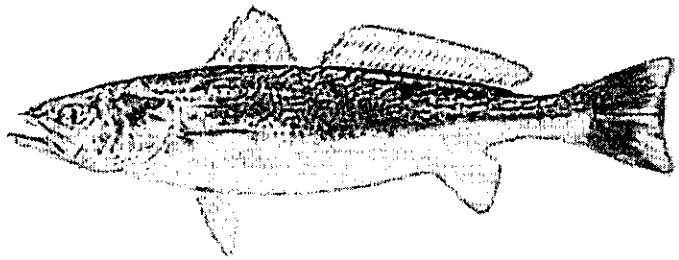
2003 Chesapeake Bay Program (CBP) Weakfish (*Cynoscion regalis*)Fishery Management Plan (FMP)



Prepared by the
Maryland Department of Natural Resources
Fisheries Service and the
Virginia Marine Resources Commission

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EXECUTIVE SUMMARY

The 1990 CBP Weakfish and Spotted Seatrout Fishery Management Plan (FMP) was revised because the stock status of Atlantic coast weakfish changed from overfished to fully exploited. The new 2003 Chesapeake Bay Program (CBP) Weakfish (Cynoscion regalis) FMP only addresses weakfish. Spotted seatrout (Cynoscion nebulosis) will continue to be managed under the 1990 CBP FMP. The goal of the 2003 CBP Weakfish FMP is to sustain and protect the reproductive capability of weakfish in the Chesapeake Bay, while maximizing the ecological, social, and economic benefits of the weakfish resource. The 2003 plan includes new biological and life history data such as preferred water quality conditions, spawning trends, fecundity analysis, growth estimates, and the temporal distribution of weakfish at specific life history stages in the Chesapeake Bay. Recent trends in commercial landings and recreational harvest from the Chesapeake region and the Atlantic Coast are summarized. Commercial landings of weakfish in the Chesapeake region have varied between 12% and 29% of Atlantic coast landings (1990-2001). Estimated recreational harvest of weakfish in the Chesapeake region has varied between 13% and 47% of the Atlantic coast harvest (1990-2001).

The coastal weakfish stock is rebounding from a period of low abundance. Weakfish spawning stock biomass (SSB) has been increasing since the early 1990s. In addition to higher levels of abundance, the age and size structure of the stock is expanding. The estimated number of age 6+ weakfish has increased from 0.3% (1990) to 6.8% (2001). Fishing mortality has decreased to 0.12 and is below the target exploitation rate of F=0.31. The CBP jurisdictions will continue to regulate the commercial and recreational fishery based on the most recent stock assessment and adopted biological reference points (BRPs). Management strategies take into consideration a full range of data including biological, ecological, socioeconomic, and fishery statistics.

Habitat preferences are linked to seasonal movements of weakfish entering and leaving the Bay; variable environmental conditions such as salinity; and biological characteristics such as the abundance and diversity of prey. As a result, weakfish abundance varies seasonally and can be widely distributed throughout the demersal and pelagic regions of the Bay. Spawning has been documented from near shore areas at the mouth of the Chesapeake Bay, north to the Maryland /Virginia border. Young of the year (YOY) and juveniles typically use the lower portions of the tributaries as nursery areas. Adults use the Bay for spawning and feeding. Weakfish are top predators in the Chesapeake Bay food web and occupy an ecological niche similar to other predatory fish. All life history stages utilize open water and key forage species generally inhabit open water or the epibenthos. Key forage species for Chesapeake Bay weakfish include bay anchovies, Atlantic menhaden, Atlantic croaker, silverside minnows and spot. Weakfish increase their dependency on benthic forage species from 10% at age 0 to 50% by age 2.

CBP jurisdictions will monitor and regulate activities that may contribute to the degradation and/or loss of weakfish habitat. Important forage species will also be monitored. If fishing activities are contributing to a higher F on forage species, additional management measures may be necessary. CBP jurisdictions will continue to identify predator/prey interactions and other interactions that may affect the abundance of weakfish. As multi-species interactions are evaluated and quantified, BRPs and subsequent management strategies may be adjusted.

INTRODUCTION

Weakfish (*Cynoscion regalis*), members of the family Sciaenidae, or drum fishes, are common along the western Atlantic coast between Rhode Island and North Carolina. Historically, spotted seatrout (*Cynoscion nebulosus*) and weakfish have been managed under the 1990 Chesapeake Bay Program (CBP) Weakfish and Spotted Seatrout Fishery Management Plan (FMP). The 1990 CBP Weakfish and Spotted Seatrout FMP utilized the guidelines developed by the Atlantic States Marine Fisheries Commission (ASMFC) for spotted seatrout in 1984 and for weakfish in 1985.

The 2002 CBP FMP will only address weakfish stocks because there is insufficient data available on spotted seatrout stock abundance, spawning stock biomass, recruitment, mortality, age structure, food preferences and habitat to develop additional management measures. The recreational and commercial harvest of spotted seatrout in Chesapeake Bay jurisdictions is minimal compared with that of weakfish and will continue to be managed under the 1990 plan.

WEAKFISH MANAGEMENT

The source documents for this plan, CBP (1990), ASMFC (2002), Chittenden et al. (1996), outline the history, management strategy, and stock status of Chesapeake Bay and Atlantic coastal weakfish and contain recent research on age determination methods, life history, growth and reproduction of weakfish in the Chesapeake Bay. Management strategies have been defined and grouped into specific categories and serve as the basis for delineating goals and objectives of the CBP Weakfish FMP. Management strategies and actions will be implemented by CBP jurisdictions to protect weakfish within the Chesapeake Bay and its tributaries. Existing regulations managing the exploitation of weakfish, will continue to be enforced except where otherwise noted by the FMP.

Goals and Objectives

The goal of this plan is to sustain weakfish stocks in the Chesapeake Bay and its tributaries and throughout the Atlantic coast. Sustaining weakfish resources will result in protecting and maximizing long-term ecological, social and economic benefits. In order to achieve this goal, the following objectives must be met:

1) Follow the guidelines set forth by ASMFC for coastwide management of weakfish and insure conservation equivalency in CBP regulatory actions.
2) Establish biological reference points that will maintain weakfish spawning stock biomass (SSB) at a size, which minimizes recruitment failure.
3) Manage fishing mortality (F) to allow the age structure of the stock to expand.
4) Promote the fair allocation of allowable harvest among various components of the fishery.
5) Improve the collection of catch data and standardize effort statistics in the weakfish fisheries.
6) Promote the cooperative inter-jurisdictional collection of economic, social and biological data to monitor and assess efforts to reach the primary goal of the CBP weakfish FMP.

7) Continue to protect water quality and weakfish habitat.
8) Investigate the multispecies linkages and ecological relationships between weakfish, striped bass, bluefish and Atlantic menhaden.

SECTION 1. BACKGROUND

Life History

Weakfish are also commonly called squeteague, gray seatrout, drummer or shad trout. Weakfish range along the Atlantic coast from Massachusetts to Florida, and sometimes as far north as Nova Scotia and as far south as the Gulf of Mexico. Sciaenid fishes are known for producing a drumming or croaking sound. The males can produce the "drumming" sound made by contracting special muscles around the swim bladder (Bigelow and Schroeder 1953). This drumming or "purring" sound can be utilized to map spawning areas with passive listening devices such as hydrophones (Luczkovich et al in prep). Weakfish sounds have been distinguished between other soniferous fishes by spectrograph analysis of mating calls of captive fish (Fish and Mowbray 1970; Connaughton and Taylor 1996; Luczkovich et al.1999).

Weakfish are found in salinities from 6 to 32 ppt and in temperatures ranging from 9 to 30°C (49 to 87° F). The presence of more than one weakfish stock along the Atlantic coast was suggested by several investigators, based on morphometric and meristic characteristics, and growth rates (Nesbit 1954; Perlmutter et al. 1956; Shepherd and Grimes 1983). In general, northern weakfish live longer (up to 11 years) and grow larger than southern weakfish (Stagg 1985). However, genetic investigations have indicated the northern and southern populations are genetically homogeneous (Crawford et al. 1988). Comparisons of morphometric and mitochondrial DNA analyses (Scoles, 1990a and McDowell et al. 1990) on each fish have shown that a single genetic stock exists with north (New York) and south (Carolinas) morphometric differences. As a result, an ASMFC workshop (1990) recognized the Atlantic coast weakfish population as a single stock. More recently, tagging and recapture studies (reviewed by Graves et al. 1992), provide additional support for differences between northern and southern populations. Thorrold and others (1998) suggest that distinct weakfish populations may exist within the Chesapeake Bay, as demonstrated by differences in otolith chemical signatures of juvenile weakfish sampled from three different tributaries. Consequently, these signatures may be used as natural markers of natal spawning areas of juvenile fish.

Adults migrate northward and inshore to estuaries, bays, and sounds during the spring to feed and to spawn. Comparisons of length frequencies by month, from adults entering the Chesapeake Bay in early spring, show that age 2 and age 3 fish arrive at least one month ahead of age 1(Massmann 1963). Age and growth studies of weakfish in the Chesapeake Bay region confirmed this trend, citing the presence of age 4 and older weakfish occurring in large numbers in the spring. Fish older than age 4, only comprised 8% of the catch in later months (Lowerre-Barbieri et al., 1995). After spawning, the adults may remain inshore or return to the ocean. It appears that a greater proportion of adults return to ocean waters and remain there all summer (Mercer 1983). When water temperatures begin to decrease in the fall, adults begin to migrate south and offshore. Most of the Atlantic coast stock overwinters off the coast of North Carolina (Lowerre-Barbieri et al. 1998). Weakfish migration does not appear to be a discrete movement from one area to another, but rather one with a shifting population center (Richards 1965).

Spawning occurs in near-shore and estuarine waters along the coast from March through October, with peak occurrence during late April through June (Mercer 1983). In the Chesapeake

Bay, weakfish spawn between May and August (Lowerre-Barbieri 1996a). During this period, weakfish spawned every 24 hours at dusk (Lowerre-Barbieri 1996b) In 1991, Goshorn and Epifano reported that when weakfish gametes were stripped into a bucket of seawater, fertilization occurred only between 1800 and 2100 hours. Fertilized eggs have been collected from a range of water temperatures, (17 to 25 °C or 62 to 79 °F), and salinities of 12 and 31ppt. Laboratory spawning and larval studies on the viability of weakfish eggs, have reported reduced hatching success due to sudden changes in temperature, salinity, turbulence, and dissolved oxygen levels below 4.3 mg/l (Harmic 1958).

Larval abundance has varied significantly in the Chesapeake Bay over the past 40 years. Larvae were scarce in the Chesapeake Bay during the 1960's (Joseph 1972), but were second in abundance only to the bay anchovy, *Anchoa mitchilli*, during 1971-1973 (Olney 1983). Peak larval abundance in the Chesapeake Bay usually occurs during late summer.

Weakfish larvae are generally distributed throughout the lower Bay with the highest densities near the Bay mouth, and along the eastern Bay margin (Olney 1983), although the center of distribution can vary annually, with high larval densities occurring in the upper portion of the main stem of the Bay, as demonstrated by the Midwater Trawl Survey (1995-1999) of the Trophic Interactions Estuarine Systems (TIES) component of the Chesapeake Bay Land Margin Ecosystem Research Project. The lower Chesapeake Bay appears to be an important nursery site for larval and juvenile weakfish including Virginia's seaside estuaries (Cowan and Birdsong 1985). Larvae prefer low salinity waters and probably use the net up-estuary movement of deep water in the main channel to reach lower salinity areas (Thomas 1971). Larvae become demersal at 8 mm TL (0. 3 inches) and growth is rapid during the first year reaching an average length of approximately 170 mm TL (6.7 inches).

Juvenile weakfish are euryhaline, capable of withstanding a broad range of salinities. They are found in low salinity waters throughout the summer and move to high salinity waters in the fall (Raney and Massmann 1953; Gunter and Hall 1963; Thomas 1971). Peak abundance of juvenile weakfish in the Maryland portion of the Chesapeake Bay occurs during August and September and in the Virginia portion of the Bay during September and October (Hornick et al. 1988). The northern distribution of juvenile weakfish in the Bay is affected by salinity. Abnormally dry summers, accompanied by higher salinities, allow a more northerly distribution. The largest concentrations of juvenile weakfish in the Bay usually occur south of the Choptank River. Juvenile weakfish usually leave the estuary and Bay areas by December (Hildebrand and Schroeder 1928; Massmann et al. 1958; Thomas 1971; and Chao and Musick 1977).

Young-of-the-year and yearling weakfish feed primarily on planktonic crustaceans and small fish (Chao and Musick 1977). Adult weakfish are top carnivores in the Chesapeake Bay and have similar food habits to bluefish and striped bass (Hartman and Brandt 1995). Behavioral observations suggest that weakfish forage along eelgrass beds eating blue crabs and spot (ASMFC 2002). Food habits appear to differ among estuarine areas. Age composition and growth rates have been estimated from scales, otoliths (ear bones) and vertebrae. Length frequencies vary from one investigator to another, season to season, year to year, and area to area (Mercer 1983). Growth differences between areas have been used as evidence for subpopulations (Shepherd and Grimes 1983).

It appears that weakfish sex ratios in estuarine waters are skewed toward females. A ratio of 3:1, female to male, ratio was observed in weakfish collected by two different geartypes within waters of the Chesapeake Bay (Lowerre-Barbieri 1996a). Female weakfish are slightly larger than males, especially after reaching age 2 and usually live longer. In southern populations, male weakfish reach sexual maturity at a smaller size than female weakfish. The length at which 50

percent of the fish are classified as having mature ovaries or testes is considered the size at which sexual maturity is attained. For southern males (North Carolina), sexual maturity is reached between 130 and 150 mm SL (5 to 6 inches) and for females between 145 mm and 190 mm SL (5.7 to 7.5 inches). Weakfish males and females probably reach sexual maturity by age 1 throughout their geographic range, with 100 percent maturity by age 2 (Merriner 1973). Adult weakfish may live up to 17+ years (Lowerre-Barbieri et al. 1995). Weakfish mature at age 1 in the Chesapeake Bay. Age 1 and age 2 fish were the only groups that did not have overlapping size distributions (Lowerre - Barbieri et al. 1995). Weakfish in the Chesapeake Bay region are multiple spawners with indeterminate fecundity throughout their range (Lowerre-Barbieri et al 1996).

Biological Profile

Natural mortality rate:	The current estimated natural mortality rate for Atlantic coast weakfish (M) is 0.25, based on a terminal age of 12 years.
Fecundity:	Weakfish are multiple spawners with indeterminate fecundity.
Age/size at maturity:	In southern populations, males reach maturity when approximately 1 year old or 5-6 inches (130-150 mm) standard length (SL), while females are slightly larger 5.7-7.5 inches, (145 – 190 mm SL) before attaining sexual maturity. In northern populations, size at maturity is similar for both sexes at about 254 mm (10 inches)TL. In the Chesapeake Bay, most age 1 fish (90%), and all age 2 fish are mature (Lowerre - Barbieri 1996a). Estimated mean length at maturity for females was 170 mm TL and 164mm TL for males in the Chesapeake Bay (Lowerre – Barbieri). Adult weakfish exhibit significant variability in size at age, therefore, size is a poor predictor of age (Lowerre–Barbieri et al., 1995).
Longevity:	A maximum age of 17 years was recorded from a weakfish caught in 1985. Maximum observed age in the Chesapeake Bay was age 12. Although it has been suggested that weakfish growth varies geographically, it is unclear whether these differences are due to different population segments (Nesbit, 1954; Perlmutter et al.,1956); or to different migration patterns (Vaughan et al., 1991, as cited in Lowerre-Barbieri, 1995). In a Chesapeake Bay regional study, most fish were 200-600 mm TL (total length) and ages 1-4 years, respectively.

Spawning and
Larval Development

Spawning season:	March through October, with peaks in May and June. In the Chesapeake Bay, fish generally spawn from May through August, but varies annually. (Lowerre-Barbieri et al., 1996b)
Spawning area:	The spawning area ranges from the Chesapeake Bay to Montauk, Long Island, New York. Weakfish spawn as far north as Maryland/Virginia border within the Chesapeake Bay (Lowerre-Barbieri et al. 1996a)
Location:	Spawning occurs within large estuaries in deeper waters or inlets, sheltered coves and river mouths, spawning also occurs outside estuaries in the nearshore coastal ocean and intercontinental shelf.
Salinity:	Larvae have been collected in salinities from 12 – 31 ppt
Temperature:	From 53 to 75° F (21 to 28° C).
Dissolved oxygen:	Minimum, probably (5mg/l).

Young-of-year

Location:	Move from high salinity to low salinity areas; abundant in deeper water from August-December.
Salinity:	Euryhaline, 0-31ppt.
Temperature:	12 to 29 °C

Sub-adults and Adults

Location:	Estuarine and ocean waters.
Salinity:	From 6 to 32 ppt.
Temperature:	From 49 to 90° F (9 to 32° C).

The Fishery

Commercial landings in Maryland increased from 70,000 lbs. in 1995 to 250,000 lbs. in 1999, but have recently demonstrated a downward trend of 210,000 lbs. in 2000, decreasing to 153,884 lbs in 2001 and falling to approximately 44,000 lbs in 2002(Figure 1). Virginia commercial

landings increased from 500,000 lbs. in 1992, to almost 1,900,00 lbs. in 1998 and decreased to 1,400,000 lbs. in 2000 and less than 1,200,000 lbs in 2001. Commercial landings for Virginia from 2002 are currently not available, as of March 2003. Commercial landings of weakfish in the Chesapeake Region (Total landings from Maryland and Virginia combined) have varied between 22% and 29% of Atlantic coastal landings during 1995 through 2001(Figure 2).

Most of the Atlantic harvest of weakfish takes place during the stock's annual northern (spring) and southern (fall) migration, along the Mid-Atlantic coast. Historical records of the commercial fishery extend back to the late 1800's (Mercer 1983). Early records indicate high weakfish abundance at the turn of the century. During the early 1940's, commercial weakfish landings began to escalate. A record level of approximately 41,500,000 lbs. was reached in 1945. After this historic peak, weakfish landings began to decline, with very low levels being recorded throughout the 1960's. An increasing trend did not begin until the early 1970's and continued until the second largest peak in commercial landings was recorded in 1980 (35,000,000 lbs.). After 1980, Atlantic coast landings, fluctuated between 26,000,000 lbs. in 1981 and 9,500,000 lbs. in 1990. Weakfish landings continued on a downward trend until 1995, with landings decreasing from approximately 9,000,000 lbs. in 1991 to 6,000,000 lbs. in 1994. Atlantic coast commercial landings increased from 7,000,000 lbs. to 8,000,000 lbs. between 1995 and 1998, and decreased to 5,000,000 lbs. in 2001. The increase in commercial landings, beginning in 1995 could be partially attributed to Amendment 2 of the ASMFC/MAFMC Weakfish FMP, that was adopted in the fall of 1994, which contained measures to reduce exploitation and reduce weakfish bycatch.

The total estimated state recreational harvest of weakfish in Maryland tidal waters, coastal bays and ocean declined from 2,000,000 lbs. in 1979 to less than 500,000 lbs. in 1980 (Williams et al.1982). During the early 1980's, the estimated recreational harvest fluctuated between approximately 200,000 lbs. in 1984 and 2,400,000 lbs. in 1986 (MRFSS). During the past decade, Maryland recreational harvest has fluctuated between 100,000 lbs. in 1992 and 680,000 lbs. in 2000 (Figure 3.). From 1995 to 2000 recreational harvest in Maryland increased from 140,000 lbs. to 680,000 lbs. in 2000. Recreational harvest in Maryland decreased to approximately 570,000 lbs in 2001.

Catch rates from a recreational fishing survey of Virginia's eastern shore (1955 –1962) indicated peak abundance during 1955 (Richards 1965). Catch rates declined to a low in 1958 and increased through 1962. From the MRFSS data, the estimated Virginia recreational harvest peaked in 1981 at approximately 9,500,000 lbs. and was followed by a decline to 500,000 lbs. (1985)(Figure 3). The harvest rebounded for a few years (2,000,000 lbs. in 1986 and 1,800,000 lbs. in 1988) and then dropped to 250,000 lbs. (1990. Estimated recreational harvest in Virginia remained below 280,000 lbs. until 1997. Since 1997, recreational harvest has varied between a low of 370,000 lbs. (2001) and 830,000 lbs. (1998).

Historical records of the Atlantic coast recreational fishery are incomplete. Based on a limited number of salt water angling surveys, weakfish catches were low in the 1960's and increased in 1970's. Along the coast, the number of anglers in the recreational fishery doubled between 1960 and 1970, with the estimated recreational catch exceeding commercial landings in 1970, 1975 and 1979 (Mercer 1983). The National Marine Fisheries Service's (NMFS) Marine Recreational Fisheries Statistics Survey (MRFSS) database began in 1981. Estimated recreational harvest from the Atlantic coast has fluctuated between a low of 1,000,000 lbs. (1993) and a high of 16,000,000 lbs. (1981) for the period between 1981 and 2000(Figure 4). There was a continuous decreasing trend in estimated recreational harvest between 1986 and 1990(Figure 4). Estimated harvest increased four fold between 1993 and 1998, rising from 1,000,000 lbs. in 1991 to more than 4,000,000 lbs. in 1998. Subsequently, coastal recreational harvest has decreased each year between

1999 and 2001. It is important to remember, that management measures implemented in 1991, and 1994, affected Atlantic coast commercial landings and recreational harvest of weakfish.

Economic Perspective

Commercial dockside values for weakfish in Maryland averaged $0.69/lb. between 1988 and 2001and Virginia dockside values for weakfish averaged $0.71/lb. for the same period. Maryland dockside values ranged between a minimum of $0.39/lb. in 1988 and a maximum of $0.93/lb in 1994 (Figure 5). Virginia dockside values ranged between a minimum of $0.30/lb. in 1998 and a maximum of $0.94/lb. in 1996 (Figure 6.). The number of Maryland commercial fisherman reporting catches of weakfish between 1980 and 2001 varied between 187 (1980) and 53 (1997).

Dockside values for Mid-Atlantic weakfish appear to have an inverse relationship with supply. A possible reason for the evolution of this dilemma may be the inconsistent supply of weakfish reaching the marketplace, especially during the first half of the 1990's (National Fisherman 1999). Consequently, consumers selected alternatives to weakfish at the marketplace when it was not available on a regular basis. Weakfish have yet to regain their historical niche in the market place.

Research and Monitoring

Research and monitoring are important tools in assessing the health of weakfish stock within the Chesapeake Bay. Maryland and Virginia conduct several surveys, using multiple gear types, to obtain biological data, which is also utilized in the coastal assessment of the stock.

Research and Monitoring - Maryland

The Maryland DNR Fisheries Service has monitored ocean and coastal bay fish stocks since 1972. Monitoring efforts help to assess fish stocks by (1) estimating trends in abundance, age structure and biological characteristics and (2) identifying habitat necessary for spawning, survival and growth.

Atlantic Ocean and Coastal Bay Trawl Survey

Juvenile Trawl Survey

Monthly trawls are conducted at 20 fixed sites, between April and October, within Maryland's coastal bays. All of the weakfish caught by the trawl were young-of-the-year (YOY) fish. During the 2000 survey, weakfish abundance continued to be above average. Weakfish were most abundant in Assawoman Bay from July through October (Casey et al., 2000). The 2000 trawl index for weakfish ranked 9th out of 29 years of the survey. Juvenile weakfish were the most abundant species captured in inshore trawl samples during 1999 and the second most abundant species captured in 1995 and 1998 (Casey et al.1999).

Seine Survey

Seining is conducted twice a year at 19 fixed sites in June and September, from beach areas along the perimeter of Maryland's coastal bays and tributaries. Statistically insignificant catches of weakfish have been made at seven seine sites between 1996 and 2000 (Casey et al., 2000). However, it is important to note that seining is not an optimal method for sampling juvenile weakfish. They are normally found several hundred yards offshore and usually swim too fast to be captured in a beach seine (Casey, pers. comm.).

Commercial Offshore Trawl Survey

Maryland has been sampling weakfish caught by commercial trawlers since 1994. This sampling provides data on size, age, and sex composition. Since 1995, otoliths removed from unsorted commercial weakfish have been used for age determination. The mean age for females was 3.0 years and the mean age for males was 3.5 years. The maximum age for females and males was 7 years and 6 years, respectively. The mean age of collected weakfish from commercial trawlers has been increasing since 1994 (Casey et al. 2000).

Maryland's Chesapeake Bay

Commercial Pound Net Survey

Maryland has been sampling commercial pound nets, between June and September, from the middle and lower Chesapeake Bay since 1993. Biological data is collected from weakfish, summer flounder, bluefish, Atlantic croaker and spot. Weakfish have been common in Maryland's Summer Pound Net Survey over the past several years. There has been an increasing trend in mean length of weakfish since 1993 (Sadzinski et al.1999). A sub-sample of the commercial pound net catch was purchased in 2000 to determine sex, weight and age of the fish. Results from 1993 through 1998, indicated the number of size classes for weakfish was truncated. Since 1999 and 2000, There have been increasing numbers of weakfish greater than 380mm (Sadzinski et al., 2000), This suggests that recruitment is increasing, and may account for a decrease in modal length from 330mm (1998) to 310mm (1999 and 2000). The 2000 Commercial Pound Net Survey sample included the largest average weakfish length (361 mm) since the study began in 1993.

Summer Headboat Survey

A recreational headboat creel survey was conducted once a month between June and September, in the Tangier/Pocomoke Sound region during 2000. The survey targeted Atlantic croaker, spot, and weakfish. Only a small fraction (10%) of headboat anglers were targeting weakfish. Weakfish accounted for approximately 12% of the combined catch and harvest. The 2000 catch and harvest reflected a 2% increase from the previous year.

Blue Crab Summer Trawl Survey

The Blue Crab Summer Trawl Survey began in 1977. Six areas of the Chesapeake Bay are sampled one day each month, from May through October and include the Chester, Eastern Bay, Tangier, Choptank, Pocomoke and Patuxent rivers. Data from the Tangier and Pocomoke Sound

region was utilized because weakfish were consistently found in these areas. Despite the fact that a slight decline in the juvenile index was demonstrated in 2000, juvenile weakfish abundance in both Pocomoke and Tangier sounds has increased exponentially since 1980 (MD DNR 2001).

Research and Monitoring - Virginia

Virginia Institute of Marine Science (VIMS) Trawl Survey

The VIMS trawl Survey began in 1955. Sixty stations within the Virginia portion of the Chesapeake Bay and its tributaries are sampled each month of the year in the survey. Sampling sites range from the mouth of the Chesapeake Bay to the tidewater limit of the James, York, and Rappahannock Rivers. Data is reported by tributary and combined tributary/bay locations.

The Chesapeake Bay Tributary Survey results indicate fluctuations of juvenile weakfish abundance between 1979 and 2001. During this period, weakfish abundance varied more than six fold between a low of 6.1 (1981 and 1984) and a high of 37.0 (1985). Weakfish abundance decreased from approximately 11.0 (2000 and 2001) to 8.6 (2002).

The Combined Chesapeake Bay and Tributary Survey also indicate fluctuations in weakfish abundance between 1988 and 2001. In this survey, juvenile weakfish abundance varied between five- and six-fold, 2.7 (1994) and 12.2 (1989). Weakfish abundance was 9.4 in 2000, 5.1 in 2001 and 6.3 in 2002.

SECTION 2. FISHERY MANAGEMENT

Management of Coastal Weakfish Fishery

Weakfish have been an important component of the Atlantic coast fishery since the beginning of the twentieth century. Weakfish are managed in Federal waters (from 3 to 200 miles offshore) by the U.S. Department of Commerce and the Atlantic coast fishery management councils, which include the New England Fisheries Management Council (NEFMC), the Mid-Atlantic Fisheries Management Council (MAFMC), and the South Atlantic Fisheries Management Council (SAFMC). In state waters (from 3 miles inshore), weakfish are managed by the Atlantic States Marine Fisheries Commission (ASMFC) Management Board (MB), with advice from the Weakfish Technical Committee (TC), and the Weakfish Advisory Panel (AP). Weakfish are managed under the guidelines of the ASMFC as a single stock, throughout the Atlantic coastal range. All states are required to implement ASMFC compliance strategies. Failure to comply will result in the closure of the state's fishery.

The ASMFC Fishery Management Plan (FMP) for Weakfish was adopted in October 1985. Management strategies for Atlantic coast weakfish included delaying the harvest of weakfish until age 1 in states from Rhode Island to Virginia and implementing Bycatch Reduction Devices (BRD's) in the south Atlantic shrimp trawl fishery. The 1985 ASMFC weakfish FMP was reviewed and updated in 1988. The objective of the 1988 update was to collect and analyze new weakfish data. At this time, it had not been determined whether Atlantic coast weakfish were comprised of a single or multiple stocks. Recommendations included stock identification work, annual workshops to coordinate and assess pertinent stock and monitoring data, as well as continued collection of commercial and recreational weakfish landings.

Weakfish abundance continued to decline because member states did not fully comply with ASMFC harvest recommendations. As a result, ASMFC developed Amendment 1 in 1990 and

adopted it in October 1991. Amendment 1 acknowledged that weakfish bycatch in the southern shrimp trawl fishery contributed significantly to age 0 and age 1 mortality. Consequently, ASMFC recommendations in Amendment 1 fostered the development and use of BRDs in the south Atlantic shrimp trawl fishery to reduce weakfish mortality in this fishery.

Significant declines in landings of weakfish during the early 1980's were believed to be a result of the lack of a strong year class since 1978. Amendment 1 called for a target fishing mortality rate of $F_{20\%}$, (the rate of fishing that would maintain a spawning population at 20% of the unfished population). Adopting a target fishing mortality rate of $F_{20\%}$ would reduce annual, coastal mortality by 52% over the long term.

Legislation was passed in 1993, that would insure full compliance of ASMFC recommendations in Amendment 1 of the Weakfish FMP, by all of the Atlantic coastal states. The name of this legislation was the Coastal Fisheries Cooperative Management Act of 1993. This act endowed the Secretary of the U.S. Department of Commerce, with the ability to close fishing in state waters, if a state failed to comply with ASMFC recommendations.

In 1994, the weakfish stock from Maryland to North Carolina was overfished (Boreman and Seagraves 1994). To further reduce exploitation of weakfish in states with directed fisheries, Amendment 2 to ASMFC's weakfish fishery management plan was passed in October 1994. Specific management measures for commercial fisheries included minimum size limits and restrictions by gear type, to reduce exploitation by 25%, and achieve a 50% reduction of weakfish bycatch in southern shrimp trawl fisheries for the 1996 fishing year.

At the end of May 1996, Amendment 3 to the ASMFC's FMP was adopted. The objectives of Amendment 3 were developed to hasten stock recovery by (1) restoring a truncated age structure, (2) increasing spawning stock biomass (SSB), (3) continuing to reduce fishing mortality; and (4) stabilizing recruitment to the fishery. Stock restoration was to occur over a five-year period. A target fishing mortality rate of $F = 0.5$ (approximately 15% of the SSB of an unfished population) was set as a goal for the Atlantic coast weakfish stock by the year 2000. Identification and conservation of weakfish habitat, along with inter-jurisdictional enforcement of ASMFC recommendations, were cited as major goals of Amendment 3.

During December 1997, the 26th Annual Stock Assessment Workshop (SAW) convened in Woods Hole, Massachusetts. The SAW reviewed the status of Atlantic coast weakfish stock and found that: (1) abundance was increasing; (2) recruitment was above average;(3) age structure was expanding; (4) SSB had significantly increased; and, (5) fishing mortality was decreasing. After examining these factors, the SAW concluded that the Atlantic coast weakfish stock was no longer over exploited but fully exploited.

In 1998, the Weakfish Fishery Management Review Team recommended that: (1) an assessment of Atlantic coast weakfish stock be conducted in 1999; (2) states continue to reduce fishing mortality; and, (3) adjust minimum size and creel limits to achieve a fishing mortality rate of $F = 0.76$ (between 10 and 15 % of the SSB of an unfished population) for both the commercial and recreational fisheries. The implementation of these objectives would increase the number of older/larger fish in the population.

The 1999 assessment of Atlantic coast weakfish stock reflected a high level of abundance and low fishing mortality rates. The virtual population analysis (VPA) of 1998 SSB was estimated at 40% of the unfished population. Biomass estimates in 1998, based on the biomass dynamic model, were 88% of the unfished stock. Fishing mortality is below the ASMFC target rate of 0.50. Significant stock rebuilding is occurring, but full age structure has yet to be restored.

In order to adopt a precautionary approach to weakfish management, biological reference points (BRPs) need to be defined. Generally, BRPs are defined according to two terms: a threshold

or the level at which a stock cannot sustain itself; and a target or a lower level of exploitation that would minimize the chance of reaching the threshold. Targets can be defined in a number of ways depending on the management goals. For example, targets may focus on maintaining a certain level of recruitment, a certain size of the spawning stock, or a certain yield from the fishery. BRPs, used as management targets and limits, were developed, following the general principles, of Caddy and McGarvey (1996) and helped to further refine the Atlantic coast fishery management strategy. The premise of this methodology, developed by Caddy and McGarvey, is to adopt a precautionary approach and set a safe fishery exploitation upper limit or overfishing threshold and then a lower level fishery exploitation target, which minimizes the chance of exceeding the overfishing threshold and collapse the stock. An extended survivors analysis (ESA), a type of VPA, was used in developing Amendment 2 and Amendment 3 to the Atlantic coast weakfish FMP.

In Amendment 3, a F = 0.5 was both a target rate and a threshold reference point. The TC did not believe an F = 0.5 would be adequate to restore the age structure of the Atlantic coast weakfish stock. The TC also believed this mortality rate was no longer appropriate as a target because it exceeded all SSB and yield per recruit reference points. Although weakfish stock abundance was high and fishing mortality was estimated at F = 0.26 (equivalent to approximately 41% of the stock's Maximum Spawning Potential (MSP)), the TC has recommended a target fishing mortality of $F_{30\%}$ and threshold of $F_{20\%}$. The target fishing mortality of $F_{30\%}$ is equivalent to an F = 0.32 and the threshold of $F_{20\%}$ is equivalent to an F = 0.5. The SSB threshold is equivalent to approximately 31,800,000 lbs. Fishing the stock at a level below 31,800,000 lbs. would begin to cause growth over fishing.

The most recent stock assessment (SARC 2000) indicated that stock biomass was high and that (F) was below the instantaneous target of (0.31) for the year 2000. Consequently, the MB developed a new Amendment 4 to keep (F) low to promote expansion in the size and age structure of the stock. Addendum I to Amendment 3, was approved by the MB in 2000, to continue the management measures of Amendment 3, until new BRPs were developed and Amendment 4 was adopted. Amendment 4 would also include a new reference period for the recreational fishery, because the reference period in Amendment 3 did not reflect the age and size structure of the weakfish stock fished at the target (F) over time.

The current recreational size and bag limits for weakfish may have a negative impact on existing stocks. States with directed weakfish fisheries could allocate weakfish resources between the commercial and recreational fisheries in a manner that decreases the negative impacts on local weakfish stocks. States could also monitor and regulate by catch in areas demonstrated to contain high densities of young fish. In addition, delineating essential fish habitat (EFH), habitat areas of particular concern (HAPC), and preventing weakfish habitat loss and degradation, would help protect existing habitat and areas that are responsible for the production of young fish.

Stock Status

The status of the Atlantic coast weakfish stock has continued to improve. Weakfish are at high levels of abundance (SARC 2000). The effects of Amendment 3 have been positive. Age and size/structure have expanded, but have not reached historical levels of cohort diversity. The estimated number of weakfish age 6+ fish was only 0.3% in 1990 and has increased to 6.8% in 2001 (ASMFC). Current fishing mortality rates have contributed to increases in older fish in the coastal stock. Fishing mortality (F) has decreased and was estimated at 0.12 in 2000 (ASMFC). SSB has increased (approximately 110,000,000 lbs.) and is above the SSB threshold of 31,800,000 lbs. (ASMFC 2000).

Currently, weakfish resources are managed under Amendment #4 to the Interstate Fishery Management Plan for Weakfish (November 2002). The ASMFC Technical Committee defined the following BRPs for the Atlantic coast weakfish stock: a target F = 0.31; a threshold F = 0.5; and a spawning stock biomass (SSB) = 20% or 31,800,000 lbs. The biological reference points are subject to change as more data is collected and included in the analyses. New BRPs reflect the most current status of the stock and management actions adjusted as necessary. As data becomes available from multispecies modeling results, the biological reference points may need to be updated.

Stock Status - Management Strategy 1.1

The jurisdictions will adopt BRPs that reflect the most current status of the weakfish stock. As data becomes available on multispecies interactions and ecological functions such as species interactions, food webs, bycatch, biodiversity and habitat, the BRPs may be modified accordingly.

Action 1.1
Maryland, PRFC, and Virginia will adopt the ASMFC recommendations for the coastwide management of weakfish.

Implementation 1.1
Annually reviewed and adjusted if necessary.

Action 1.2
In order to achieve the fishing target rates defined by the adopted BRPs, CBP jurisdictions will utilize a combination of size limits, possession limits, and/or seasons or areas to manage the commercial and recreational fisheries in state waters.

Implementation 1.2
Annually

The Fishery

Weakfish have been an important component of both the commercial and recreational fisheries of the Chesapeake Bay region. Historically, the mid-Atlantic region and the Chesapeake Bay have accounted for the majority of reported weakfish landings from along the coast. The bycatch of small weakfish in other fisheries, especially the South Atlantic shrimp fishery, has been documented. The requirement of bycatch reduction devices (BRDs) has significantly reduced the bycatch problem. It is believed that the use of these devices was one of the main reasons the weakfish stock began rebuilding so quickly. Bycatch losses, however, continue to contribute to weakfish mortality and must be considered when developing management recommendations.

The Fishery - Management Strategy

The CBP jurisdictions will regulate the commercial and recreational fishery based on the most recent status of the stock and the established fishing targets (Actions 1.1 & 1.2).

Action 2.1
The CBP jurisdictions will consider regional differences when determining state allocation issues and regulations.

Implementation 2.1
As necessary

Action 2.2
The CBP jurisdictions will consider the economic impacts of management measures on the fishery and promote the utilization of economic data in the management decision process.

Implementation 2.2
Dependent on the availability of economic data

Action 2.3
The CBP jurisdictions continue to support the use of BRDs in non-directed fisheries and the appropriate mesh sizes in directed fisheries, to reduce the fishing mortality on small weakfish.

Implementation 2.3
Annually

The Fishery - Research and Monitoring

Developing appropriate management recommendations for the weakfish stock is dependent on comprehensive biological, ecological, socioeconomic and fishery data. Chesapeake Bay weakfish monitoring results are an important component to the coastwide assessment of the weakfish stock. Recreational and commercial fishery statistics provide important information on harvest.

The Fishery - Research and Monitoring Strategy 3.1

The CBP jurisdictions will continue to monitor the biological characteristics of the weakfish stock in the Chesapeake Bay and coordinate monitoring activities within the Bay and the Atlantic coast.

Action 3.1
The CBP jurisdictions will continue fishery dependent sampling and improve catch data. Economic information from the recreational and commercial fisheries will also be reviewed.

Implementation 3.1
Continue

Action 3.2
The CBP jurisdictions will conduct fishery independent sampling and collect data on abundance, age structure and recruitment.

Implementation 3.2
Continue

Action 3.3
CBP jurisdictions will continue to coordinate state activities with the Atlantic Coast Cooperative Statistics Program (ACCSP).

Implementation 3.3
Continue

Action 3.4
CBP jurisdictions will begin to collect and examine stomach contents data and examine the effects of environmental variables upon weakfish growth rates.

Implementation 3.4
Ongoing

SECTION 3. HABITAT ISSUES

The Chesapeake Bay, contains a diverse combination of habitat types that are utilized by weakfish during all of their life stages. Near shore areas, at the mouth of the Chesapeake Bay, have been cited as one of four "Priority Ocean Areas for Protection, in the Mid-Atlantic", by the Natural Resources Defense Council. Adults migrate into the Bay during the spring to spawn and some adults may enter the Bay to feed. Spawning has been documented from near shore areas at the mouth of the Chesapeake Bay, north to the Maryland/Virginia border. Young of the year (Y-O-Y) fish and juveniles use the Bay and lower portions of the tributaries as a nursery. Weakfish have been sampled throughout the entire length of the Bay (See Map I and Map II).

Habitat - Description

Habitat preferences for weakfish within the Chesapeake Bay are linked to (1) seasonal movements of weakfish entering and leaving the Bay; (2) variable environmental conditions, which delineate the range of movement of weakfish throughout the Bay and its tributaries; and (3) biological characteristics, such as the diversity and abundance of prey species, that can influence weakfish mortality, recruitment and year class strength.

Estuarine habitat requirements of direct benefit to weakfish are primarily water quality related because all life history stages exploit open water, and prey generally inhabit open water and/or epibenthos (Varnell, personal comm., 2001). Consequently, the improvement and protection of water quality within the Chesapeake Bay will provide direct and indirect benefits to the Bay's weakfish stock.

Weakfish abundance varies seasonally in the mainstem of the Chesapeake Bay and its tributaries as demonstrated by their presence in independent trawl surveys and seine surveys. Present information suggests that weakfish are widely distributed throughout the demersal and pelagic regions of the Chesapeake Bay. Exploitation of these regions further supports the idea that water quality is a key component of weakfish habitat.

It is important to note that estuarine habitats such as tidal marshes, SAV beds, and benthic substrates, which include oyster reefs, oyster shell bars and sand bars are not considered essential

habitat to a specific weakfish life history stage. Benthic substrates, however, provide shelter and serve as feeding grounds for species, that are important forage for weakfish, such as mysids, grass shrimp, anchovies (Table III), clupeid fishes, Atlantic croaker (*Micropogonias undulates*), Spot (*Leiostomus xanthurus*), and invertebrates, which include annelid worms, blue crabs (Callinectes sapidus) and clams.

Coastal states have been directed to identify and conserve weakfish habitat through ASMFC's Amendment #3 to the coastal weakfish FMP. Protecting weakfish habitat ensures the sustainability of the spawning stock that resides within state boundaries. States should: inventory historical habitats; identify habitats presently used; specify habitats targeted for recovery; and, impose or encourage measures to retain or increase the quantity and quality of weakfish essential habitats. States should also monitor, identify and regulate activities that have negative impacts on weakfish stocks, such as reducing bycatch in weakfish nursery areas.

Habitat - Spatial and Temporal Distribution

Spawning Adults

Spawning adults are found in the mainstem of the Chesapeake Bay between May and September and during May and June in the tidal portions of the Rappahannock, York, James and during August in these same rivers (Table IV).

Eggs

Weakfish eggs are abundant in the Chesapeake Bay during May and June and from August through September. They are common in the mainstem of the Bay in July and common in the tidal portions of the Rappahannock, York, and James rivers between May and September and are found rarely between May and September in the Tangier and Pocomoke Sounds.

Larvae

Weakfish larvae have been documented in the mainstem of the Bay in large abundance during May and June and in August and September. Larvae are common during May through August in the tidal portions of the Rappahannock, York, and James rivers and uncommon in the Tangier and Pocomoke Sounds during the same period.

Juveniles and Adults

Between May and September, juvenile and adult weakfish occupy the mainstem of the Chesapeake Bay, Chincoteague Bay, Tangier and Pocomoke Sounds and are also found in the tidal portions of the Chester, Choptank, Patuxent, Potomac, Rappahannock, York, and James rivers.

Habitat - Food Web Considerations

Weakfish are top predators in the Chesapeake Bay food web. They occupy an ecological niche similar to predator fishes such as striped bass (*Morone saxatilis*) and bluefish (*Pomatomus saltatrix*), although some studies (Chao and Musick 1977; Wilk 1979; Mercer 1983 as cited in Hartman and Brandt 1995) have specifically described weakfish as demersal predators often

associated with deep channel habitats. Weakfish have the ability to exploit a wide variety of prey species and estuarine habitats.

Hartman and Brandt (1995) observed seasonal and ontogenetic changes in Chesapeake Bay weakfish diets. In this study, the diets of weakfish were compared among seasons and age. Pelagic species dominated the diets of weakfish. The dominant forage fish utilized by weakfish were the bay anchovy (Anchoa mitchilli) and Atlantic menhaden (*Brevoortia tyrannus*), although weakfish cohorts utilized demersal prey species between May and June.

Although weakfish diets consisted mainly of pelagic fish, mysid shrimp comprised less than 14% of the diet age 0 (July-August) and age 1 (May-August) fish. More than 50% of the diet for age 0 and age 1 weakfish were bay anchovies. Weakfish foraging preferences then shifted from pelagic sources to benthic sources (Figure 6). Use of benthic food sources by weakfish increased from approximately 10% at age 0 to approximately 50% by age 2. Utilization of benthic forage species was highest between May and August.

Observed weight fluctuations of these predatory species were examined to determine how different types of forage species contributed to the growth of individuals. Hartman and Brandt (1995) found that weakfish appeared to grow rapidly during estuarine residency and that variation of weight at age for weakfish, diminished as age increased. This study also suggests that top piscivore production within the Chesapeake Bay depends on relatively few species such as bay anchovies, menhaden, Atlantic silversides, croaker and spot.

Habitat - Management Strategy 4.1

CBP jurisdictions will monitor and regulate activities, which may be harmful to weakfish habitat. These activities include the discharge of toxic pollutants and excessive nutrients into the Chesapeake Bay and its tributaries; interruption or changes in water discharge patterns; deposition of solid waste; sewage sludge or industrial waste (which may lead to anoxic conditions); rapid coastal development; unregulated agricultural practices; net coastal wetland loss; and the dredging of contaminated sub-aqueous soils. Activities which contribute to the degradation and/or loss of habitat that weakfish utilize throughout their life history stages, will also be monitored and regulated by CBP jurisdictions.

Action 4.1
CBP jurisdictions will monitor and regulate land-based activities and water-based activities that may negatively impact Chesapeake Bay water quality and weakfish spawning, rearing and foraging areas.

Implementation 4.1
Continue

Action 4.2
The CBP jurisdictions will monitor important weakfish forage species to insure that activities, such as directed fisheries or incidental bycatch in non-directed fisheries, do not adversely affect abundance. These managed species, which serve as forage for weakfish include Atlantic croaker, spot, Atlantic menhaden, and blue crab. If fishing activities are contributing to higher fishing mortality on these forage species, additional management measures may be necessary.

Implementation 4.2
Continue

Action 4.3
CBP jurisdictions will monitor the abundance of weakfish forage species that are not managed under CBP FMPs, such as bay anchovies and Atlantic silversides, using on-going monitoring and surveys.

Implementation 4.3
Continue

Action 4.4
CBP jurisdictions will continue to identify predator/prey interactions, both inter-and intra-species competition and other interactions that might effect the abundance of weakfish. As multispecies interactions are evaluated and quantified, biological reference points and management strategies may be adjusted.

Implementation 4.4
On-going

Table I. Weakfish minimum size limits and restrictions by gear type for Virginia's commercial fishery.

Gear Type	Minimum Size	Additional Restrictions
Pound Net	No minimum size	Closed season: May 1-22; Sep.13-31 No closed season if the number of Pound net/licensee is decreased (See VA regulations for clarification
Haul Seine	No minimum size	Closed season: April 1-15; June 11 - Aug20; Sep. 20-26; Oct.3-Mar 31
Gill Net	12"	Closed season: May4-Oct7;Dec18-Mar 31
Trawl	12	Closed season: Sep 26-Mar31 Minimum mesh size = 3"
Hook & Line	12"	4 fish/person/day/possession limit
Non-specified gear	9"	

Table II. Weakfish minimum size limits and restrictions by gear type for Maryland's commercial fishery.

Gear Type	Chesapeake Bay	Coastal (< 3 miles from shore)	Additional Restrictions 2002
Pound Net	Minimum size 12" Open season 8/9-9/30 *150 lb./day Bycatch allowed outside of open season*	N/A	N/A
Gill Net	Minimum size 12" Open season 3/18-4/24 & 9/2-11/27 [1]Revised mesh size *150 lb./day Bycatch allowed outside of open season*	Minimum size 12"	Atlantic Ocean Gill Net Open season 3/18-4/24 & 9/2-11/27,Closed Sat & Sun [1]Revised mesh size *150 lb./day Bycatch allowed outside of open season*
Trawl Net	No Trawling is allowed in the MD portion of the Chesapeake Bay	Minimum size 12"	Atlantic Ocean Trawl Net Open season 10/21-12/20 [2]Revised mesh size *150 lb./day Bycatch allowed outside of open season*
Hook & Line	Minimum size 12" Season closes 10/1 *No bycatch is allowed with this gear type*	Minimum size 12"	
Fyke Nets, Fish Pots	Minimum size 12" *150 lb./day Bycatch allowed outside of open season*	Minimum size 12"	
Unknown Gear	Minimum size 12"		

[1]**Revised mesh size** for the commercial gill net fishery is a stretch mesh size not less than 3 inches
[2]**Revised mesh size** for the commercial trawl net fishery is a mesh size not <3 $^3/_8$ sq. inches or 3 $^3/_4$ inche diamond stretched mesh size

Table III: Habitat Preferences of Weakfish in the Chesapeake Bay

Life Stage	Prey Type	**Limiting Environmental Factors**	**Seasonal Movements**	**Biological Characteristic: Prey Availability**	**Possible Structural Habitat**
Adults	Epibenthic Crustaceans, Small fish	Salinity, Temperature, Dissolved Oxygen	Enter the Bay during the spring to begin spawning. Some adults leave, others may remain and feed	Diversity of forage species, prey abundance	[1]SAVs Benthic Substrates
Juvenile/y-o-y	[2]Planktonic crustaceans and small fish	Dissolved Oxygen	[3]After hatching juveniles begin to migrate to low salinity waters for the summer and then move to higher salinity waters in the fall	prey abundance	Assorted habitat types which provide cover from predation
Eggs		Temperature, Salinity, Dissolved Oxygen Turbidity	Mouth and mainstem of the Bay during early summer	Sex ratios of weakfish in the Bay are skewed toward females	

[1]Submerged Aquatic Vegetation(SAV). Behavioral observations suggest that weakfish forage along eelgrass beds eating blue crab and spot. Food habits appear to vary among estuarine habitats.

[2](Chao and Musick 1977)

[3](Raney and Massman 1953; Gunter and Hall 1963; Thomas 1971)

Table IV. Presence of Weakfish Life History Stages in Chesapeake Bay and its Tributaries by Month												
Life Stage	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**
Eggs					*MD/ VA*	*MD/ VA*	*MD/ VA*	*MD/ VA*	*MD/ VA*	*MD/ VA*		
Larvae[1]					*MD/ VA*	*MD/ VA*	*VA*	*MD/ VA*	*MD/ VA*			
Juvenile[2]					*MD/ VA*	*MD/ VA*	*MD/ VA*	*MD/ VA*	*MD/ VA*			
Adult[3]			*MD/ VA*	*MD/ VA*	*MD/ VA*	*MD/ VA*	*MD/ VA*	*MD/ VA*	*MD/ VA*	*MD/ VA*	*MD/ VA*	

[1]**Larval Stage** – Weakfish larval stage extends from hatching until larvae reaches approximately 17mm in length.
[2]**Juvenile Stage** – Weakfish juvenile stage extends from 17mm to length at sexual maturity at age 1.
[3]**Adult Stage** – Weakfish in the Chesapeake Bay mature at age 1. Estimated mean length at maturity for males is 164mm TL and 170mm TL at maturity for females in the Chesapeake Bay. (Lowerre-Barbieri et al., 1995)

Figure 1. Commercial Weakfish Landings from Maryland and Virginia, 1950 - 2001

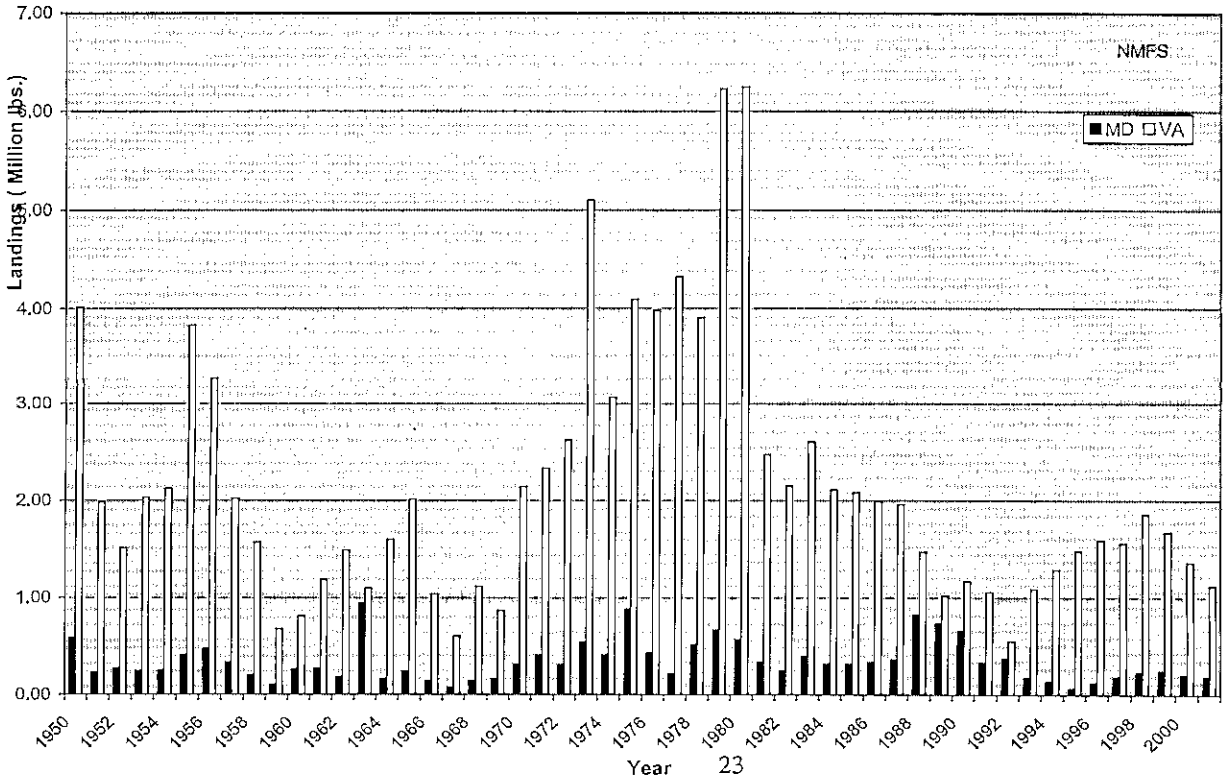


Figure 2. Commercial Weakfish Landings from the Chesapeake Region*
and Atlantic Coast, 1950 - 2001

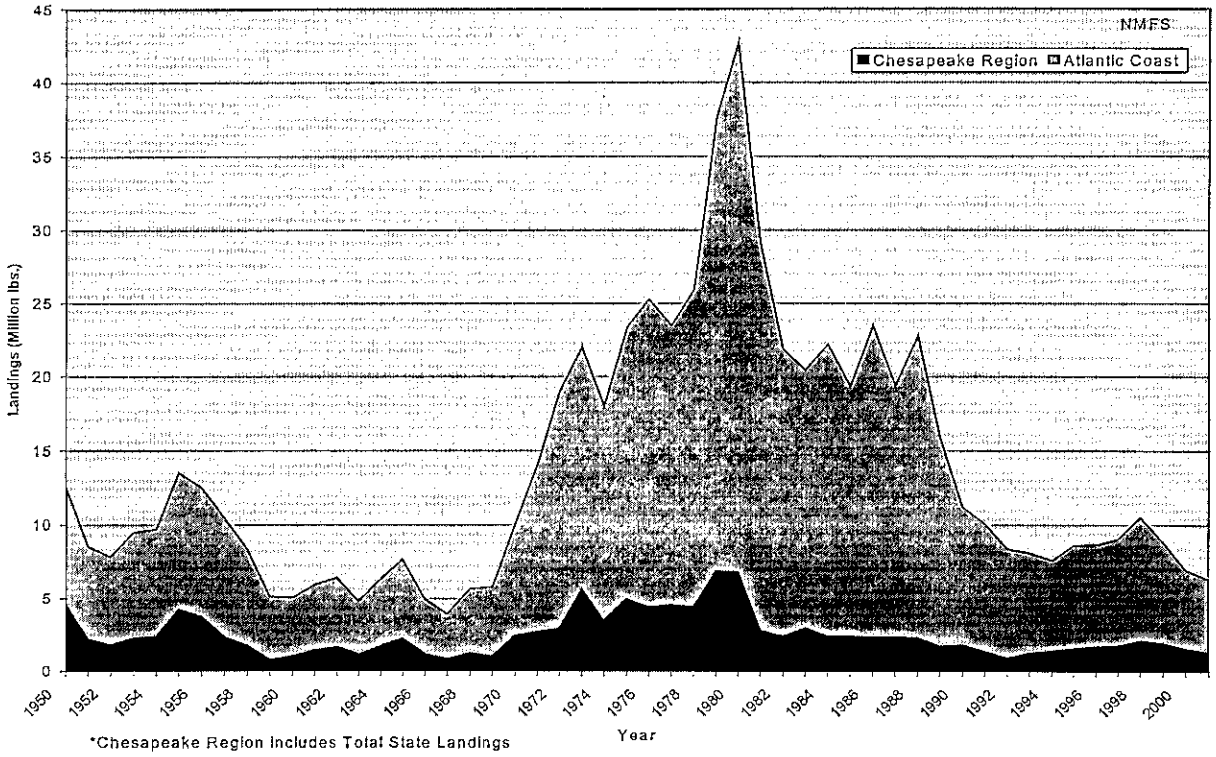


Figure 3: Estimated Recreational Weakfish Harvest from Maryland and Virginia,
1981 - 2001

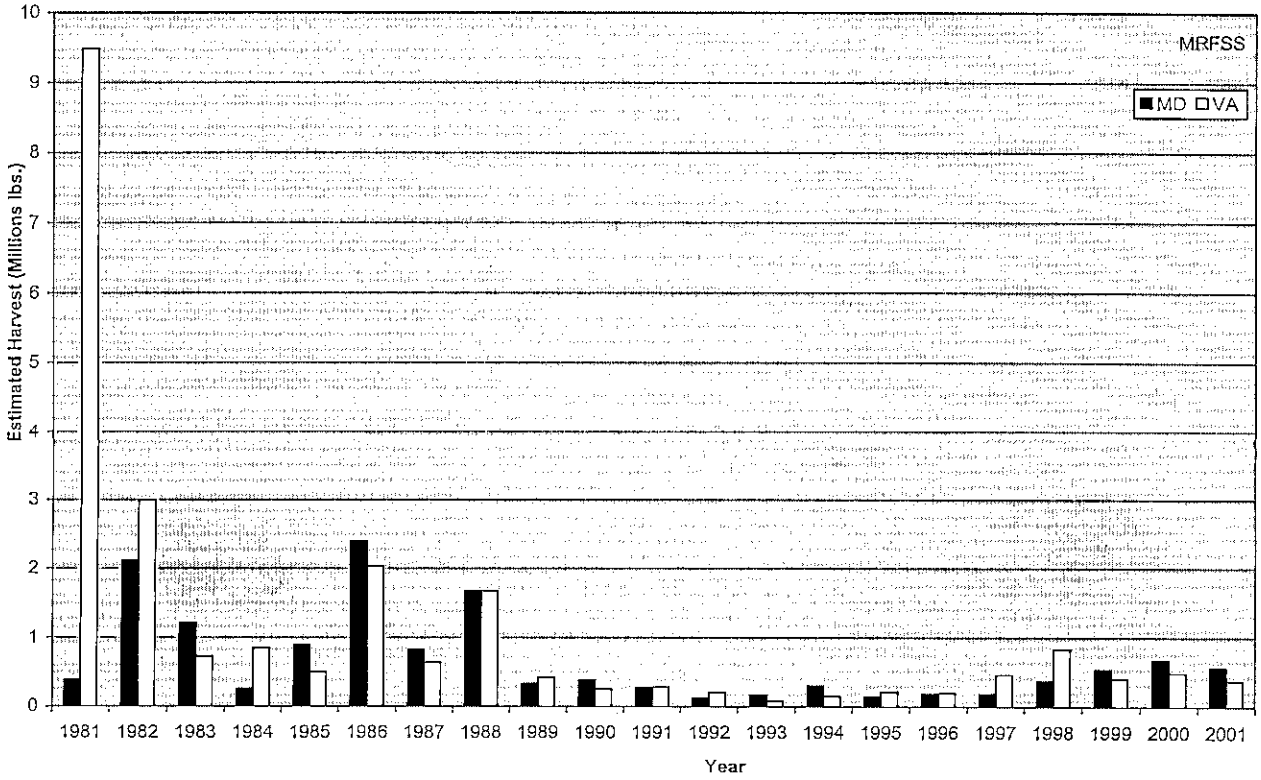
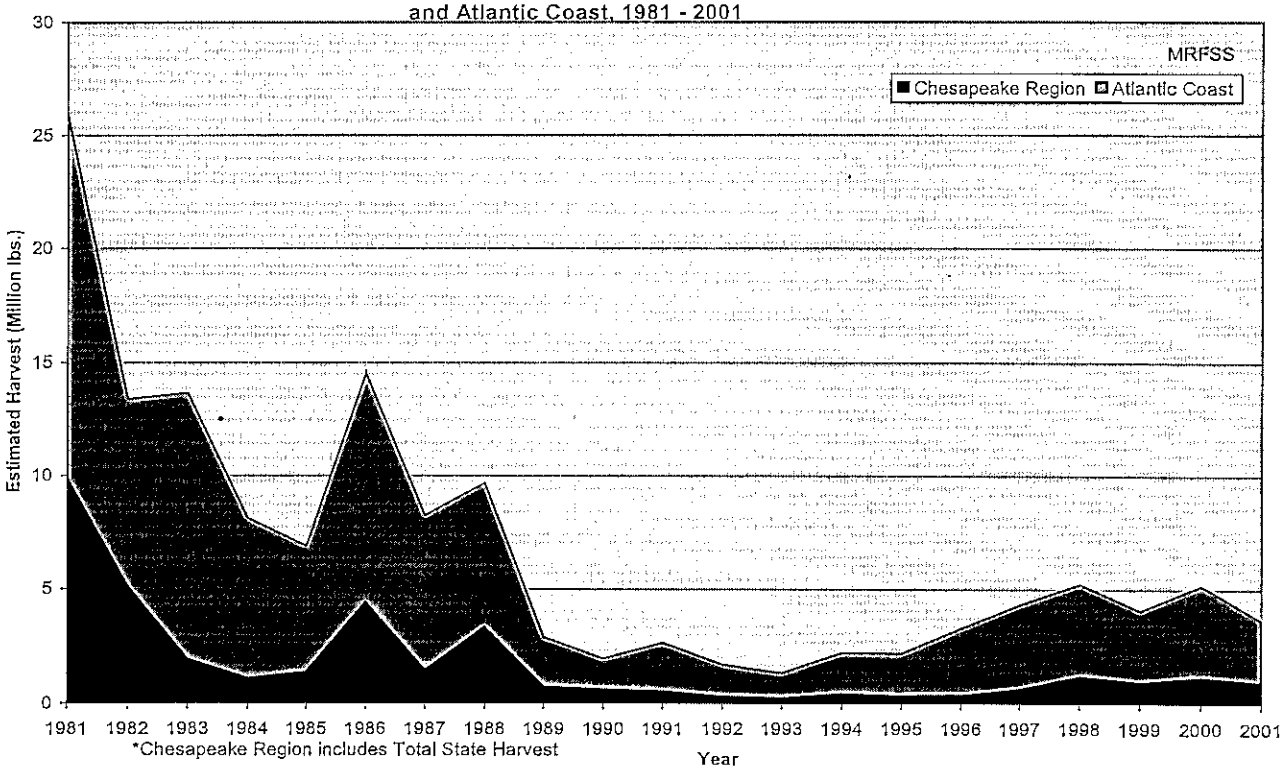


Figure 4. Estimated Recreational Weakfish Harvest from the Chesapeake Region* and Atlantic Coast, 1981 - 2001



*Chesapeake Region includes Total State Harvest

Figure 5. Commercial Weakfish Dockside Values from Maryland and Virginia, 1988 - 2001

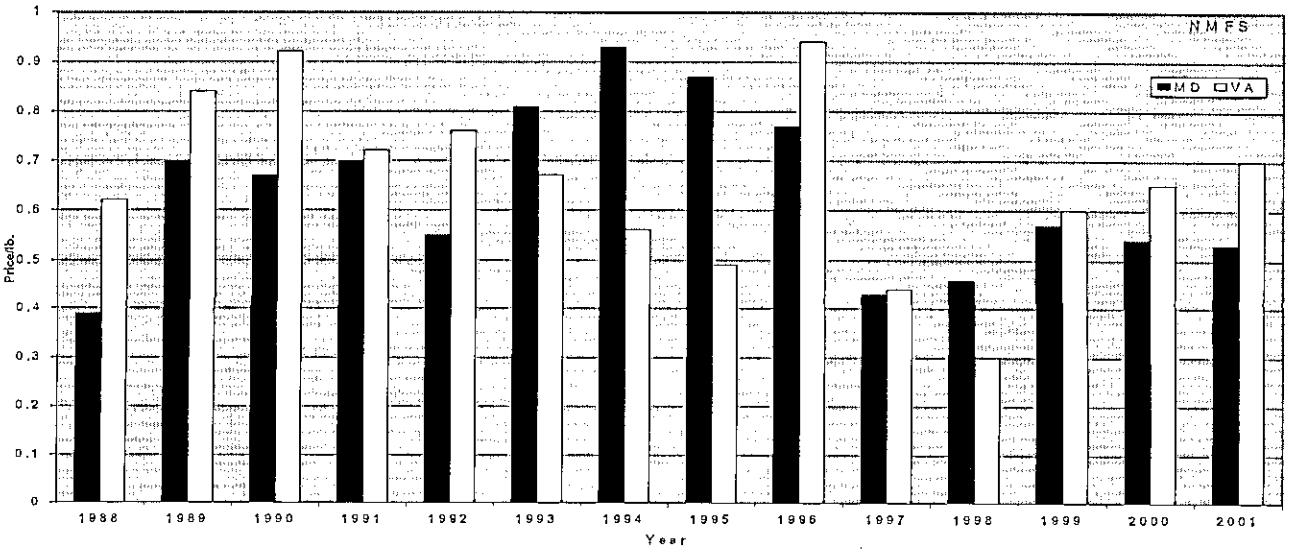
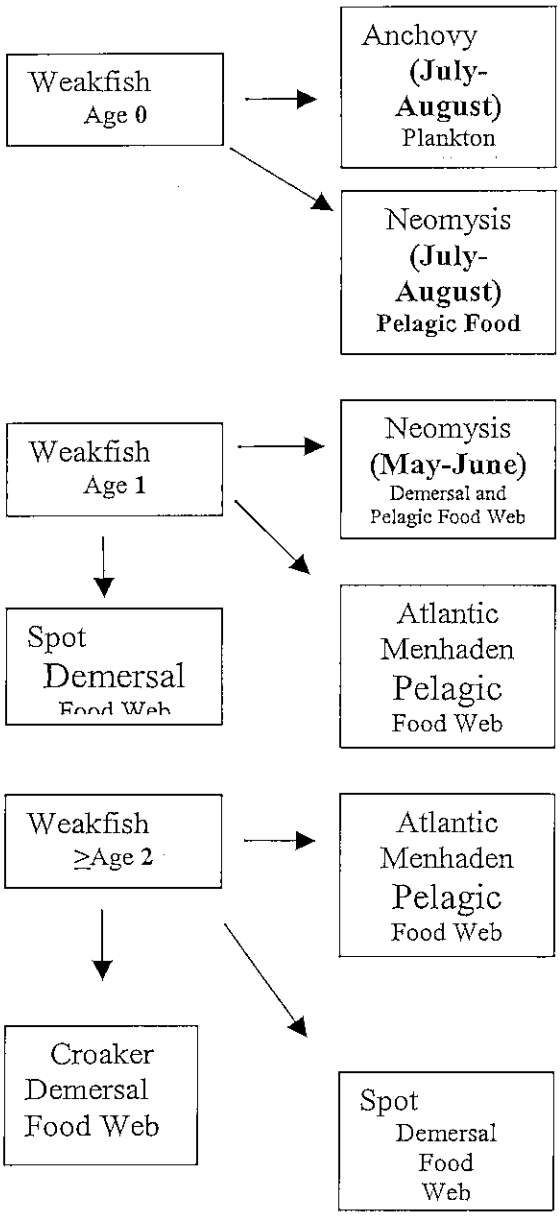
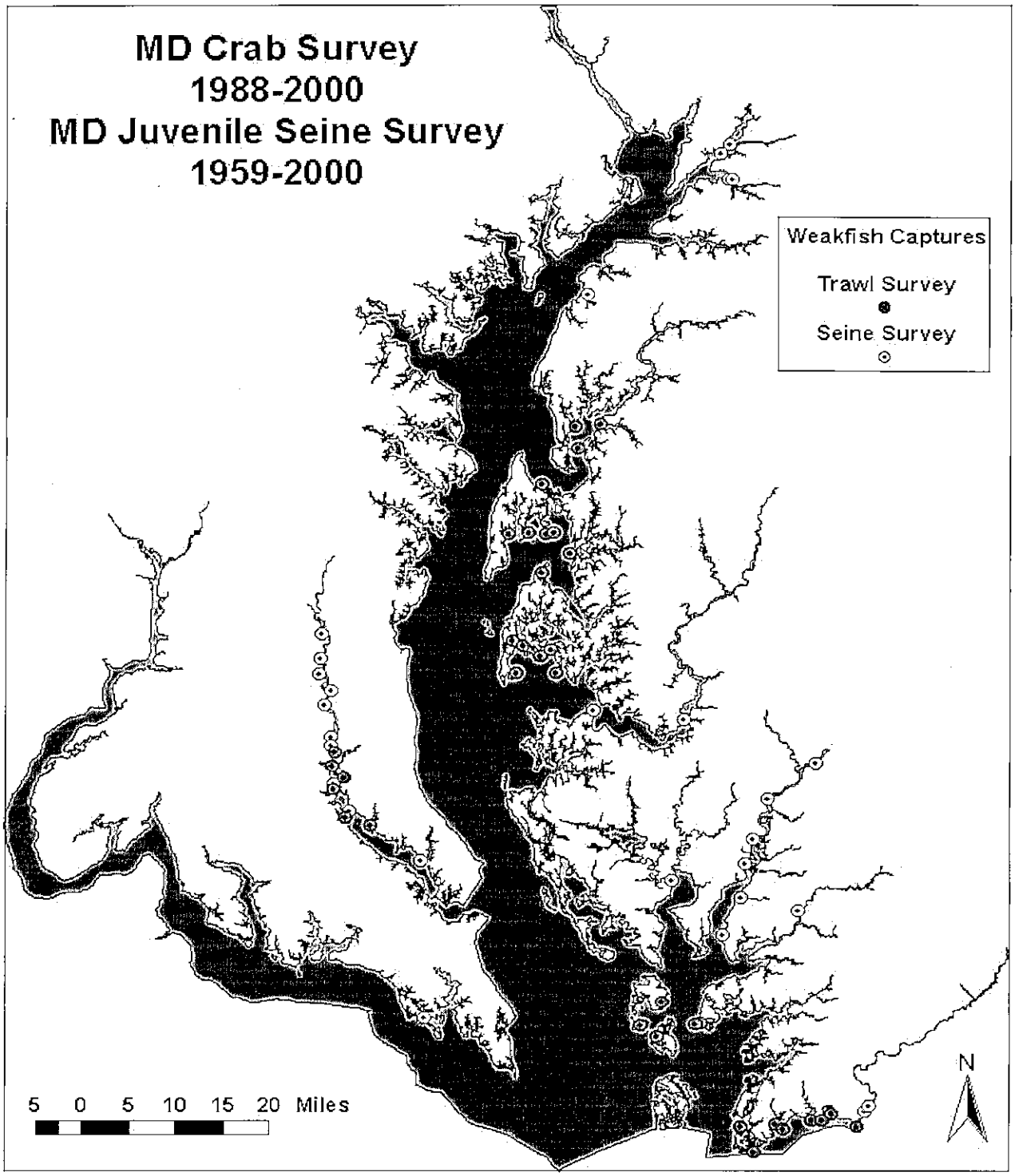
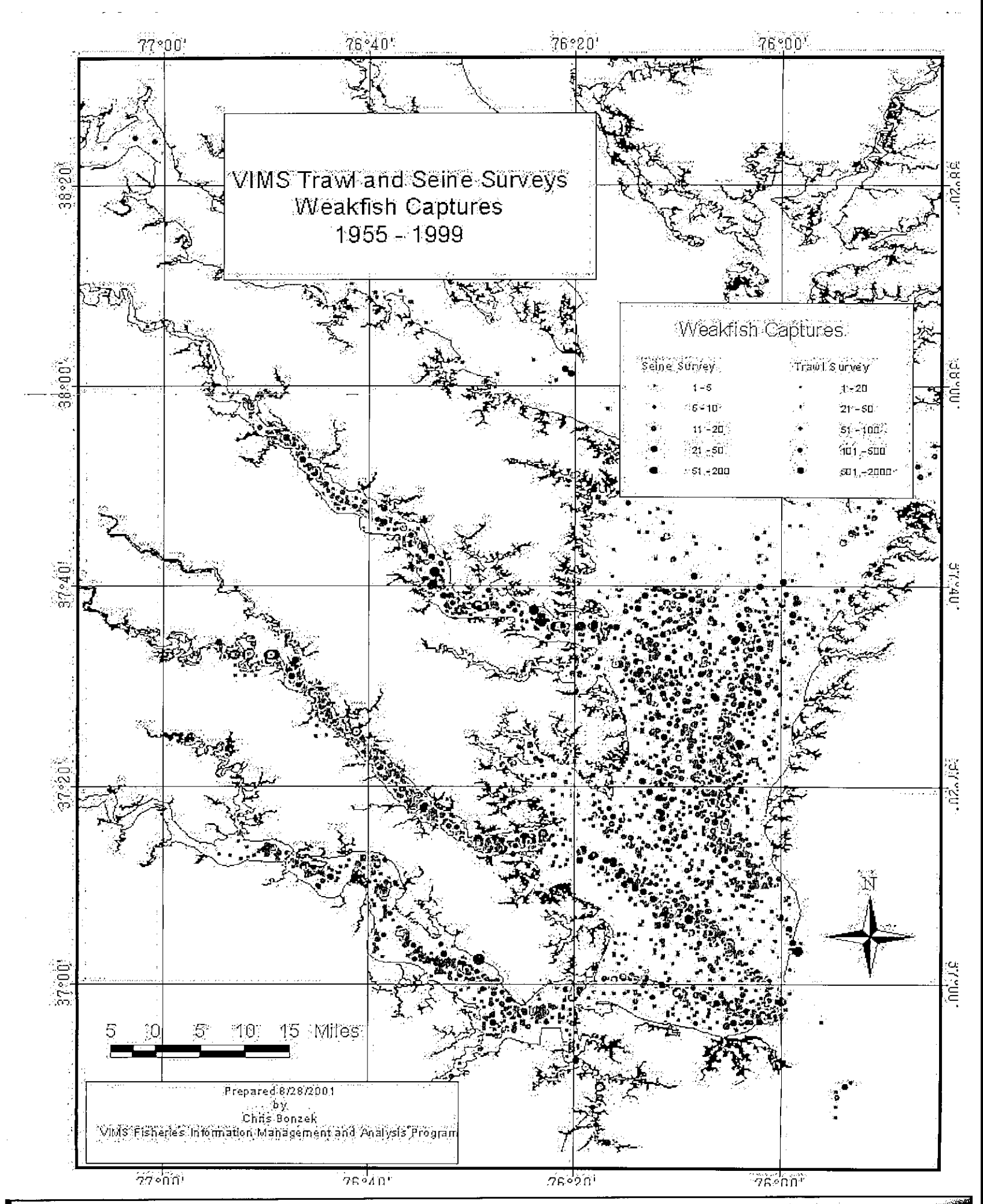


Figure 6. Primary Food Preferences at Age for Chesapeake Bay Weakfish



Food preferences data for weakfish in the Chesapeake Bay is taken from Hartman and Brandt, 1995, "Trophic Resource Partitioning, Diets, and Growth of Sympatric Estuarine Predators". *Transactions of the American Fisheries Society*. 124:520-537. Additional food types of lesser preference included in this study were: *other fish, other invertebrates, grass shrimp, and blue crab*.


MD Crab Survey
1988-2000
MD Juvenile Seine Survey
1959-2000
Weakfish Captures
Trawl Survey
Seine Survey
5 0 5 10 15 20 Miles
N


VIMS Trawl and Seine Surveys
Weakfish Captures
1955 - 1999
Weakfish Captures
Seine Survey
1 - 5
6 - 10
11 - 20
21 - 50
51 - 200
Trawl Survey
1 - 20
21 - 50
51 - 100
101 - 500
501 - 2000
77°00'
76°40'
76°20'
76°00'
38°20'
38°00'
37°40'
37°20'
37°00'
N
5 0 5 10 15 Miles
Prepared 8/28/2001
by
Chris Bonzek
VIMS Fisheries Information Management and Analysis Program

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