, possession, and/or gear restrictions.

The Chesapeake Bay Program will continue its commitments to restore water quality and living resources in the Chesapeake Bay. Special emphasis will be placed on the following specific habitat needs of tautog: the restoration of submerged aquatic vegetation (SAV), oyster reefs, and wetlands.

GOALS AND OBJECTIVES

The goal of the *Chesapeake Bay and Atlantic Coast Tautog Fishery Management Plan* (FMP) is to:

> *"Enhance and perpetuate tautog stocks and their habitat in the Chesapeake Bay and its tributaries, and throughout its Atlantic coast range, so as to maintain the ecological role of the stock while generating optimum long-term social and economic benefits from their recreational and commercial harvest and utilization over time."*

In order to achieve this goal, the following objectives must be met:

1) Follow the guidelines established by the Atlantic States Marine Fisheries Commission (ASMFC 1996) for coastwide management of the Atlantic tautog stocks and make Bay management actions compatible where possible.

2) Promote conservation of the resource and an equitable distribution of the responsibility of resource conservation

3) Promote protection of the resource by maintaining a clear distinction between conservation goals and allocation issues.

4) Maintain yield-per-recruit in the fishery to optimize benefits, both biologically and economically.

5) Maintain the size composition of the tautog stock to promote a healthy fishery and the Bay's reputation as one of the prime tautog fishing locations on the east coast.

6) Coordinate the cooperative interstate collection of economic, social, and biological data required to effectively monitor and assess management efforts relative to the overall goal.

7) Improve collection of standardized catch and effort statistics in the tautog fisheries.

8) Promote fair allocation of allowable harvest among various components of the fishery.

9) Continue to provide guidance for the development of water quality goals and habitat protection necessary to protect the tautog population within the Bay and state coastal waters.

SECTION 1. BACKGROUND

Introduction

The tautog, *Tautoga onitis*, is one of about 500 species comprising the wrasse or Labrid family. In the northeastern United States, it is often known by the common name "blackfish." Most labrids are inhabitants of tropical waters, making the tautog an exception to the rule, since it ranges from Nova Scotia to South Carolina (Bigelow and Schroeder 1953, Bearden 1961). Tautog are most abundant between Cape Cod and the Delaware Capes.

The tautog shares this preference for temperate waters with one other labrid, the cunner, *Tautogolabrus adspersus*, whose range extends even further north to Labrador. The tautog can be distinguished from the cunner in that the former is stouter, has a higher head profile, and lacks scales on its gill covers (Migdlaski and Fichter 1976). Tautog also grow to a much larger size than the cunner, with tautog growing to over 20 pounds with cunner reaching a maximum reported size of around two pounds (Bigelow and Schroeder 1953).

Distribution and Migration

Tautog have been caught in Chesapeake Bay waters as far inland as the Maryland Chesapeake Bay bridge (Jesien pers. comm.), but are normally a coastal species associated with the predominately saline waters of bays and estuaries (Cooper 1967). They are typically associated with the inner shelf waters in the southern part of their range. Cooper (1966) found that tautog rarely occurred in water more than four miles offshore or greater than 60 feet deep when north of Cape Cod. South of the Cape, they could be found as deep as 80 feet and 10 to 12 miles offshore. In Virginia, they are commonly encountered 40 miles offshore and in 120 feet of water (VSWFT 1976-1998; Musick et al. 1979).

A portion of the adult population (>25 cm) migrates inshore and offshore according to water temperature, preferring temperatures between 50-76°F (10-24.40°C; Cooper 1967, Briggs 1977, Olla and Samet 1977), but found in waters up to 82°F (26°C; USFWS 1978). During most years this population spends the cooler spring and fall months inshore, moving offshore again in the summer and the coldest winter months. Another segment of the adult population remains offshore year-round. Juveniles remain on inshore structure year-round, moving seasonally to nearby reefs as temporary homes and feeding locations, and aggregating at perennial locations to overwinter in areas with deep crevices. The fall migration of tautog appears to be triggered by either photoperiod or temperature. Tautog from New York and Rhode Island reefs begin their migration offshore by mid to late October and large tautog disappear from inshore reefs in both locales by early November (Cooper 1966, Briggs 1969). Olla et al. (1974) found all sizes of fish present on October 12 when water temperature was 63°F (17°C) off Long Island, New York, but no large tautog were present on November 1 when water temperature had dropped to 50°F (10°C). Since temperatures were not given at the other test sites, it is difficult to determine the decisive factors influencing the time of departure. Olla et al. (1974) also noted that large and small tautog were on site and active on May 10, the following spring, when water temperature was 50°F (10°C).

Water temperature may not allow adult tautog in some parts of their range to remain active throughout the year. There is research, however, that indicate 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). Cooper (1966) found adult tautog in a state of dormancy two miles offshore in 80-90 feet of water. Most of these adult fish had no food in their digestive tracts, illustrating their lethargic lifestyle in frigid water.

Habitat Preferences

Tautog are a demersal species inhabiting areas which provide them with cover. Preferred habitats include wrecks, jetties, pilings and naturally rough topography. They exhibit a diurnal pattern of activity with normal feeding and movement limited to the daylight hours and a quiescent nocturnal behavior. Tautog usually initiate roaming and feeding soon after daylight and return to their home environment before dark (Briggs 1969). There is some variation between the movements of large mature fish and small fish (Briggs 1977). Larger fish were found to leave the home area and travel a greater distance to favored feeding grounds, while the small fish exhibited a distinct territorial behavior.

Sogard et al. (1992) found that sea lettuce (*Ulva lactuca*) in shallow water (<one meter depth) is the preferred habitat for young-of-the-year (YOY) tautog, as it usually coincides with a greater abundance of important prey species and related hard substrate than other habitats. It was also noted these young tautog appear green, similar to the surrounding sea lettuce habitat. Sogard et al. (1992) also suggest that larger YOY and age 1 juveniles may leave the sea lettuce nursery habitat and move to deeper waters. Submerged aquatic vegetation (SAV) such as eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*) has also been noted as essential habitat for newly recruited juveniles and young fish to about 3.94 inches (100mm; Briggs and O'Conner 1971).

Young tautog are particularly dependent on structure and stay near their home base during all activity. Olla et al. (1974), made underwater observations on a tautog population occupying a reef at Fire Island, New York. They found that tautog of all sizes began feeding one half hour after sunrise and ceased feeding about one hour and 15 minutes before sunset. Large fish were observed leaving the reef area and roaming actively in pursuit of food, while fish less than 10 inches (254 mm) in length did not move more than 7 feet (two meters) from their home territory. This pattern of behavior was observed with scuba equipment and ultrasonic tracking devices.

Dependence upon a single shelter area for young fish extends throughout the year, as well as on a daily basis. During November and December, when water temperatures were 35-41°F (2-4.80°C), Olla et al. (1974) observed tautog less than 10 inches (254 mm) long lying in a torpid state in crevices and on the bottom. It was apparent that the fish had been lethargic for an extended period of time, since several individuals were covered with silt.

It has been suggested that the movement of tautog away from the home area on a daily and seasonal basis is a mechanism to increase food supply and available shelter for younger fish (Olla et al. 1974, 1978). Under conditions of limited space, a hierarchy of dominance was established according to fish size. Large tautog kept in tanks displayed aggressive behavior by chasing smaller fish from preferred feeding locations. Dominant fish would frequently linger in the feeding area and chase off subordinate fish when they approached (Olla et al. 1978).

Dominance of larger fish included choice of shelter locations, as well as preferred feeding sites. When tautog of various sizes were introduced into a tank with a limited number of shelters, the larger fish would quickly move to the shelters and exclude the smaller ones from that area. If smaller fish were released into the tank first, they would establish themselves in the shelter. Upon the introduction of the larger fish, the smaller ones would initially retain their position, but eventually the larger fish would assert their dominance and displace the others from the shelter (Olla et al. 1978).

Spawning

Tautog spawn in spring or early summer, depending on latitude at which they are found. White (1996) determined from gonadosomatic indices (the ratio of gonad weight to body weight) and histological examination of ovarian tissue, that tautog in the lower Chesapeake Bay and coastal Virginia waters spawn from April to June, with peak spawning in April during the 1995 spawning season. Increasing water temperature during springtime is a major cue to initiate spawning, but termination of spawning activity has not been related to environmental cues (White 1996). Potential annual fecundity ranges from 167,970 eggs (259 mm; 10.20 inches, age 3 fish), to 11,052,606 eggs (511 mm; 20.12 inches, age 9 fish), with fecundity more closely related to total length and total weight, than to age (White 1996). Tautog eggs are buoyant, about one mm in diameter, and hatch in 42-45 hours at 68-70°F (20-21°C) (Hildebrand and Schroeder 1927). The larvae hatch at 0.09 inches (2.20 mm) in length and first resemble the adult fish when 0.40 inches (10 mm) long. Later, juveniles (>40mm; >1.57 inches) move into stands of eelgrass prior to becoming associated with the harder bottom substrates typical of the adult fish.

Tautog normally reach sexual maturity at age 3 and age 4 . Briggs (1977) found that in New York waters the first influx of mature fish occurred at 8.50-9.50 inches (215-240 mm) and age 3-4 for males and 9.10 inches (230 mm) and age 4 for females. Rhode Island fish of both sexes matured at age 3 and an average length of 7.90 inches (200 mm) for males and 7.50 inches (190 mm) for females (Cooper 1966). Growth in the warmer waters of Virginia is accelerated. Age 3 fish from the southern Chesapeake Bay measure 11.40 inches (289 mm; Hostetter and Munroe 1993) and have spawned at least once. Some fish may even be mature by age 2, but these fish are just reaching 10.70 inches (272 mm) and probably do not make a significant contribution to spawning. Based on trawl survey data from Rhode Island, egg production per unit ovary weight was at a maximum in age 7 to age 9 fish (16"-19") and declined in fish age 16 (20") and over (Chenowith 1963).

Large mature tautog are sexually dimorphic. Male tautog are distinguished from females by a more pronounced mandibular structure (Cooper 1967). Dominant males have a white coloration on the chin and lips which is lacking on females. Females develop external changes in coloration immediately prior to and during the spawning act. A mottled white vertical bar, termed a "saddle," develops down the mid-flank on each side of the body (Olla and Samet 1977). A smaller grayish-white patch resembling eyebrows develops in the supraorbital area, though this is less noticeable. Changes in aggression are also apparent. The largest males initially demonstrate aggression towards both the female and the smaller males by driving them from shelter and feeding areas. As the spawning exhibition develops, the dominant males display increased aggression towards the subordinate males, while mitigating this behavior in respect to the females.

The spawning process was described under laboratory conditions in an experiment conducted by Olla et al. (1978). Replicate trials were performed and a large number of spawns observed. The male rushes towards the female aggressively, but the female remains in position instead of fleeing. The male breaks off pursuit before encountering the female. After several passes, the female follows the male for a short distance. At the time of actual spawning, the male rushes the female, she leaves her resting place and swims parallel to and slightly ahead of the male. The pair then accelerates toward the surface, turn so their ventral sides are facing each other, and release their gametes as they arch their bodies simultaneously at the surface (Olla and Samet 1977). The fish often broke the water's surface resulting in turbulence that aided mixing of reproduction products. The spawning process has yet to be observed in a natural setting due to typically turbid waters and the tendency of fish to retreat from intruding divers.

The process of pair formation and spawning lasts up to 57 days of successive spawning under laboratory conditions (Olla et al. 1979). A study by White (1996) indicated spawning frequency every 1.14 days during the 70 day spawning period of 1995, yielding 61 spawns per season per female. Olla and Samet (1977) concluded that pair formation was the principal mode of spawning, but noted subordinate males sometimes join the pair at the surface and simultaneously release their gametes in a form of "accessory" spawning.

Feeding

Studies of feeding behavior and analysis of gut contents show tautog feed mainly on blue mussel, *Mytilus edulis*, with a lesser portion of the diet composed of other decapod and cirriped (barnacles) crustaceans and invertebrates (Olla et al. 1974). Feeding behavior of all size tautog was similar, with the exception that large fish roamed freely while smaller ones remained close to their home territory. Mussels made up 78% of analyzed gut contents, followed by decapod and other cirriped crustaceans (15%) and other invertebrates (5%; Olla et al. 1974). Tautog would move up to a clump of mussels, grasp them with their canine teeth and tear off a portion with a shaking movement of the head. Shell crushing was done solely with the pharyngeal teeth and no prior crushing with the canines was observed. A result of this feeding method is that tautog of all sizes are limited to eating small mussels, average size 0.50 inches (11.90 mm), and one to two years old. Larger mussels can not be ingested because the pharyngeal apparatus is only 0.47 times the size of the mouth (Olla et al. 1974). Food contents were found to pass through the digestive system in less than 8 hours based on the tautog's diurnal feeding regimen and the fact that fish sampled from 0400-0500 had empty guts. Chee (1977) has described a pattern of seasonal depletion in the mussel population at the Chesapeake Light Tower, offshore of the Chesapeake Bay entrance, presumably due to predation by resident fishes such as tautog.

Feigenbaum et al. (1985) analyzed digestive tracts of tautog taken during a study on artificial reefs. Tautog taken over artificial reefs at Cape Charles and Gwynn Island, Virginia in 1984 had been feeding on a variety of shellfish and invertebrates. The two Cape Charles samplings saw large quantities of Xanthid and miscellaneous crabs, while Gwynn Island tautog fed largely on barnacles and hard clams. Other prey from both sites include razor clams, mussels, oyster, bryozoans and hydroids (Feigenbaum et al. 1985).

Adult tautog begin their daily activity shortly after sunrise when they leave shelter and begin an active search for food. Individual fish have been observed to move as far as 3.80 miles (6.20 km) from their home base, although the majority stayed within 0.33 miles (0.50 km; Olla et al. 1974). Most fish moved to areas with large concentrations of mussels and remained in that area throughout the day. Laboratory observations indicate peaks of activity in early morning and early afternoon with lower levels around mid-day (Olla et al. 1978). Return to the home reef occurred one half hour to two hours preceding sunset.

Age and Growth

Studies on age and growth of tautog indicate a relatively slow-growing, long-lived fish. Comparison of growth from various locations is difficult, because uniform methods of measurement have not been employed. Cooper (1966) evaluated the Rhode Island tautog population using opercular (cheek) bones to age fish. He found male tautog grew faster in length than females, but slower in weight. Virginia fish demonstrate similar variation in length-weight ratios by sex (Hostetter and Munroe 1993). In Virginia waters, growth may be accelerated due to warmer temperatures. Hostetter and Munroe (1993) found that age 2 fish were 10.70 inches (272 mm) in total length and 1.03 pounds (468 g; both sexes combined), age 3 fish were 11.38 inches (289 mm) and 1.18 pounds (534 g), and age 5 fish were 13.90 inches (353 mm) and 2.08 pounds (946 g). Feigenbaum (1986) estimated that a 9 pound (4,086 g) fish was age 15, a 15 pound (6,810 g) fish was age 20, and a former world record fish from Virginia waters, a 21.50 pound (9,761 g) specimen was approximately age 35. Opercular bones were taken from several tautog weighing between 14 and 21.38 pounds caught off Virginia in 1993. Munroe (pers. comm.) aged these fish and determined that none exceeded age 25. Fish over age 10 showed substantial variation in length and weight at a given age, making age determination by fish size alone very difficult for larger specimens (Hostetter and Munroe 1993).

Biological Profile

Total mortality rate:	Total mortality in Virginia waters is currently estimated at Z=0.51 (42%) based on catch curve analysis and MRFSS data from 1994-1996 (White pers. comm. 1998). Total mortality in Maryland waters is estimated at Z=0.53 (43%; ASMFC Tautog Management Board 1998).
Natural mortality rate:	M=0.15 (14%) for males and 0.20 (18%) for females, coastwide.
Fecundity:	Potential annual fecundity per female ranges from 167,970 eggs (259 mm, age 3 fish), to 11,052,606 eggs (511 mm, age 9 fish; White 1996).
Age/Size at maturity:	100% maturity in Virginia waters occurs at age 4 (~ 13.50 inches) in females and age 3 (11.40 inches) for males in Virginia waters (Hostetter and Munroe 1993).
Longevity:	Tautog are long lived fish with males living longer than 30 years and females around 25 years (Hostetter and Munroe 1993).

<u>Spawning and Larval Development</u>

Spawning season:	Spawning off the Virginia coast is protracted, with fish in spawning condition observed from early April to mid June (White 1996). Larval sampling indicate peak abundance in May

and June off southern Virginia and in June off the Delmarva Peninsula (Sogard et al. 1992). Spawning frequency was determined to be every 1.14 days during the spawning season (White 1996).

Spawning area: Off Virginia, larval surveys showed greatest abundance from 10-45 nautical miles (18-83 km) offshore (Sogard et al. 1992). Tautog were collected in spawning condition within the Chesapeake Bay and out to 30 nautical miles (56 km) off the Virginia coast by Hostetter and Munroe (1993) and White (1996).

Location: Spawning occurs at depths of 8-30 feet in coastal waters to 140 feet deep off Virginia's continental shelf (Sogard et al. 1992).

Salinity: 26 to 29 ppt. in Long Island Sound (USFWS 1978).

Temperature: Adults inhabit water ranging from 50-82°F (10-26°C) and spawning has been observed throughout this temperature range (USFWS 1978).

Young-of-Year

Location: Juveniles initially assume demersal life in coves and channels of coastal areas and associate with algae or eelgrass (USFWS 1978, Hostetter and Munroe 1993). Early juveniles were found to be much more abundant in sea lettuce than in eelgrass (Sogard et al. 1992). Later juveniles (>40mm) occupy eelgrass beds before assuming the structure oriented lifestyle typical of sub adults and adults.

Salinity: No data.

Temperature: No data.

Subadults and Adults

Location: A portion of the adult population (>25 cm) migrates inshore and offshore according to water temperature, preferring temperatures between 76-50°F (24.40-10°C). During most years this population spends the cooler spring and fall months inshore, moving offshore again in the summer and the coldest winter months. Another segment of the adult population remains offshore year-round. Juveniles remain on inshore structure year-round, moving seasonally to nearby reefs as temporary homes and feeding locations and aggregating at perennial locations to overwinter in areas with deep crevices. Juveniles become torpid at very cold temperatures 35-41°F (2-4.80°C; Olla et al. 1974) and less active at high temperatures (28.70°C; Olla et al. 1978).

Salinity: Predominately saline waters, but no data available on lower salinity limits.

Temperature: 35 to 83.70°F (2-28.70°C; Olla et al 1980).

Fisheries

Coastwide, the recreational fishery has landed an average of 9 times as many fish as the commercial fishery (6.4 million pounds vs. 700,00 lbs.) between 1981 and 1997 (NMFS fishery statistics). The percentage of fish taken by the commercial fishery has fluctuated between 4.8% (1982) and 14.5% (1990) of the total catch. Most recently (1994-1997), the commercial fishery has caught between 7.5% (1995) and 12.4% (1997) of the total catch.

Recreational Fisheries

Recreational catch data for the Chesapeake Bay region is limited and fluctuations in the reported number of fish caught are large. According to the National Marine Fisheries Service (NMFS) Marine Recreational Fisheries Statistics Survey (MRFSS 1979-1998), the estimated number (excludes fish that are caught and released) of tautog caught in Virginia waters between 1981-1997 (Figure 1) varied between 71,599 (1982) and 579,795 fish (1983). The average annual catch from Virginia waters during that period was 220,319 fish. This estimate of the annual catch is undoubtedly low, because MRFSS does not collect Virginia data during January and February, when tautog are one of the few species available to the recreational fisherman. MRFSS estimates of the Maryland recreational fishery averaged 50,326 fish from 1981-1997 (Figure 2), with a range of 486 (1985) to 157,260 fish (1994; MRFSS 1979-1998).

Estimates of the number of recreational anglers participating in the tautog fishery are probably under-reported due to the lack of sampling in January-February (wave one) of the MRFSS survey. Anecdotal evidence (Bain pers. comm.) suggests increased numbers of participants in the fishery, especially those fishing offshore wrecks. There has also been a significant decline in the number of citation tautog taken from the Chesapeake Bay Bridge Tunnel complex, where fishing pressure has likely remained more consistent.

The only other Virginia recreational catch data comes from records of the Virginia Saltwater Fishing Tournament (VSWFT 1975-1998). The minimum citation weight was increased to 9 pounds in 1975, so data prior to that time is not comparable to current figures. From 1975 to 1996, an average of 170 citations (fish > 9 pounds) have been awarded each year. During 1975-1979, 147 citations per year were issued (Figure 3). Following a fairly dramatic one year drop in 1980, citation numbers increased steadily to 390 in 1986. In 1987, the number of citations dropped to 130 and has remained at a low level since that time. A developing tautog fishery off Virginia's eastern shore was largely responsible for the surge in citation numbers from 1980-1986 (Bain pers. comm.; Reiger 1985). These data represent only fish over 9 pounds and so may not be representative of the total number of fish caught. The increased number of citations caught from Virginia waters during the development of the eastern shore fishery and subsequent decline may well represent the initial exploitation of a "virgin" fishery and a return to status quo (Reiger 1985). Two past world record tautog were caught in this area between 1980 and 1986. However, the lower number of citation fish registered in the late 1980s and early 1990s may represent an early warning of a decline in this fishery, particularly when the advance in technology for locating offshore wrecks is considered.

Maryland's citation data (fish > 8 pounds) indicates the number of citations awarded has increased from 6 in 1990 to 45 in 1993. The number of participants has varied over the years, so effort is not comparable from year to year.

Commercial Fisheries

Tautog are most frequently caught by handlines, fish traps, and rod and reel. Trawls are capable of catching large numbers of tautog when the fish are migrating over open bottom, but gear modifications are necessary to operate around structures and rough bottom where tautog aggregate. Commercial fishermen in the Mid-Atlantic and New England States use gill nets, otter trawls, fish pots and rod and reel to take tautog (Lynch 1990, 1991, 1992). During 1982-1991, gill nets dominated commercial landings in Maine and New Hampshire, otter trawls in Rhode Island through New York and hand lines (including rod and reel) in Delaware, Virginia and Massachusetts. Fish pots caught the bulk of Maryland and New Jersey's commercial landings (MAFMC 1993).

Cooper (1966) cited the annual Rhode Island commercial catch at about 4,000 fish and noted that the species' preference for rugged topography made trawling an inefficient fishing method. Musick et al. (1979) sampled the continental shelf area of the Chesapeake Bight in the spring and fall from 1967 to 1975. Despite their stations coinciding with areas tautog are known to frequent (VSWFT 1975-1998), only a single tautog was caught by trawling during that time period. Recently, however, the Mid-Atlantic Fishery Management Council (MAFMC) has become concerned about the impact on tautog and Northern Star coral populations from modifications in trawl gear (rockhopper or roller gear) which enables fishing over naturally rough bottom (MAFMC 1993).

Weekly samples of pound net catches off Lynnhaven Inlet, Virginia, in 1982-1983 from March through December contained 100 species of fish. Tautog were taken sporadically and only during the months of March-May. They were sometimes common in weekly samples, but never listed as abundant (Birdsong et al. in Feigenbaum and Blair 1986). Virginia Saltwater Fishing Tournament citation records (1975-1993) show consistently large numbers of tautog taken in this area (Chesapeake Bay mouth) from May 1-November 31 (entire listing period). Hence, the low incidence of pound net catches in this same area is considered an indicator of the ineffectiveness of this gear for tautog.

Total commercial landings of tautog in Virginia waters from 1966-1997 ranged from 50 to 30,000 pounds (NMFS 1966-1997) and fluctuated in an unpredictable fashion. There has been a recent increase in landings, however, which may largely be due to the implementation of mandatory reporting in 1993 (Figure 4). Commercial landings from Maryland averaged 3,000 pounds annually from 1981-1997, with a range of 140 to 7,700 pounds (Figure 5). Virginia and Maryland's commercial landings for 1997 represent 8.3% (25,000 lbs) and 2.5% (7,700), respectively, of the total commercial harvest. Hildebrand and Schroeder (1927) indicated that in 1921-1922 retail values averaged 0.10-0.15 cents per pound. The current economic value of tautog in Virginia is $1.09 per pound (VMRC 1966-1997; Figure 6) and $1.06 per pound in Maryland (NMFS 1997 statistics).

Fishery Parameters

Status of exploitation: No official estimates for Delaware to Virginia populations, though there is a small directed commercial fishery consisting of hook and line and fish potting in both Maryland and Virginia. Tautog populations from Massachusetts to New York are overexploited (ASMFC 1996).

Long-term potential catch: Total coastwide, historical catches have been as high as 17.84 million pounds (1986) (NMFS data). Average landings from 1990-1997 were 5.60 million pounds. The 1997 landings were 2.44 million pounds. No estimate of long term potential catch or MSY has been established.

Importance of recreational fishery: Significant in certain areas and seasons such as the winter fishery in the Chesapeake Bay and the recreational headboat fishery out of Ocean City, Maryland. The recreational catch of tautog has comprised between 85% and 92% of the total Atlantic coast landings since 1990. Tautog are an important catch as they can be active year-round, making them available to fishermen year-round.

Importance of commercial fishery: The commercial catch in Virginia is primarily by rod and reel and fish potting. The Virginia catch averaged 3,448 pounds from 1983-1992. Since the implementation of mandatory reporting in Virginia in 1993, tautog landings (reported) have increased significantly; 11,441 pounds in 1994; 30,000 pounds in 1995; 26,137 pounds in 1996; and 25,000 pounds in 1997 (NMFS data). Maryland commercial landings ranged from 140 pounds to 7,700 pounds between 1980-1997, averaging 3,000 pounds (NMFS data). The local Bay market is poorly developed and the tautog's structure-oriented lifestyle makes them unavailable to most gear types on a regular basis. The Atlantic coast commercial fishery averaged 766,000 pounds with a peak in 1987 of 1.16 million pounds (1984-1997, NMFS data). The majority of commercial landings come from New Jersey-Massachusetts.

Fishing mortality rates: The fishing mortality rate for Virginia is F=0.36 (u=28%) based on catch curve analysis and MRFSS data from 1994-1996 (White pers. comm. 1998). Maryland tautog is estimated to have a fishing mortality rate of F=0.38 (u=29%;ASMFC Tautog Management

Board 1998). Estimates for F from other areas of the Atlantic coast range from 0.15 (u=13%; Connecticut) to 1.0 (u=59%; Rhode Island). Fishing mortality estimates from catch curve analysis from Massachusetts to New York averaged 0.58 (u=41%,1988-1992). An estimate from a New Jersey trawl survey indicated a F=0.79 (u=51%) from 1988-1991, and F=0.77 (u=50%) from 1991-1994 (ASMFC 1996).

Problems and Concerns

Fisheries Data Needs

Poor quality data on recreational and commercial landings, lack of tagging studies and catch-per-unit-effort data makes estimates of population size or exchange impossible. Potential causes of population variance include a lack of suitable habitat, habitat destruction or creation, population migration, variance in water temperature, and relative abundance of prime food supplies, such as mussels.

Currently, research at the Virginia Institute of Marine Science (VIMS) is working towards improving data on Virginia tautog populations. Age analysis, as well as exploitation rates, are being estimated from extensive sampling of tautog in the Chesapeake Bay and the offshore waters of Virginia. Additionally, the Virginia Saltwater Fishing Tournament has been tagging tautog since 1995. Results from this continuing survey help to provide data on migration and exploitation of the species.

The Maryland Department of Natural Resources is conducting a headboat creel survey from Ocean City, Maryland. The recreational survey will be conducted twice a week from April through November during 1998 and 1999. Fishing effort and biological data on a number of species will be collected. Results of this survey should provide some valuable data on tautog caught off Maryland's coast.

Habitat Issues

Coastal and estuarine areas are extremely important as feeding, spawning, and nursery areas for tautog. Consequently, habitat modifications such as dredging, filling, coastal construction, energy development, sewage effluent and ocean dumping pose serious threats to the tautog resource. Tautog are particularly susceptible to inshore and nearshore disturbances since they are one of the few species that live in the lower Chesapeake Bay and nearby coastal waters year-round.

Aquatic Reefs

Juvenile tautog have been observed in association with oyster bars in the Piankatank River (Harding and Mann, In review) The decline of the Chesapeake Bay oyster may have had a detrimental effect on the tautog resource. Historically, oyster reefs were the predominant natural habitat available in the Bay and probably supported tautog populations, especially providing habitat for young-of-the-year and age 1 fish. Oyster reefs are created by the vertical and horizontal colonization of oysters, which use one another as a place for attachment. The 3-dimensional nature of this community provides increased surface area and allows for greater biotic diversity.

Overharvesting, degraded water quality from pollution, and the emergence of the oyster diseases *Haplosporidium nelsoni* (MSX) and *Perkinsus marinus* (Dermo), have extensively impacted oyster populations. Of the historic 243,000 acres of public oyster reefs (Baylor Grounds) in Virginia waters of the Chesapeake Bay, only about 5% of these reefs are still growing and producing healthy oysters (Chesapeake Bay Program 1996a). Since the decline in oyster reefs, young tautog have relied upon manmade structure such as artificial reefs, jetties, bridge and dock pilings and shipwrecks for their primary habitat.

Artificial Reefs

Habitat for tautog has been improved through the use of artificial reef structures in both Virginia and Maryland. Virginia's artificial reef program, which began in the early 1970s as an outgrowth of private efforts, now has a total of 13 sites extending from the Gwynn Island site well inside the Bay to the Triangle Wreck site about 30 miles offshore. Several additional reef sites are currently under consideration. Various materials have been used to construct these reefs including Liberty Ships, tire in concrete units, donated bridge and concrete pipe materials and newer concrete structures designed specifically for the artificial reef program. More stringent environmental standards have curtailed the use of some formerly common reef building materials, such as junked automobiles and wooden vessels. Maryland has developed over 20 reef sites in Bay waters and many are providing protection and habitat for oysters. To date, Maryland has deployed approximately 95,000 cubic yards of fossil oyster shell and 6,500 concrete cubes in order to create and enhance oyster reef habitat in the Bay. These structures attract tautog, black sea bass and other species of fish by providing shelter, often within days after deployment, and subsequently develop an overlay of encrusting marine organisms which soon form a food chain for the resident fish. They provide important habitat for juvenile and adult tautog along the coast and a nursery area for juveniles in the Chesapeake Bay since structure is believed to be limited in this area.

Submerged Aquatic Vegetation (SAV) and Coastal Wetlands

SAV provides important food and shelter to developing juvenile tautog. In the Chesapeake Bay, SAV underwent a dramatic decline during the late 1960's and early 1970's. The decline was attributed, in part, to increased nutrient enrichment and sedimentation as a result of change in land use and population in the surrounding watershed (Kemp et al. 1983).

Increased physical disturbance due to shoreline alterations, dredging and intense boat traffic played an additional role in the decline of SAV. Intense population pressures have adversely affected many estuarine and marine habitats along the Atlantic coast. As residential and commercial use of coastal lands increase, so does the recreational use of coastal waters. Marinas, public access landings, private piers, and boat ramps all vie for space. Furthermore, the impact on the environment from boat discharge, boat traffic, litter, fuel and oil spillage substantially degrades localized habitat. As population densities increase in these areas, greater pressures are exerted to develop remaining lands, and the demand for nuisance insect control on adjacent undeveloped wetlands either through chemical or physical (i.e. ditching) methods, also intensifies.

Significant coastal wetlands have been lost in the Chesapeake Bay watershed. Demand for land suitable for home sites, resorts, marinas, and industrial expansion has resulted in the loss or alteration of large areas of wetlands through dredging, filling, diking, ditching, upland construction, and shoreline modification. Between 1955 and 1978 about 24,000 acres of Maryland's coastal wetlands and inland vegetated wetlands disappeared, accounting for 9% of its coastal wetlands (Tiner 1987). Between 1956 and 1977, over 63,000 acres of Virginia's coastal and inland vegetated wetlands were lost, with an overall loss of 6.30% of the coastal wetlands (Tiner 1987). These wetlands act as a buffer, improving water quality throughout the Bay, benefiting all species that reside within. Recently, however, the rate of decline in the loss of wetlands has slowed, with only a net loss of about 19,500 acres (2.50%) within the entire Chesapeake Bay watershed between 1982-1989 (USFWS 1994). The quality of the remaining and mitigated wetlands may not be as great as original wetland habitat, though, as many wetlands have been altered or transformed.

Water Quality

The general decline in baywide water quality is directly and indirectly linked to the decline of vital tautog habitats such as oyster reefs, SAV, and wetlands. Increased nutrient inputs into the Bay from agriculture and urban runoff, as well as increased urbanization, industrial development and shoreline alterations, have negatively impacted water quality.

Chemical contaminants of coastal waters include inputs from municipal and industrial wastewater, agricultural pesticides and fertilizers, animal waste, urban nonpoint sources, stormwater runoff and atmospheric deposition. Within the Mid-Atlantic region (Cape May, N.J. to Cape Fear, N.C., as defined in the Mid-Atlantic Marine Research Plan 1994), there are more than 75 coastal counties and cities that have one or more publicly owned treatment works discharging to coastal waters (MAFMC 1995). Toxic components of these contaminants include heavy metals such as lead, cadmium, chromium, zinc, copper, silver and mercury, and organic compounds such as DDT, chlordane, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs). The source of these compounds are generally discharges to coastal waters from human activities, although there are some cases of natural concentrations. In the Mid-Atlantic region, the northern Chesapeake Bay (especially Baltimore Harbor) and the Elizabeth River in Virginia contain the highest levels of these contaminants except for DDT (Mid Atlantic Marine Research Plan 1994).

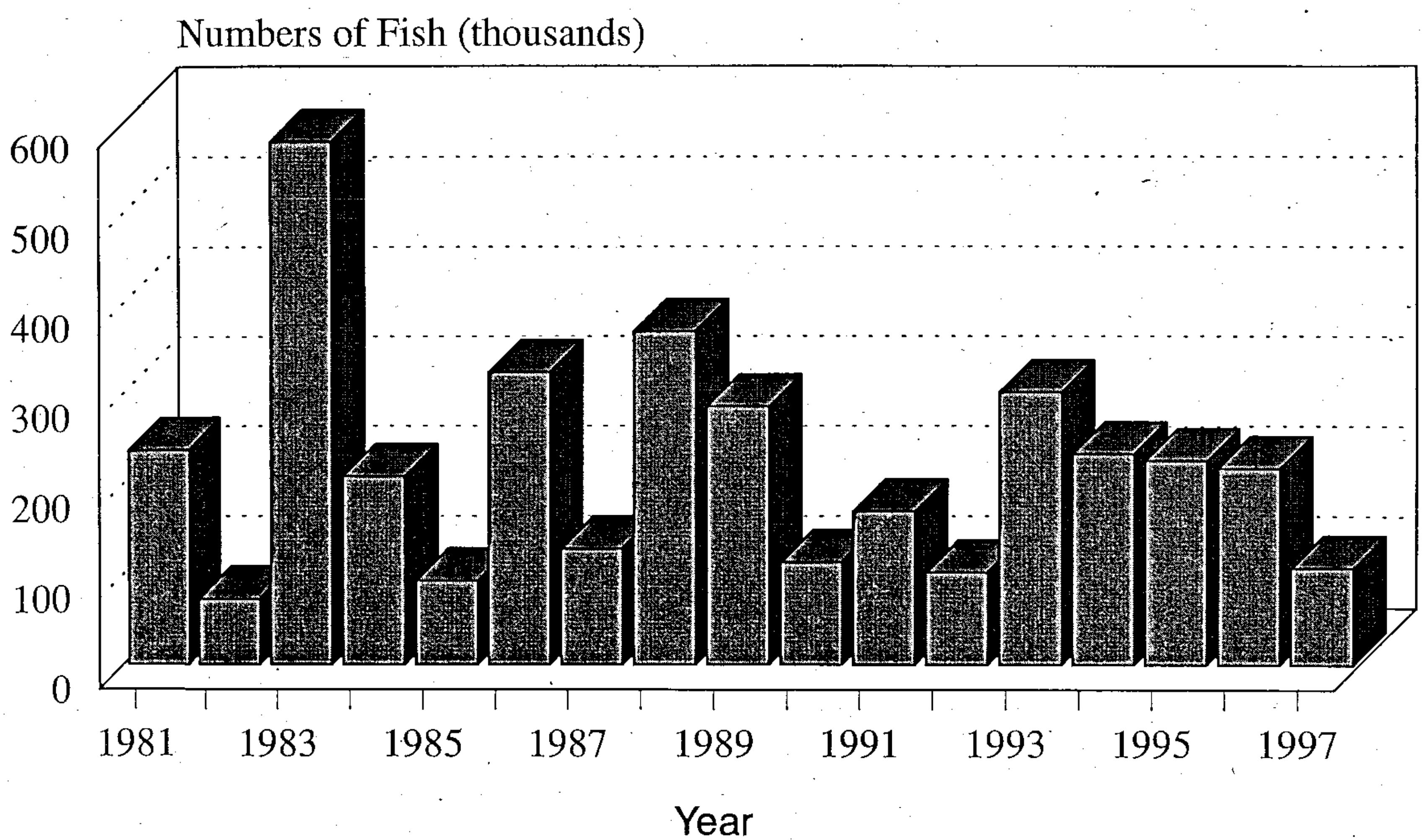
Coastal Urbanization

According to recent demographic estimates roughly 60% of the world's population (some 3.80 billion people) lives within 100 miles of the coast (Hinrichsen 1990). Population shifts to the Chesapeake Bay region and associated industrial and municipal expansion have accelerated competition for use of the same habitats as those required by tautog and other aquatic species. As a result, these habitats have been substantially reduced and continue to suffer the adverse effects of human-related activities. Coastal population is particularly dense in the mid-Atlantic region as several major cities (Hampton Roads, Va.; Washington, D.C.; and Baltimore, Md.) are in relatively close proximity to each other. Between 1970 and 1994 population in the Bay region increased 26% and is expected to increase another 12% from 1995 to 2010 (Chesapeake Bay Program 1996a).

A major impact in the Baltimore-Washington-Norfolk corridor, in addition to commercial and industrial activities, is suburban sprawl. Suburban development patterns have increasingly become low-density and single use residential areas. Low density, single-use development increases traffic congestion and airborne sources of pollution entering the Bay. The creation of multiple communities outside of major work centers increases the demand for new roads and infrastructure, makes effective mass transit less possible, and creates additional traffic by increasing commute miles traveled between work and home. The amount of vehicle miles traveled in the Chesapeake Bay watershed increased by 105% from 1970 to 1994 (Chesapeake Bay Program 1997). The construction of roads and infrastructure remove natural buffer areas, such as forests, wetlands, and open space and increase the area of impervious surface in the watershed. In 1997, Maryland passed legislation that directs state funds for development and infrastructure to growth centers and discourages development in non-designated growth areas. The Smart Growth Initiative represents a substantial effort to limit sprawl development and preserve existing neighborhoods and agricultural, natural, and rural resources.

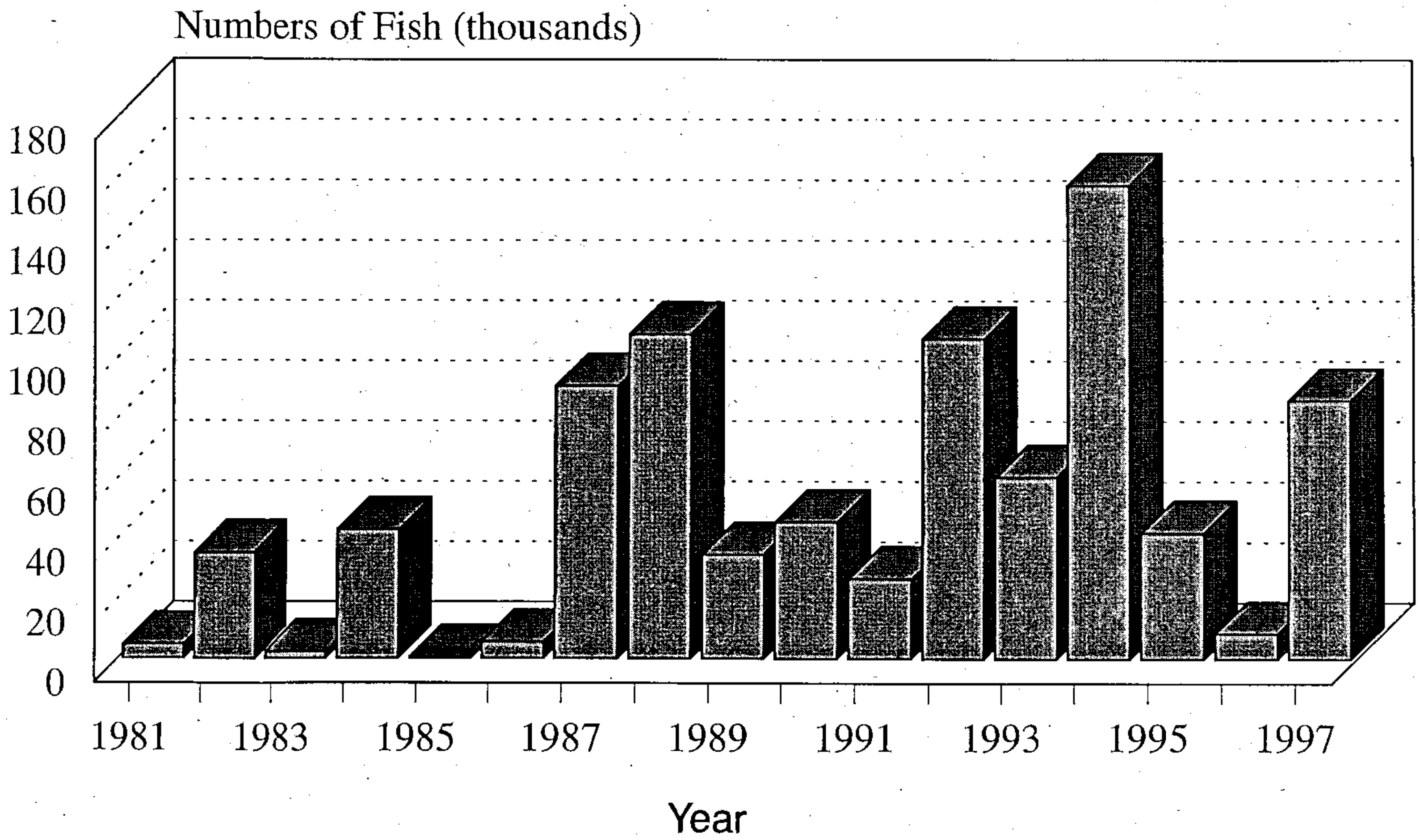
These sprawl development patterns that tend to consume resource land such as farms, wetlands and forests, directly impacts the water quality of Chesapeake Bay and its tributaries. Sprawl increases impervious surface coverage from roads, parking lots and rooftops. Pollutants that contact impervious surfaces run directly into the Chesapeake Bay and its rivers, increasing runoff of soil, fertilizers, biocides, heavy metals, grease and oil products, polychlorinated biphenyls (PCBs), and other materials. Excessive suspended sediment can abrade sensitive epithelial tissues, clog gills, and decrease egg buoyancy. Turbidity from sediments reduces light penetration; affecting photosynthesis of phytoplankton and bay grasses (MAFMC 1995). Underwater plants help maintain dissolved oxygen levels in the Bay (Moore et al. 1995).

Figure 1. VIRGINIA TAUTOG RECREATIONAL LANDINGS



MRFSS Data (excludes caught and released fish)

Figure 2. MARYLAND TAUTOG RECREATIONAL LANDINGS



MRFSS Data (excludes caught and released fish)

Figure 3. TAUTOG CITATIONS

Virginia Saltwater Fishing Tournament, 1958-1996

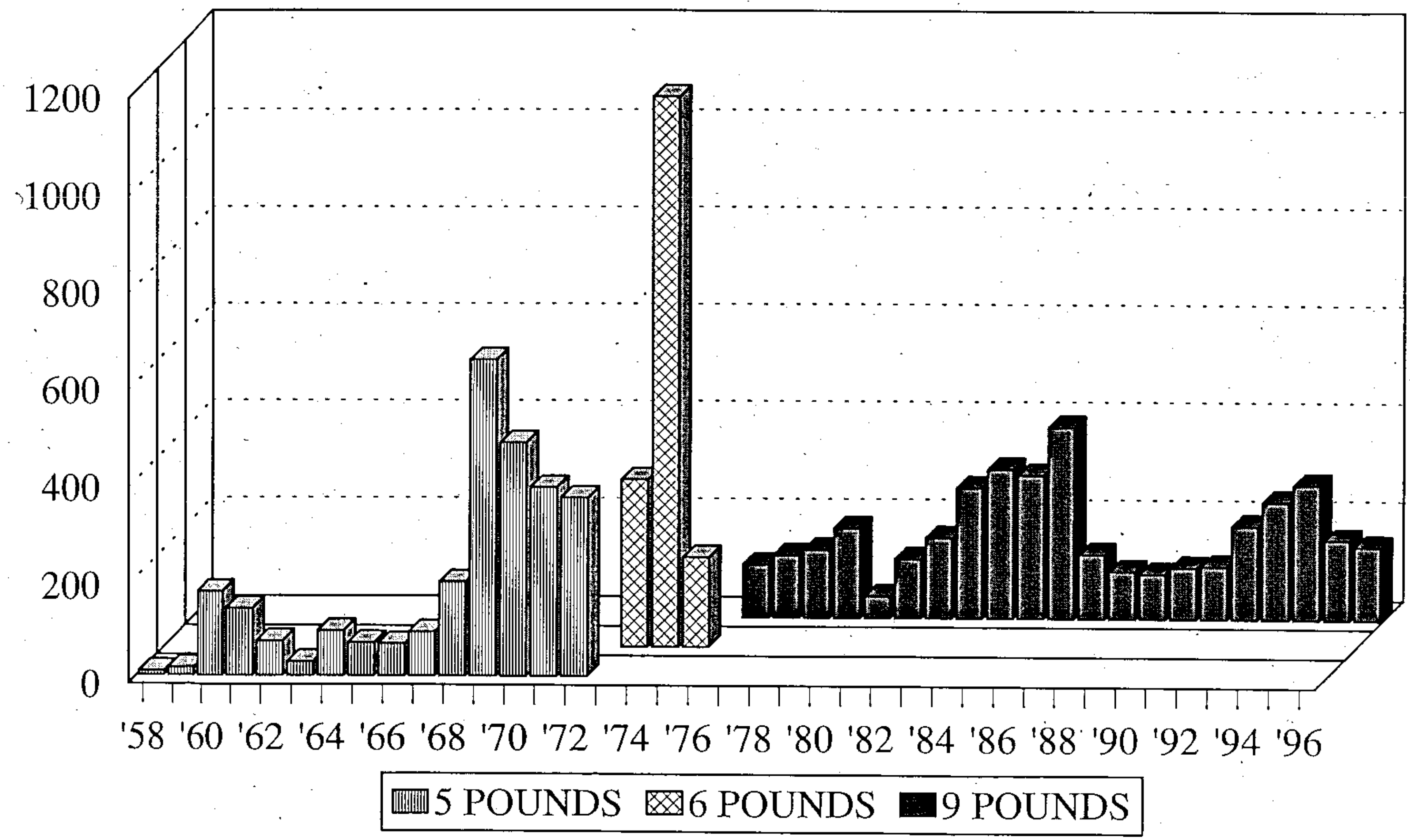


Figure 4. VIRGINIA TAUTOG COMMERCIAL LANDINGS AND DOCKSIDE VALUE

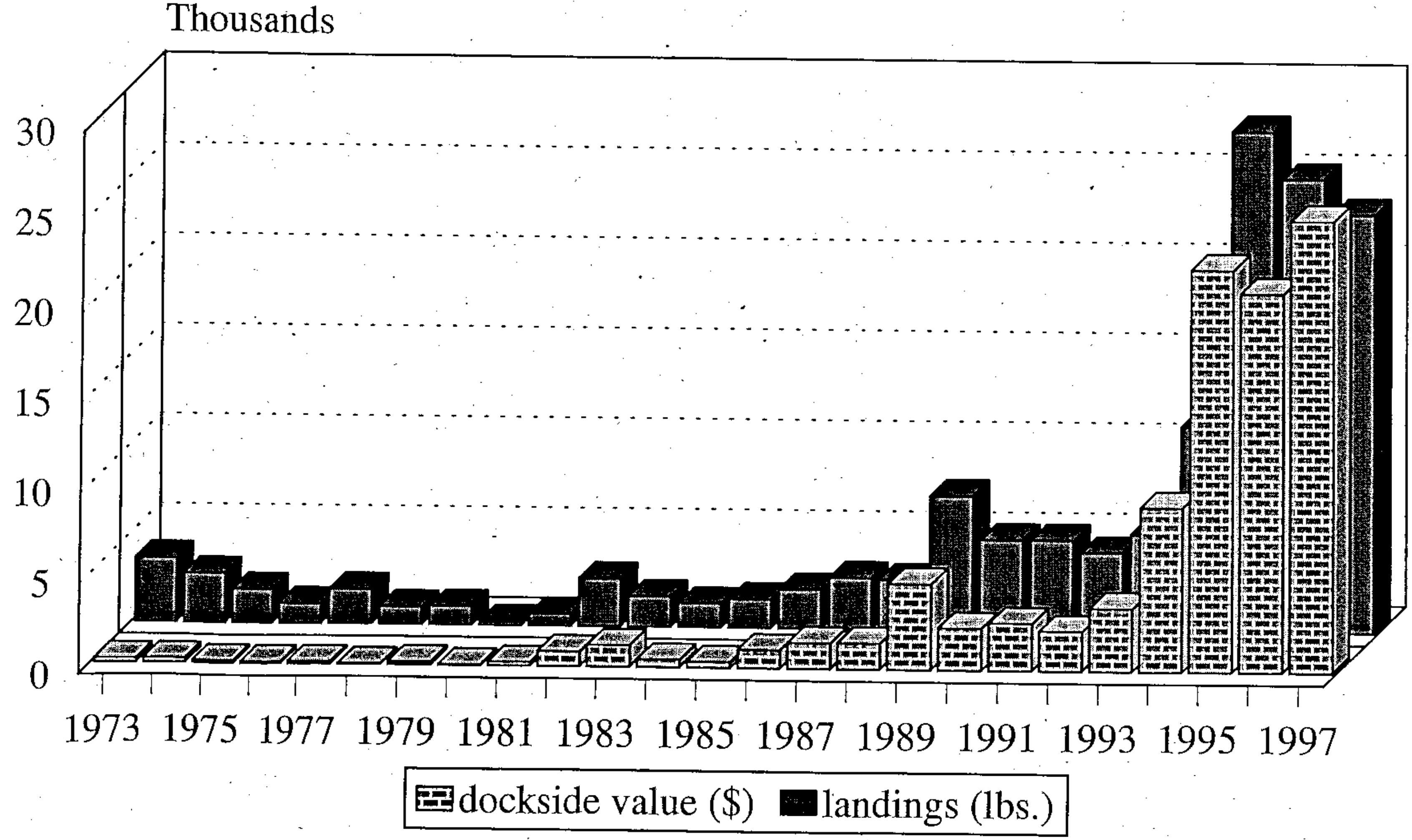
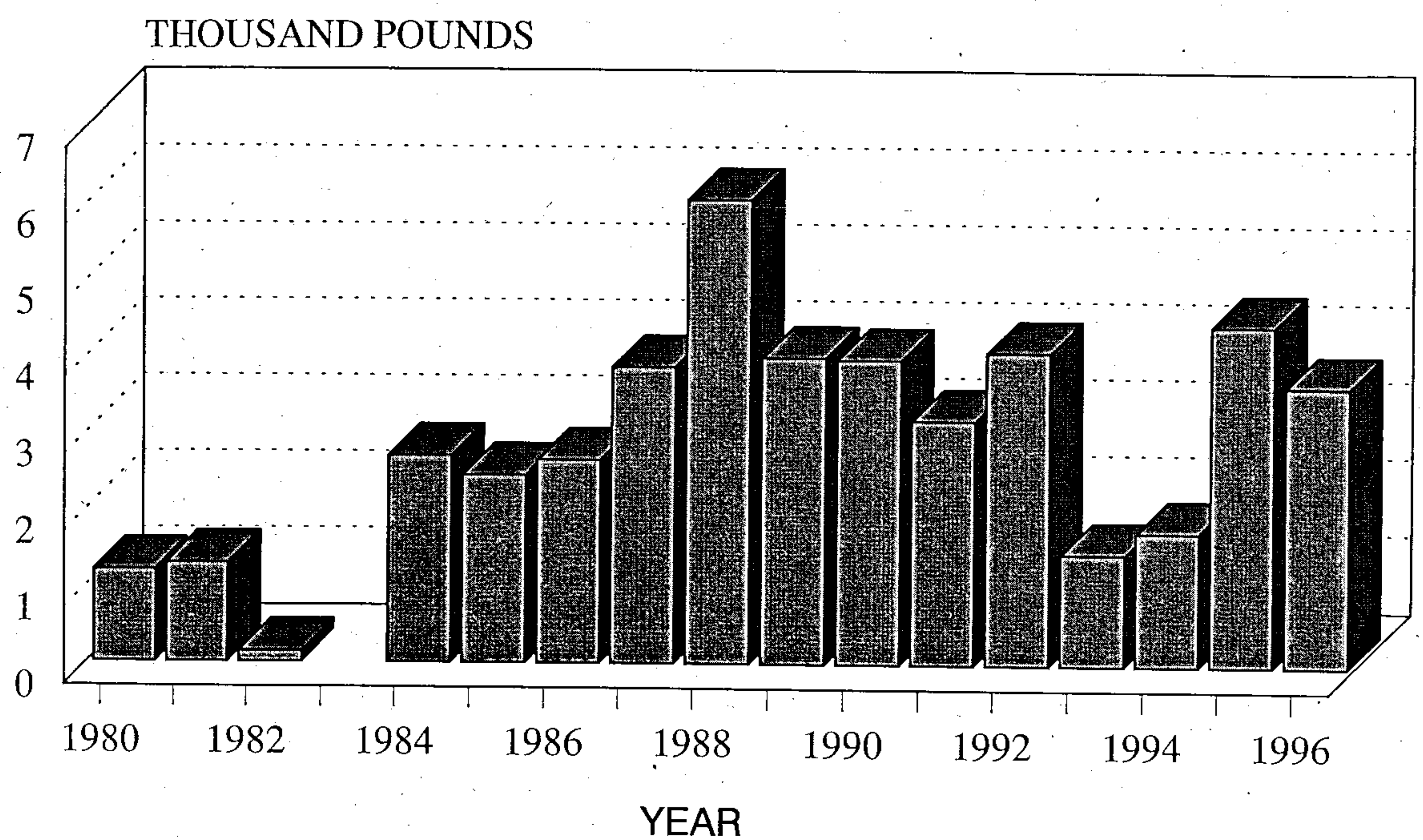
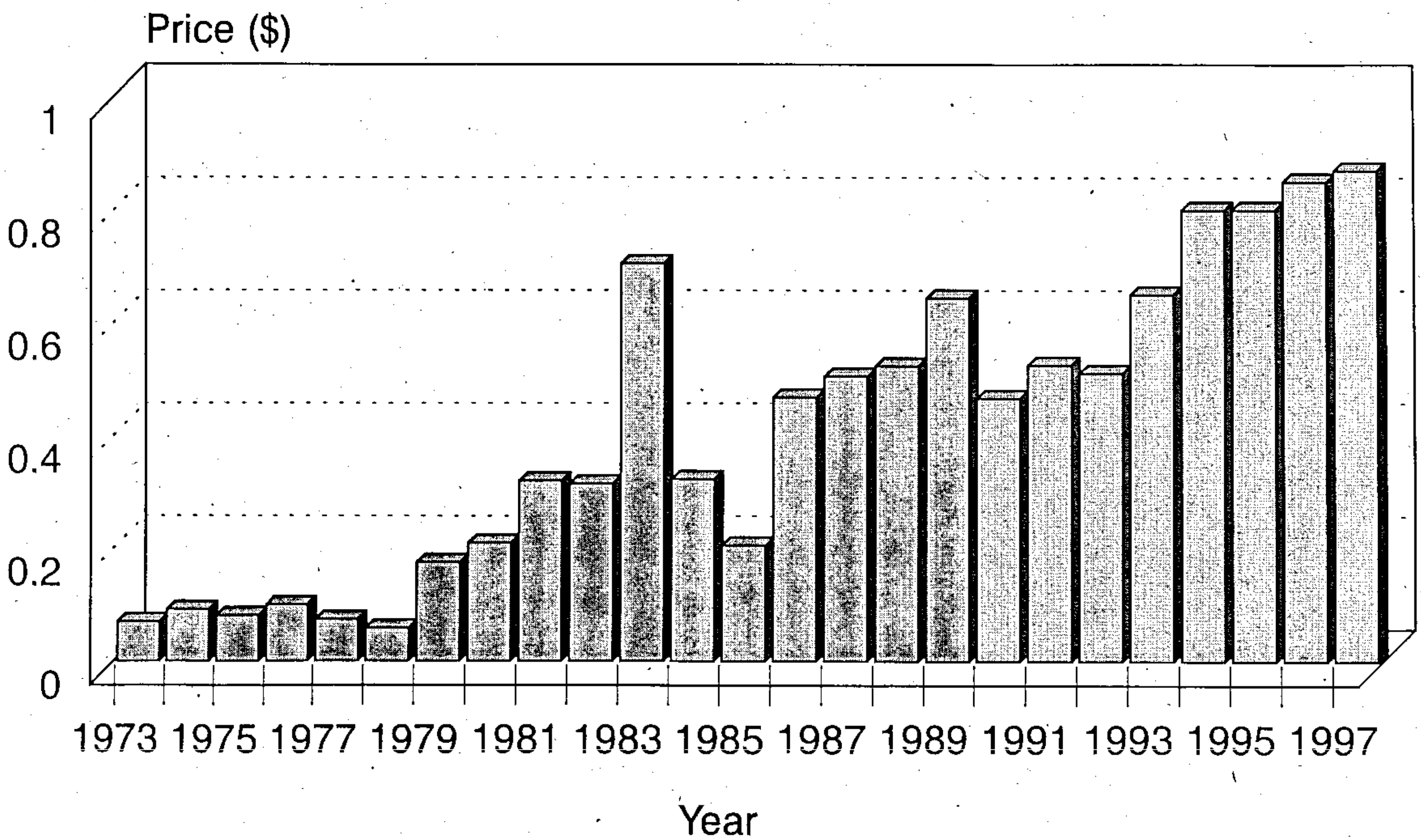


Figure 5. MARYLAND TAUTOG COMMERCIAL LANDINGS



NMFS Data

Figure 6. VIRGINIA TAUTOG PRICE PER POUND



1997 data through July only

SECTION 2: TAUTOG MANAGEMENT

FMP STATUS AND MANAGEMENT UNIT

The Atlantic States Marine Fisheries Commission (ASMFC), in cooperation with the Mid-Atlantic Fishery Management Council (MAFMC), has developed a tautog management plan for the states of Massachusetts to North Carolina (ASMFC 1996). For the purposes of coastal management, tautog from Delaware to North Carolina are currently considered a unit stock. For the CBP Tautog FMP, the management unit encompasses all estuarine waters of the Chesapeake Bay, coastal bays, and coastal Atlantic Ocean to 3 miles offshore.

A. SPECIFIC COMPLIANCE ISSUES DEFINED BY THE ASMFC TAUTOG FMP

The Fishery Management Plan for Tautog (ASMFC 1996) and the ASMFC Addendum 1 to the FMP for Tautog (1997) sets forth size limits for compliance and adopts a target fishing mortality rate (F) to be met through regulatory programs. The interim target fishing mortality rate during 1998-2000 is F=0.24 (20%). At the end of this interim period, each state must reduce F to the natural mortality rate (M)=0.15 (13%).

Recreational Fishery Management Measures:

A. *Size Limit*: The FMP specifies a 14 inch minimum size for recreational fisheries.

B. *Fishing Mortality Reduction*: Recreational fisheries reductions to reach the interim target F rate and finally, the natural mortality rate, may be achieved through possession limits, seasons, or a combination of both.

Commercial Fishery Management Measures:

A. *Size Limit*: The FMP specifies a 14 inch minimum size for commercial fisheries.

B. *Fishing Mortality Reduction*: Commercial fisheries reductions to reach the interim target F rate are to be achieved through state-specific plans requiring the ASMFC Tautog Technical Committee approval. After submission of commercial plans in April 1996, and approval by the ASMFC Tautog Management Board, effort controls to reach the interim motality rate of F=0.24 (u=20%) are to be implemented by April 1998 for the Delaware to North Carolina stock. Management measures to reach F=0.15 (u=13%) are to be implemented by April 2000.

B. PROBLEM AREAS AND MANAGEMENT STRATEGIES

PROBLEM 1: POTENTIAL FOR OVERFISHING

There are indications that the tautog stocks are overfished. White (1997; pers. comm. 1998) completed a fishing mortality study on Virginia tautog stocks that estimates the average fishing mortality (F) at 0.36 (u=28%). The recommended target fishing mortality rate is 0.15 or u=13% (ASMFC 1996).

Tautog are a long-lived, slow growing species; 100% maturity in Virginia waters occurs at age 4 (approximately 13.50") for females and age 3 (11.40") for males (Hostetter and Munroe 1993). As younger fish are generally found within Bay waters, a potential decline in the future spawning stock can occur if small, immature fish are constantly removed through fishing activities.

Commercial landings in Virginia peaked at 30,000 pounds in 1995 and have remained around 25,000 pounds (1996-97, NMFS data) since then. Maryland commercial harvest has also increased with 7,700 pounds harvested in 1997. The estimated recreational harvest (excludes the number of fish caught and released) has averaged 211,182 fish from Virginia (1988-1997) and 67,432 fish from Maryland (1988-1997, MRFSS data). Furthermore, a developing speciality market for live tautog in the northeast, coupled with an expansion of the trawl fishery using "rockhopper" or roller gear in that region, prompted the development of a fishery management plan by the ASMFC (1996). Coastwide, trawls account for approximately 35% of the harvest and pots and traps account for approximately 27% (ASMFC 1996).

There is concern that as stocks of other species decline and entry to other fisheries becomes more restricted, greater pressure will be placed on tautog stocks. Tautog and black seabass are the only two finfish species consistently available to fishermen in the winter months, increasing the demand for maintenance of healthy stocks. Recreational and charter boat operators support management measures that prevent overexploitation in this fishery. Compatibility of state and Exclusive Economic Zone (EEZ) regulations are essential for effective management of the tautog fishery. Non-compatibility would allow a possible shift of the fishery into the EEZ upon CBP Plan implementation. Once the CBP 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 (3-200 miles from the United States coast).

STRATEGY 1

Implement minimum size and possession limits applicable to the commercial and recreational fisheries to prevent overexploitation. Monitor size composition of landings in the recreational fishery to prevent compression of age structure in the population. Use size composition of fish in the recreational fishery and total landings in the commercial fishery as triggers to implement further management of the fishery, should statistically significant compression of the age structure occur. This plan recommends that the Secretary of Commerce implement minimum size and 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.

ACTION 1.1

Virginia, Maryland and the PRFC will implement a minimum size limit of fourteen inches in the recreational and commercial tautog fisheries. Minimum size limits may be changed as more data becomes available on stock condition and biological reference points are re-evaluated.

IMPLEMENTATION 1.1

Maryland:	October 1997
Virginia:	April 1998
PFRC:	March 1998

ACTION 1.2

Virginia, Maryland and the PRFC will reduce fishing mortality to interim and target rates, as defined by ASMFC (1996 and 1997), through a combination of possession limits, gear, seasons, and/or other restrictions. Target rates may be changed and management measures adjusted as more data becomes available to manage the stock. Due to differences in fishing mortality rates between Maryland and Virginia, different management strategies may be necessary to reach the target fishing mortality rate set by ASMFC (1996). The jurisdictions will continue to work towards a unified, Baywide management strategy.

IMPLEMENTATION 1.2

Interim F:	1998
Target F:	April 2000

ACTION 1.3

Virginia and Maryland waters will continue to require degradable fasteners in tautog pots and traps, utilizing one of the following materials:

a. Untreated hemp, jute, or cotton string of 3/16" (4.80 mm) or smaller;
b. Magnesium alloy, timed float releases (pop-up devices) or similar magnesium alloy fasteners;
c. Ungalvanized or uncoated iron wire of 0.09" (2.39 mm) or smaller.

IMPLEMENTATION 1.3

Virginia:	April 1997
Maryland:	October 1997
PFRC:	Not applicable

PROBLEM 2: STOCK ASSESSMENT AND RESEARCH NEEDS

Fishery managers lack most of the biological and fisheries data necessary for effective management of the tautog resource. Estimates of sex and size composition within recreational and commercial catches are poor. There have been no recent studies completed that provide a current estimate of stock condition or of fishing mortality for Cheaspeake Bay and associated coastal waters, though the current estimate of Virginia tautog fishing mortality is F=0.36 (u=28%). Furthermore, it is not known whether tautog, like seabass, change sex at some point in their life. Initial studies don't appear to support sex reversal within the species (White pers. comm. 1997). Additionally, data on the rate of inshore-offshore migration, movement between localized habitats and spatial extent of daily feeding excursions is lacking, especially in local waters.

STRATEGY 2

Research will be encouraged on the size, age, and sex composition of the Chesapeake Bay tautog stock. Finfish stock assessment surveys will monitor the age and sex structure of the catch for changes in stock composition. More emphasis will be placed on surveys of the recreational fishery to refine estimates of landings in this segment of the fishery. Expanded and continued tagging studies will provide valuable information on sex-reversal and migration for a relatively small cost.

PROBLEM 2.1: SEX-REVERSAL AND MISSING DATA

Effects of sex-reversal on tautog populations are unknown, as well as the effects of minimum size limits on the spawning stock. Data on commercial discards and length frequency, as well as a juvenile index and index at age survey, are lacking.

STRATEGY 2.1

Virginia and Maryland will work with the Virginia Institute of Marine Science, Old Dominion University, the University of Maryland, Smithsonian Institute and National Marine Fisheries Service's Marine Recreational Fisheries Statistics Survey to conduct research into the size, age, and sex composition of tautog in the Chesapeake Bay. The agencies' stock assessment departments will continue to collect information on size composition to monitor the status of tautog stocks. This stock assessment data will be used to determine a baseline of age and sex distribution for the local stock, significant deviation from which will be used as a trigger mechanism to determine the need for future management measures.

ACTION 2.1

The management agencies will gather data on age, size and sex distribution to be used as a baseline measurement of a healthy population and will encourage research into the possibility of sex-reversal in the tautog population.

A) Virginia will continue the Baywide trawl survey of estuarine finfish species and crabs to measure size, age, sex, distribution, abundance and CPUE.

B) Virginia implemented a mandatory reporting system for commercial licensees beginning January 1, 1993. Maryland's mandatory reporting system has been in effect since 1944 (excluding eel). Improved reporting of commercial landings, along with more detailed information on catch location and effort are some of the expected benefits of these programs.

C) Virginia will continue to supplement the Marine Recreational Fisheries Statistics Survey to obtain more detailed catch statistics at the state level. Virginia's new recreational saltwater fishing license may provide funding for more extensive surveys of the state's recreational fishery.

D) Maryland's Coastal Bays Fisheries Investigation will be expanded by conducting a creel survey from recreational headboats . The survey will collect biological data on tautog such as sex, length, and age, and information on recreational fishing effort.

IMPLEMENTATION 2.1
A-C) Continuing; D) 1998-1999

PROBLEM 2.2: MIGRATION
Data on the rate of inshore-offshore migration, movement between localized habitats and spatial extent of daily feeding excursions needs to be improved, especially in local waters. Mortality rates, age composition, and recruitment of localized stocks depend partially on migration between each area and are poorly understood. The Virginia Game Fish Tagging Program, may help alleviate this lack of information on migration and stock composition. The tagging of tautog was initiated 1995, and as of January 15, 1998, 1435 tautog have been tagged, with 142 recaptures (~10% recapture rate).

STRATEGY 2.2
The jurisdictions will promote research to determine the extent of migration and mortality in localized tautog populations. As reliance of this species on structure for both food and shelter may limit populations in the Chesapeake Bay area, studies designed to determine the relationship between population size and available shelter and food sources should likewise be encouraged.

ACTION 2.2
Research on migration of tautog between areas is encouraged. Tagging experiments to provide data on tautog migration may be funded from sales of saltwater fishing licenses. The Virginia Game Fish Tagging Program will be continued.

IMPLEMENTATION 2.2
Continuing

PROBLEM 3: HABITAT DEGRADATION
Resource managers involved in habitat decisions should begin to recognize that habitat loss and degradation can have as important an effect on fishery resources as overfishing (Able and Kaiser 1991). This is especially true of species such as tautog that inhabit estuarine and coastal areas during critical life stages. Coastal and estuarine habitats, namely submerged aquatic vegetation (SAV) and macrophytic algae (*Ulva lactuca*), tidal wetlands and natural oyster reefs, provide shelter and food for both juvenile and adult tautog. In Chesapeake Bay, these nearshore and inshore areas have substantially declined in both quality and quantity over the past several decades. Increased nutrient loadings from agriculture and urban runoff into the Bay, as well as increased urbanization, industrial development and shoreline alterations have all contributed to the decline of SAV and wetlands, as well as the decline in water quality. Decreased water quality, the invasion of oyster pathogens, and the oyster harvest techniques have all contributed to the destruction of the natural oyster reef system. The degradation of these vital habitats may pose a serious threat to the health of the tautog population.

STRATEGY 3
The jurisdictions will continue their ongoing commitment to develop: "guidelines for the

protection of habitats and water quality conditions necessary to support the living resources found in the Chesapeake Bay system, and to use these guidelines in the implementation of water quality and habitat protection programs" (Chesapeake Executive Council 1987). They also will strive to develop and implement new and innovative habitat restoration strategies to evaluate and supplement the progress of these programs. The importance of coordinating and integrating these habitat restoration programs will also be stressed. Integration will aid the effective management of the Bay's ecosystem (Chesapeake Bay Program 1995).

PROBLEM 3.1: THE DESTRUCTION OF AQUATIC REEFS

Oyster reefs, once plentiful in the Bay, have slowly been destroyed by oyster harvest techniques, water pollution, and the spread of oyster pathogens. Reef structures are important to both juvenile and adult tautog. They provide habitat for the dispersal of young fish, thereby, reducing predation and competition. Depending on salinity, healthy reef systems attract large numbers of adult tautog, black sea bass, scup and other species of fish, providing them with food and shelter. Of the recorded 243,000 acres of public oyster grounds in Virginia waters (Baylor Grounds), only about 3,000 acres are still capable of producing healthy oysters (Wesson pers. comm. 1996). At the same time that the aquatic reef programs work toward the restoration of the Bay's reef systems, artificial reef programs are gaining popularity. Artificial reefs provide habitat for a variety of marine life that once relied on the oyster reefs for food and shelter. Both Virginia and Maryland will continue to increase available habitat for tautog through artificial reef programs.

STRATEGY 3.1.1

Restoration of aquatic reefs could lead to increased habitat for tautog. Jurisdictions will continue to expand and improve their current oyster restoration programs with periodic program evaluations to ensure maximum success.

ACTION 3.1.1

A) Maryland and Virginia will continue the implementation of the 1994 Oyster FMP (Chesapeake Bay Program 1994b), which combines the recommendations of both the Virginia Holton Plan and the Maryland Roundtable Action Plan. Strategies in both Virginia and Maryland have taken a new focus as the programs intensify efforts to manage around the devastating oyster diseases, Dermo and MSX, currently infecting Chesapeake Bay oysters.

IMPLEMENTATION

Continuing

B) Maryland and Virginia will continue the implementation of the Aquatic Reef Habitat Plan (Chesapeake Executive Council 1990c). "The purpose of the Aquatic Reef Habitat Plan is to guide the development and implementation a regional program to rebuild and restore reefs as habitat for oysters and other ecologically valuable aquatic species."

IMPLEMENTATION
Continuing

STRATEGY 3.1.2
The creation of new artificial reefs and the expansion and improvement of preexistingreefs will provide additional habitat for the tautog population. Again, when the decisions are made concerning new reef locations and monies are spent on their development, the importance of this habitat to tautog should be considered (see Appendix E-Potential Tautog Habitat).

ACTION 3.1.2
A) Jurisdictions will continue to maintain, expand, and improve their artificial reef programs. Since 1995, Virginia has developed three new reef sites within the Bay and expanded several existing sites, deploying more than 6,000 designed structures (concrete tetrahedrons) and over 5,000 tons of concrete rubble. Maryland has designated 3 sites as oyster sanctuaries where harvest is not allowed: Plum Point, lower Severn River and Cambridge. Maryland will also be examining the efficacy of small hill sanctuaries at 3 sites: Tangier, Choptank and Strong Bay (Chester River).

IMPLEMENTATION
Continuing

B) Virginia has recently prohibited the use of all gear except recreational rod and reel, hand-line, spear, or gig on four artificial reefs in state waters. The result of this regulation is similar to the MAFMC/ASMFC Special Management Zones that protect vital tautog habitat.

IMPLEMENTATION
Continuing

PROBLEM 3.2: THE DEGRADATION OF SAV
Submerged aquatic vegetation (SAV) provides important food and shelter to developing juvenile tautog. Vegetated areas generally yield greater fish densities than nonvegetated areas (Funderburk 1991) because of food abundance and shelter from predation. In Chesapeake Bay, SAV underwent a dramatic decline from the late 1960s through the early 1980s. The decline was attributed, in part to increased nutrient enrichment (Kemp et al. 1983). Increased physical disturbance due to shoreline alterations, unregulated dredging activities, and intense boat traffic also contributed to the decline of SAV. In 1976, the decline of SAV was chosen as one of the top three problems in the Bay.

Researchers believe that recent efforts to improve water quality, through nutrient input reductions and reduced shoreline development, have influenced the recovery of SAV in Chesapeake Bay (Maryland Sea Grant 1994). SAV acreage has increased from a 1984 low of 37,000 acres to just under 60,000 acres in the Bay and its tributaries in 1995 (VIMS data 1984-

1995). Chesapeake Bay Program scientists estimate that historically 400,000 to 600,000 acres of SAV might have existed. In 1993 the Chesapeake Executive Council adopted an "interim SAV restoration goal" of 114,000 acres Baywide.. Total SAV acreage has increased in the last few years (1996-1997) with the 1997 acreage representing 61% of the interim restoration goal. This goal corresponds to the first of three target restoration goals established by the Chesapeake Bay Program:

Tier I. Restore SAV baywide to areas currently or previously inhabited by SAV as mapped through aerial surveys conducted 1971-1990. If current recovery rates continue, this goal (114,000 acres) will be achieved by the year 2005.

Tier II. Restore SAV to all shallow water areas delineated as existing or potential SAV habitat down to one meter depth contour.

Tier III. Restore SAV to all shallow water areas delineated as existing or potential SAV habitat down to the two meter depth contour (611,000 acres).

STRATEGY 3.2.1

Jurisdictions will continue efforts to: "achieve a net gain in submerged aquatic vegetation distribution, abundance, and species diversity in the Chesapeake Bay and its tributaries over current populations" (Chesapeake Executive Council 1990a) by the following actions:

ACTION 3.2.1.1

A) Protect existing SAV beds from further losses due to increased degradation of water quality, physical damage to the plants, or disruption to the local sedimentary environment as recommended by the Chesapeake Bay Submerged Aquatic Vegetation Policy Implementation Plan (Chesapeake Executive Council 1990a).

B) The Guidance for Protecting Submerged Aquatic Vegetation in Chesapeake Bay from Physical Disruption (Chesapeake Bay Program 1995) was developed in response to the above action and should be used by agencies making decisions that influence SAV survival in Chesapeake Bay. The following recommendations from the guidance document should be strongly considered when making decisions that impact SAV, with special emphasis on SAV that falls within the salinity range of juvenile tautog:

1) Protect SAV and potential SAV habitat from physical disruption. Implement a tiered approach to SAV protection, giving highest priority to protecting Tier I and Tier II areas but also protecting Tier III areas from physical disruption.

2) Avoid dredging, filling or construction activities that create turbidity sufficient to impact nearby SAV beds during SAV growing season.

3) Establish an appropriate undisturbed buffer around SAV beds to minimize the direct and indirect impacts on SAV from activities that significantly

increase turbidity.

4) Preserve natural shorelines. Stabilize shorelines, when needed, with marsh plantings as a first alternative. Use structures that cause the smallest increase in local wave energy where planting vegetation is not feasible.

5) Educate the public about the potential negative effects of recreational and commercial boating on SAV and how to avoid or reduce them.

IMPLEMENTATION
Continuing

ACTION 3.2.1.2
Set and achieve regional water and habitat quality objectives that will result in restoration of submerged aquatic vegetation through natural revegetation as recommended by the Chesapeake Bay Submerged Aquatic Vegetation Policy Implementation Plan (Chesapeake Executive Council 1990a).

IMPLEMENTATION
Continuing

ACTION 3.2.1.3
Set regional submerged aquatic vegetation restoration goals in terms of acreage, abundance, and species diversity considering historical distribution records and estimates of potential habitat as recommended by the Chesapeake Bay Submerged Aquatic Vegetation Policy Implementation Plan (Chesapeake Executive Council 1990a).

IMPLEMENTATION
Continuing

STRATEGY 3.2.2
The jurisdictions will use The Submerged Aquatic Vegetation Habitat Requirements and Restoration Targets: A Technical Synthesis (Chesapeake Bay Program 1992), as a guide to set quantitative levels of relevant water quality parameters necessary to support continued survival, propagation and restoration of SAV, as well as established the regional SAV restoration target goals defined earlier in this section.

ACTION 3.2.2
When choices must be made in selecting SAV restoration projects, to fund and support under the Chesapeake Bay Submerged Aquatic Vegetation Policy Implementation Plan (Chesapeake Executive Council 1990a), specific attention should be given to action

items that lead to the protection and restoration of SAV found within the juvenile tautog habitat range.

IMPLEMENTATION
Continued

PROBLEM 3.3: WETLAND DESTRUCTION AND LOSS

Over the past 40 years, wetlands have undergone a demise similar to SAV, as coastal development and land use pressures in the Chesapeake watershed continue to increase. The U.S. Fish and Wildlife Service reported that of the 1.70 million acres of wetlands in the Chesapeake watershed, 12% are estuarine wetlands. Between the 1950s and 1970s, annual losses of Chesapeake Bay wetlands averaged over 2,800 acres (Tiner 1986). Although this average annual loss dropped to 129 acres from 1982 through 1989, the no net loss goal of the Chesapeake Bay Wetlands Policy has not yet been achieved. As coastal wetlands in Chesapeake Bay and along the Atlantic coast disappear, so does vital tautog habitat; therefore, the protection and restoration of estuarine wetlands in the salinity range of the tautog, i.e. the mesohaline and polyhaline range, should be given high priority in management decision making.

STRATEGY 3.3

In 1988, the Chesapeake Executive Council adopted the Chesapeake Bay Wetlands Policy in recognition of the ecological and economic importance that wetlands play in the Chesapeake Bay. The Wetlands Policy establishes an immediate goal of no net loss with a long-term goal of a net resource gain for tidal and nontidal wetlands (Chesapeake Executive Council 1990b). It identifies specific actions necessary to achieve both the short term goal of the Policy, "no net loss" and the long term goal of "a net resource gain for tidal and nontidal wetlands."

ACTION 3.3

The Jurisdictions should strive towards achieving the following, especially in the salinity range of the tautog.

A) Define the resource through inventory and mapping activities.
B) Protect existing wetlands.
C) Rehabilitate, restore and create wetlands.
D) Improve Education.
E) Further Research

IMPLEMENTATION
Continuing

PROBLEM 3.4: DEGRADATION OF WATER QUALITY

Poor baywide water quality is partly to blame for the decline of estuarine and coastal habitats. Therefore, improvements in baywide water quality are paramount to protect tautog habitat.

STRATEGY 3.4.1
Jurisdictions will continue efforts to improve Baywide water quality through the efforts of programs established under the 1987 Chesapeake Bay Agreement (Chesapeake Bay Program 1987). In addition, the jurisdictions will implement new strategies, based on recent program reevaluations, to strengthen deficient areas.

ACTION 3.4.1
A) Based on 1992 baywide nutrient reduction plan reevaluation, the jurisdictions will:

1. Expand program efforts to include the tributaries.
2. Intensify efforts to control nonpoint sources of pollution from agriculture and developed areas.
3. Improve on current point and nonpoint source control technologies.

IMPLEMENTATION
Continuing

B) Based on the 1994 Chesapeake Bay Program Toxics Reduction Strategy Reevaluation Report (Chesapeake Bay Program, 1994a) the jurisdictions will emphasize the following four areas:
1) Pollution Prevention: Target "Regions of Concern" and "Areas of Emphasis".
2) Regulatory Program Implementation: Insure that revised strategies are consistent with and supplement pre-existing regulatory mandates.
3) Regional Focus: Identify and classify regions according to the level of contaminants.
4) Directed Toxics Assessment: Identify areas of low level contamination, improve tracking and control nonpoint sources.

IMPLEMENTATION
Continuing

C) The jurisdictions will continue to develop, implement and monitor their tributary strategies designed to improve bay water quality.

IMPLEMENTATION
Continuing

STRATEGY 3.4.2
The Chesapeake Bay Program partners will "Plan for and manage the adverse environmental effects of human population growth and land development in the Chesapeake Bay watershed" (Chesapeake Bay Program 1987). In 1996, the Chesapeake Bay Program accepted the *Priorities for Action for Land, Growth and Stewardship in the Chesapeake Bay Region* (Chesapeake Bay Program 1996) as a framework to address land use and development

pressures in the Chesapeake Bay. This approach recognizes that communities are the basic unit for addressing growth, land-use and long-term stewardship of the natural environment. These priorities are voluntary actions which are expected to be accomplished through a variety of public and private partners, including but not limited to, the Chesapeake Bay Program. Jurisdictions will forward the goals of the *Priorities for Action,* which encourage sustainable development patterns. Given the fact that tautog are particularly vulnerable to suspended solids which abrade epithelial tissues and to decreasing SAV and shellfish beds which serve as habitat and feeding areas, the goals of the *Priorities for Action* which are germane to nutrient and sediment load reduction will be promoted.

ACTION 3.4.2

Encourage efficient development patterns which reduce nutrient and sediment loads to the Chesapeake Bay and promote responsible land management practices and decisions regarding present and future development by pursuing the following:

1. Revitalize existing communities. Revitalization efforts can assist existing communities and help reduce sprawl by encouraging the use of state-of-the-art storm water management and pollution prevention practices.
2. Encourage efficient development patterns. Ecologically sound, efficient development patterns encourage higher population density; compact and contiguous development. Benefits to the Bay include reduced impervious surfaces; conservation of farms, forests, and wetlands.
3. Foster resource protection and land stewardship. Cooperation and linkages among local watershed protection planning efforts should be increased to foster a regional sense of stewardship toward the bay's natural resources. The development of new policies that integrate natural and community infrastructure in public and private planning, development and protection efforts will further this goal.

IMPLEMENTATION

Continuing

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APPENDIX A

SCHEDULE FOR REVIEWING FISHERY MANAGEMENT PLANS

SPECIES	COMPLETE REVIEW	UPDATE SCHEDULE
Blue Crab	1989- adopted 1993- reviewed 1997- revised 1999- review	Annually
Striped Bass	1989- adopted 1995- reviewed 1997- draft Amendment	Annually
Summer Flounder	1991- adopted 1996- reviewed 1997- Amendment #1	Annually
Weakfish/Spotted Seatrout	1990- adopted 1996- reviewed 1998- revise	Annually
Shad & Herring	1989- adopted 1995- reviewed 1998- Amendment #1 1999- revise	Every other year 2000 2002
Oysters	1989- adopted 1993- reviewed 1994- revised 1998- review	Every other year 2000
Bluefish	1991- adopted 1995- reviewed 1997- reviewed	Every third year 2000
American Eel	1991- adopted 1996- reviewed	Every third year 1999 2002
Atlantic Croaker/Spot	1991- adopted 1995- reviewed 1998- review	Every third year 2001
Black Drum	1993- adopted 1997- review	Every third year 2000

SPECIES	COMPLETE REVIEW	UPDATE SCHEDULE
Red Drum	1993- adopted 1997- review	Every third year 2000
Spanish/King Mackerel	1994- adopted 1998- review	Every third year 2001 2004
Horseshoe Crabs	1994- adopted 1998/1999 - review	Every third year 1999 2002
Black Sea Bass	1997 - adopted	Every third year 2001

APPENDIX B

LAWS AND REGULATIONS

Limited entry: Virginia's limited entry program, effective in 1992, requires previously unlicensed applicants to wait two years after registering with the respective state agency before a license to harvest finfish with commercial fishing gears will be issued. As of June, 1998, Maryland implemented new changes to its limited entry program. The moratorium on commercial fishing licenses was removed but the number of tidal fish licenses will continue to be capped. MDNR will set, by regulation, targets for the number of tidal fish licensees for each fishing activity based on the number issued between September 1, 1998 and March 31, 1999. The PRFC also has a moratorium on any new gill net, pound net, or hook and line licenses.

Minimum size limit: Virginia currently has a 14" minimum size for tautog effective April 1, 1998. A 14" minimum size was implemented on October 20, 1997, in Maryland. PRFC 14" minimum size limit became effective on March 15, 1998.

Creel limit: Currently, there is a 10 fish possession limit in Virginia. Maryland has a 5 fish limit for both the recreational and commercial fisheries. There currently is no limit for the PRFC.

Harvest quotas: Not in effect for Maryland, Virginia, or Potomac River.

By-catch restrictions: None in effect for Maryland, Virginia, or Potomac River.

Season: No closed season for Maryland, or Potomac River. There is a closed season in the recreational fishery in Virginia from May 1 - June 30, annually. The commercial fishery is closed annually from May 1 - August 31.

Gear/
Area restrictions: Maryland: purse seines, trawls, trammel nets, and monofilament gill nets are prohibited (otter and beam trawls are legal on the Atlantic Coast at distances of one mile or more offshore). Prohibition on gill netting in most areas of Chesapeake Bay and its tributaries during the summer.

Virginia: trawling is prohibited in Chesapeake Bay and territorial sea. It is unlawful to set, place or fish a fixed fishing device of any type within three hundred yards, in either direction, from the Chesapeake Bay Bridge Tunnel. Also, §§28.1-52 and 28.1-53 of the Code of Virginia outline placement, total length, and distance requirements for fishing structures.

Potomac River: current moratorium on any new gill net, pound net, or hook and line licenses. The use of a purse net, beam trawl, otter trawl or trammel net is prohibited. Length restrictions for various gear types exist. Gill nets are restricted to a mesh size of 5 to 7 inches. Seasonal restrictions for gill net also exist.

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" (4.80mm) or smaller;
B) Magnesium alloy, timed float releases (pop-up devices) or similar magnesium alloy fasteners; or
C) Ungalvanized or uncoated iron wire of 0.09" (2.39mm) or smaller.

APPENDIX C

GLOSSARY OF TERMS AND ACRONYMS

Anoxia: No oxygen

ASMFC: Atlantic States Marine Fisheries Commission.

Benthos: Community of organisms living on the bottom or burrowed in the sediment.

Bivalve: Mollusk with two shells connected by a hinge (e.g. clams, oysters).

Catch Per Unit Effort (CPUE): CPUE is an indicator of stock abundance or stock density. It is the *number or weight* (biomass) of fish caught by an amount of effort. Effort is a combination of gear type, gear size, and length of time a gear is used. CPUE may be influenced by changes in abundance. For example, higher CPUE may mean more tautog are available to be caught.

CBP: Chesapeake Bay Program

Demersal: Community of organisms living near the bottom.

Dermo: *Perkinsus marinus*, a pathogen that causes widespread mortality in oysters, though harmless to humans.

Dimorphism: The state of having two distinct forms in the same species when the sexes differ in secondary as well as primary sexual characteristics.

Diurnal: Occurring or active during the daytime rather than at night.

Exclusive Economic Zone (EEZ): The area in the ocean 3-200 miles offshore. Often called "federal waters," because the U.S. federal government has exclusive management authority over fisheries resources (except for tuna) in this area. Formerly called the Fishery Conservation Zone.

Exploitation (u): The *fraction* of a population at a given time that is removed by fishing over the course of a year. Exploitation may also be expressed as a percentage of the population.

Fmax: The level of fishing mortality (F) that maximizes the yield per recruit. Fmax is one of the biological reference points used to define overfishing.

Fishery-dependent: Data obtained from commercial or recreational harvest.

Fishery-independent: Data collected from an independent survey rather than from commercial or recreational harvest.

Fishing mortality (F): A measure of the *rate* at which fish are removed from the population by the fishing activities of man. If F is constant over time, harvest will be greater during times of high abundance and less during times of low abundance. Mortality rates can be expressed in terms of instantaneous or annual mortality. Instantaneous rates are used extensively in fisheries management for ease of comparing the relative importance of different sources of mortality. Annual mortality rates can be easily converted to percentages, whereas, instantaneous rates cannot. Fishing mortality (F) is expressed in terms of an instantaneous rate.

FMP: Fishery Management Plan

Gonadosomatic indices: The ratio of the weight of a fish's reproductive organs to its total weight; used to indicate spawning period or spawning condition.

Growth overfishing: When fishing pressure on smaller fish/crabs 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.

Histological (histology): Referring to the production of microscope slides to analyze tissue at the cellular level. In many cases, refers to analysis of development within reproductive tissue.

Hypoxia: Low oxygen.

Mandibular: Referring to the lower jaw.

Maximum Sustainable Yield (MSY): The largest average catch or yield that can continuously be taken from a stock under existing environmental conditions. MSY should be used cautiously, as an over-estimate of MSY can lead to overfishing.

MDNR: Maryland Department of Natural Resources.

Mean batch fecundity: Average number of eggs released in one spawning event, or one DAY of spawning if that day is broken into numerous spawning events. This is usually dependant on size, and classified by length groups.

MRFSS: Marine Recreational Fisheries Statistics Survey.

MSX: *Haplosporidium nelsoni*, a pathogen that causes widespread mortality in oysters, though harmless to humans.

Natural mortality (M): A measure of the rate of mortality over time due to natural causes (predation, disease, etc.). Does not include mortality due to fishing effort. See also, total mortality.

NMFS: National Marine Fisheries Service.

Nocturnal: Active at night.

Pharyngeal apparatus: For tautog, the region of the throat which contains crushing plates (one on floor of throat, two on roof) used to break up food prior to swallowing. There is a maximum food size that can fit in between these plates to be crushed and ingested.

Plankton: Small or microscopic algae and organisms associated with surface water and the water column.

Post-release mortality: Death that occurs some time after a fish has been caught and released (in this context, similar to catch and release mortality). Post-release mortality could also refer to mortality after stocking efforts.

ppt: Parts per thousand.

PFRC: Potomac River Fisheries Commission

Recruitment: A measure of the number of fish entering a class during some period of time. Recruitment may be to a spawning class, age class, or size class.

Recruitment overfishing: The rate of fishing above which recruitment to the fishable stock is reduced. Recruitment overfishing is characterized by a reduced spawning stock and generally very low production of young year after year.

SAV: Submerged Aquatic Vegetation. Also called grass beds.

Spawning stock: All females that survive natural and fishing mortality to reproduce.

Spawning Stock Biomass (SSB): SSB is the weight of all (mature) adult females in the population, calculated as the number of individual females in each year-class times the percent that are mature times their average weight (The total weight of female fish in a stock that are old enough to spawn).

Stock: A grouping of fish usually based on genetic relationship, geographic distribution and movement patterns. A region may have more than one stock of a species.

Supraorbital: The region directly above the eye.

Total mortality (Z): A measure of the rate of mortality over time due to natural causes and removal by the fishery. Natural mortality plus fishing mortality, equals total mortality (M+F=Z). The measurement is an instantaneous rate and is calculated as the natural log of the ratio of the number of deaths in a given time to the total number of fish alive during that time.

VSWFT: Virginia Saltwater Fishing Tournament.

Virtual Population Analysis (VPA): Utilizes catches from a given year class and fishing mortality rate to back-calculate the total number of fish that were alive before removal by the fishery.

VMRC: Virginia Marine Resources Commission

Yield-per-recruit (YPR): The theoretical yield that would be expected from a group of fish of one year class if harvested at a constant and specified level over the lifespan of the fish.

APPENDIX D

FISHERY MANAGEMENT PLAN WORKGROUP MEMBERS

The *1998 Chesapeake Bay and Atlantic Coast Tautog Fishery Management Plan* was developed under the direction of the Fisheries Management Plan (FMP) Workgroup, of the Living Resources Subcommittee, Chesapeake Bay Program. Habitat recommendations were developed by the Submerged Aquatic Vegetation (SAV) Workgroup, Aquatic Reef Habitat Workgroup, and the Habitat Objectives/Restoration Workgroup, all of the Living Resources Subcommittee.

FMP Workgroup Members

Robert Bachman - Co-Chair - Maryland Department of Natural Resources (MDNR)
Jack Travelstead - Co-Chair, Virginia Marine Resources Commission (VMRC)
Nancy Butowski, Assistant Chair - MD DNR

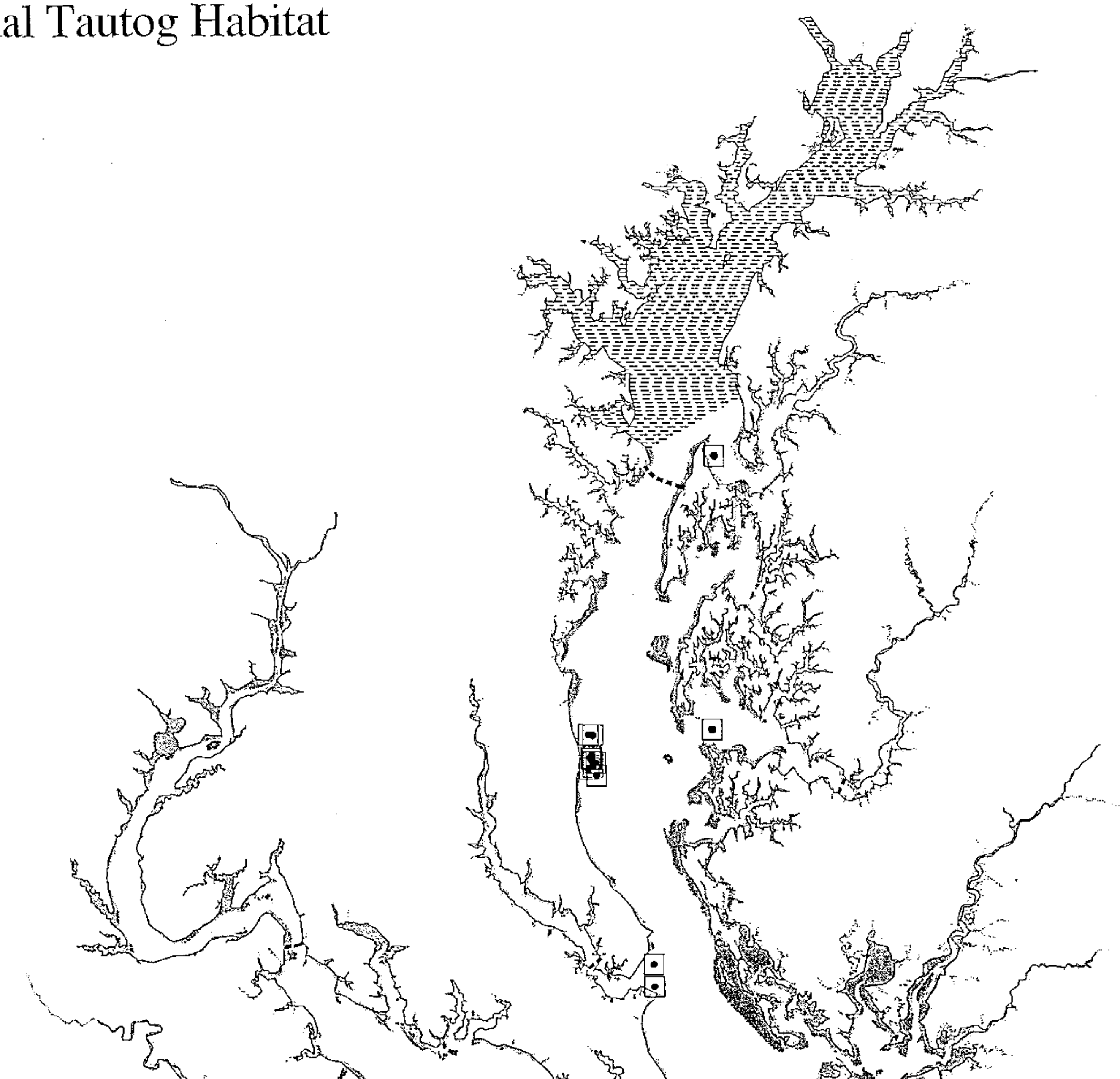
Dave Blazer - Chesapeake Bay Commission
Ernie Bowden - VMRC Finfish Subcommittee
K. A. Carpenter - Potomac River Fisheries Commission
Ellen Cosby - VMRC
James Drummond - Citizen Representative
Jeffrey S. Eutsler - MD Waterman
William Goldsborough - Chesapeake Bay Foundation
Anne Henderson-Arzapalo - Leetown Science Center
Rick Hoopes - Pennsylvania Fish & Boat Commission
Edward Houde - Chesapeake Biological Laboratory
Roman Jesien - University of MD, Horn Point Environmental Laboratory
Ron Klauda - MDNR
Andrew Loftus - Citizen's Advisory Committee
David Martin - MD Seafood Dealer
Robert Murphy - Alliance for the Chesapeake Bay
Richard Novotny - MD Saltwater Sportsmen's Association
Ed O'Brien - MD Charterboat Association
Derek Orner - National Oceanic & Atmospheric Administration (NOAA)
Ira Palmer - District of Columbia, DCRA
Larry Simns - MD Watermen's Association
Jorgen Skjeveland - US Fish & Wildlife Service
Lt. Col. Thomas Turner - MD DNR-Police
Lyle Varnell - Virginia Institute of Marine Science

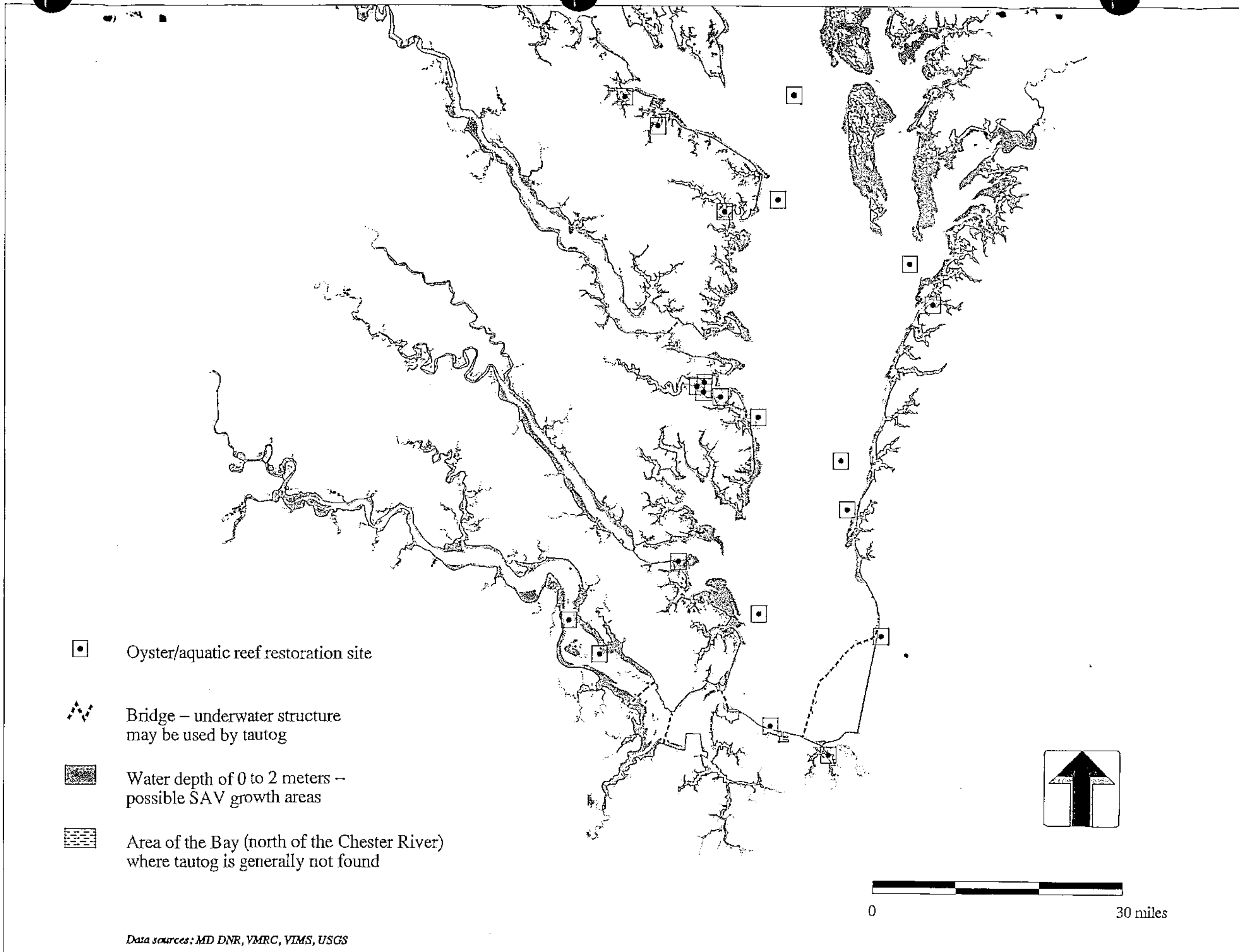
Staff to the Workgroup
Beverly Sauls - MDNR David Boyd - VMRC Mike Barnette - VMRC

APPENDIX E

POTENTIAL TAUTOG HABITAT

Potential Tautog Habitat




Oyster/aquatic reef restoration site
Bridge – underwater structure may be used by tautog
Water depth of 0 to 2 meters – possible SAV growth areas
Area of the Bay (north of the Chester River) where tautog is generally not found
0
30 miles
Data sources: MD DNR, VMRC, VIMS, USGS