Part II

Status of Stock Assessment Knowledge Used to Manage Important Virginia Finfish Species

PREPARED BY
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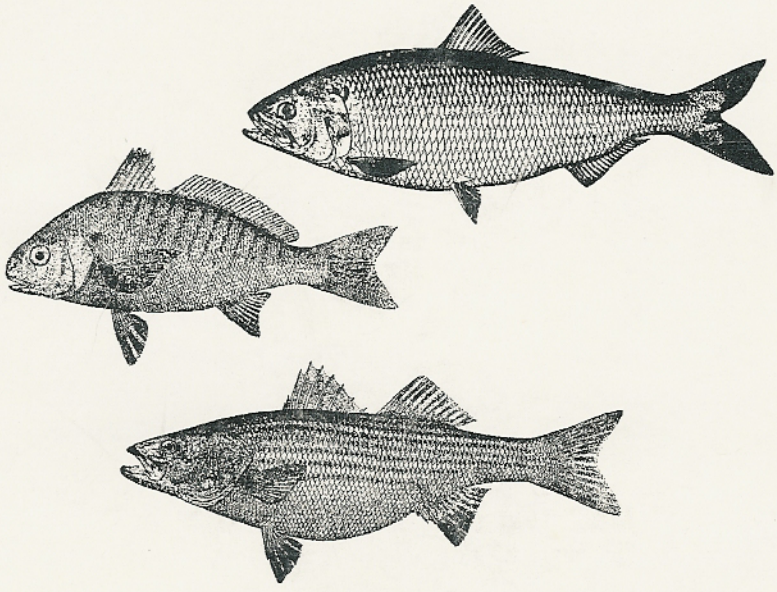

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Including
Key Assessment Terms
Species Bibliographies

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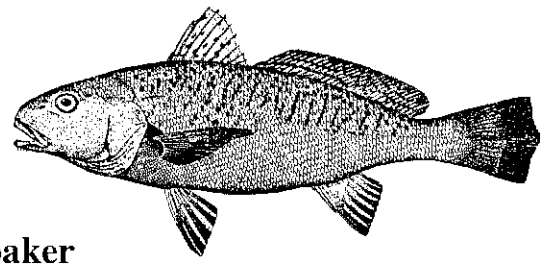

Croaker

Micropogonias undulatus

The croaker is a coastal subtropical species, common south of Cape Hatteras and in the Gulf of Mexico. It ranges northward to the New England states, but is rare north of Delaware. The Chesapeake Bay is the northern-most point of fishery abundance. Although common during summer and early fall in the Bay, the croaker is not a Chesapeake Bay residential species. Adult croaker migrate into the Bay each spring from wintering grounds south of Hatteras and spend the summer where they are subject to an intense recreational and commercial fishery. In the fall they migrate out of the Bay, and depending upon shelf water temperatures, spawn north of Hatteras during warm years, or delay spawning until after they migrate south of the Cape. Recruitment to the Bay is dependent upon surface wind-driven transport, and the survival of the young-of-the-year dependent upon winter temperatures in the Bay. Age of first maturity is 182 mm (7.2") for males and 173 mm (6.8") for females. More than 85% are mature at age one, and all by the end of their second year (14").

There is a significant hook and line fishery for croaker from small boats and fishing piers. During years of abundance small croaker (8") are also commonly taken by surf casters. The croaker are a summer mainstay of the Bay pound net and haul seine fisheries. Combined, Virginia and North Carolina make up 98% of the commercial landings.

Management of the croaker is provided for by an ASMFC FMP including the states Maryland through Florida. In 1993 the instantaneous total annual mortality rate (Z) ranged from 0.55 to 0.63, and natural mortality (M) was estimated at 0.25-0.40. From this, and using an age of first capture of 2 years, the range of $F_{0.1}$ is 0.35 to 0.64. Current F is believed to be 0.35, and it appears that the stocks in the Chesapeake Bay can resist overfishing. If age of first capture is reduced to 1 year, F will rise to 0.50 to 0.75. If however, F increases to 0.40 or above, juvenescence may occur.

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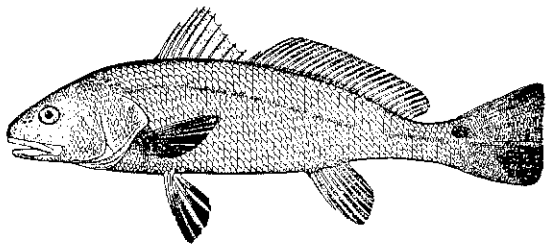

Red Drum (channel bass)

Sciaenops ocellatus

Red drum occur in a variety of habitats distributed from Massachusetts to Key West Florida on the Atlantic Coast. Red drum have historically-been found as far north as Massachusetts with concentrations great enough to support a moderate commercial fishery in New Jersey in the early 1930's. Commercial red drum landings have generally declined along the mid-Atlantic Coast and none have been reported north of Virginia since 1950.

The Atlantic States Marine Fisheries Commission (ASMFC) adopted an FMP for red drum in 1984. The plan recommended management measures for the species in state jurisdictional waters along the Atlantic coast from Maryland to Florida. In 1988, states north of Maryland were requested to enact the plan's regulatory measures to prevent the development of a large scale offshore fishery on southern spawning stocks with landings in northern states.

Amendment #1 to the Red Drum FMP was adopted in 1988, as a result of failing stock abundances. A target of 30% escapement by juvenile to the adult stock was adopted. The Exclusive Economic Zone (EEZ) was closed to all harvest of red drum and fishing mortality rates were further reduced through such actions as gear restrictions, closed seasons, quotas, size limits and bag limits.

Research efforts are needed to further define "unit stock" for red drum in.the South Atlantic, by such methods as mark recapture and genetic discrimination. Future fishery independent sampling of subadult and adult red drum may be necessary on an interstate basis since regulation changes make catches, and thus samples, not reflective of stock composition.

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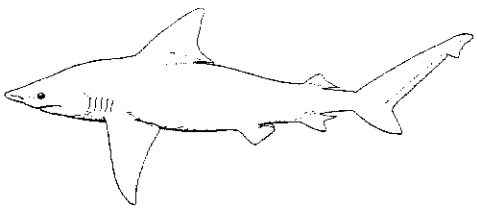

Sharks

During the last twenty years the recreational and commercial fisheries for sharks along the US Atlantic coast and in the Gulf of Mexico have expanded at rapid rates (Anderson 1985, 1990; Casey and Hoey 1985; Hoff and Musick 1990). Recreational catch has been estimated at 2.5 million sharks (ca. 35,000 mt) annually; 20-40% of this is killed. Driven by increased marketability, the commercial fishery has rapidly expanded since 1985, with landings exceeding 7100 mt in 1989. Both fisheries target highly migratory species. Along the east coast of the U.S. sharks move north in the spring with warming temperatures, and south again the fall. In the Gulf of Mexico, the species may be available all year, being most common in the summer. These migrations which encompass areas of the Caribbean for some species, and southern Gulf of Mexico for most, also bring the fish in contact with long established and expanding fisheries of other countries such as Cuba and Mexico (Anderson 1985; Bonfil et al. 1990). Thus, exploitation of these stocks is even greater. Shark mortality within FAO area 31 (US mid-Atlantic through the Caribbean) has exceeded 42,000 mt, of which approximately one-half was from U.S. waters. This annual mortality has exceeded the estimated maximum sustainable yield by >15,000 mt.

The increased exploitation of sharks prompted the development of a US Fisheries Management Plan (FMP) for shark resources of the Atlantic and Gulf coasts. Sharks are susceptible to over fishing, in part, because they are slow growing with late maturation, and low fecundity (Hoff and Musick 1990). At present, a fishery management plan developed by NMFS has been in force since spring 1993. In addition, several states (Virginia, North Carolina, Texas and Florida) have enacted laws to regulate shark fishing in their respective regions (14% of commercial and 64% of recreational catches occur in state controlled waters).

Regardless, a Scientific Review Panel of Experts concluded in April 1994 (Anon. 1994) that the stocks of large coastal sharks were depleted to much lower relative levels than realized in the FMP and that stock recovery would take decades rather than two years as stated in the plan. Consequently, the Panel recommended that the total allowable catch (TAC) of sharks not be increased in 1995 as recommended in the management plan, but that the TAC remain constant. Some members of the panel suggested that the TAC be reduced instead of being held constant, or that the directed commercial fishery be closed.

The annual rate of replacement (r) used in the FMP model, 26% per year is much higher than that calculated to be biologically possible for both fast-growing and slow-growing carcharhinids using accepted demographic models (Bonfil-Sanders, 1993; Cailliet 1993; Cortes, 1994; Hoening and Gruber 1990; Hoff 1990). Recent modeling in our laboratory suggests that for sandbar sharks the annual population increase rate can vary from 2.6% to 11.9% with an age at maturity of 15 years. If a more conservative age of first maturity of 29 years is used (Casey and Natanson 1992) then the annual population increase rate may vary from -2.6% to 5.2%. These low rates of intrinsic increase are probably close to the real situation and reflect the K-selected life history parameters typical of virtually all sharks. The reasons for the unrealistic "r" used in the FMP might lie in the simple use of the number of fishing vessels in the FMP model as an estimate of fishing effort. Longline vessels might increase the number of sets, or the number of hooks per set. to increase their effort. In addition, major components of the fishery such as the winter long-line fishery off North Carolina can provide catch-per-effort trends that are misleadingly high. In the winter, large vulnerable concentrations of sharks occur in a relatively narrow geographic band at the edge of the Gulf Stream, sandwiched by cold coastal water to the west and the

edge of the continental shelf to the east. In summer, these sharks disperse inshore off the Carolinas and north into the mid-Atlantic Bight (Musick et al. 1993).

The Virginia Institute of Marine Science has carried out a longline sampling program since 1973 to study the distribution, abundance and biology of sharks and large pelagic teleosts from Cape Hatteras, NC to Cape Henlopen, DE. This long-term program contributes to several data needs: biological data, catch/effort by species, and fishery independent assessment. The program was expanded during 1980 and 1981 with Sea Grant support (Colvocoresses and Musick 1980), thus providing a strong historical baseline concerning the sharks inhabiting coastal waters prior to the escalation of the recreational and commercial fisheries. More recently the survey has been supported by funding (1990-1994) through the Wallop-Breaux program. Currently (1995-1998) the program is being supported by the Virginia Salt Water Recreational Fishing Development Fund administered by VMRC. These recent studies have provided insights into the effects of the fishery expansions on the shark stock during the last 14 years (Musick et al. 1993; Musick et al. 1994). The Virginia data base was the only available long-term fishery independent data source incorporated into the NMFS 1994 re-evaluation of the FMP (Anon. 1994). Thus, its value has been recognized as an important tool in defining trends in East Coast shark abundance over a twenty year period. When the catch per unit effort (CPUE) indices from the VIMS fishery independent survey were subjected to analysis using a general linear model (GLM) and compared with eight various fishery dependent indices derived primarily from fisheries in the south Atlantic and Gulf, the historical trends in CPUE agreed very well (Anon. 1994). In addition, information about CPUE statistical variance were not available for many of the fishery dependent indices, but because the VIMS survey was scientifically designed, variances could be generated to test reliability of CPUE estimates.

Continuation of this program is critical to determining whether the FMP is leading to stock recovery, or whether more stringent regulations need to be adopted.

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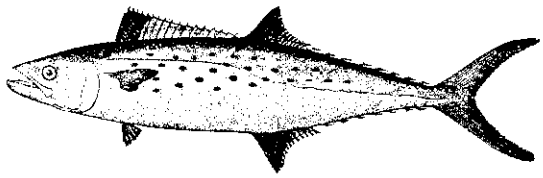

Spanish mackerel

Scomberomorus maculatus

The Spanish mackerel, *Scomberomorus maculatus*, is a pelagic, warm-temperate species that generally ranges from Cape Cod, Mass. south along the Atlantic coast to Florida and through the Gulf of Mexico to the Yucatan Peninsula of Mexico. It is now abundant along the East coast north only to Chesapeake Bay. It enters Chesapeake waters only during the warmer months. This species supports important recreational and commercial fisheries throughout US waters from the Chesapeake region south. At least two stocks exist, at least one in the Gulf of Mexico and at least one along the South Atlantic coast. Boundaries between these stocks are taken to occur off the lower east coast of Florida.

Spanish mackerel were once extremely abundant in the Chesapeake and mid-Atlantic region, the last third of the 1800's. They have generally not been abundant in these waters since 1910. Abundance greatly increased in the Chesapeake region about 1987, however, and it has remained high since then. This species is currently managed jointly by the Gulf of Mexico and South Atlantic Fishery Management Councils, as well as the various states.

Much work has been done on Spanish mackerel. Nearly all this work, however, has been directed at stocks off Florida or in the Gulf of Mexico. Other than recent work (Chittenden et al 1993 a, b), there has been no study directed at this species in the cold temperate waters north of Cape Hatteras, NC since about 1880. As a result, published knowledge of the biology of this species in our region is almost non-existent other than in general terms not well-suited to management.

The following materials provide, first, a listing of recent studies in the Chesapeake region and then, second, a "range-wide" listing of reports and studies in reference to knowledge on important stock assessment characteristics of Spanish mackerel.

Recent studies on Spanish mackerel in the Chesapeake Region

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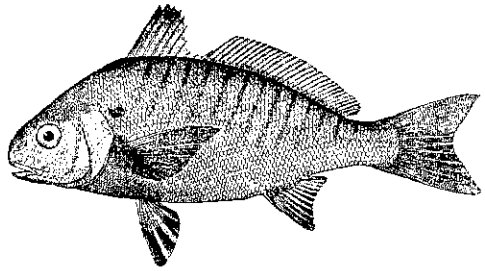

Spot

Leiostomus xanthurus

The spot is one of the most common inshore, Bay, and sound species taken in the mid-Atlantic Bight during the warmer months of the year by both recreational and commercial fishermen.

Commercial harvests in the Virginia waters of the Bay are principally gill and pound nets in the main stem. While the harvest period is May through October, the peak is during August and September as the fish exit the Bay. Two year classes are taken in Maryland, one in Virginia. One year old fish, 175 mm (7") and two year old fish 200 mm (8") are harvested in Maryland, while in Virginia the larger two year old fish are harvested by gill nets (215 mm, 8.5") and the smaller group (190 mm , 7.5 mm) in pound nets.

The ASMFC FMP for spot covers the states of Delaware to Florida. The plan, and subsequent annual ASMFC reviews, do not contain estimates of mortality. The main recommendation of the plan is a reduction of juvenile by-catch, particularly by the shrimp fisheries.

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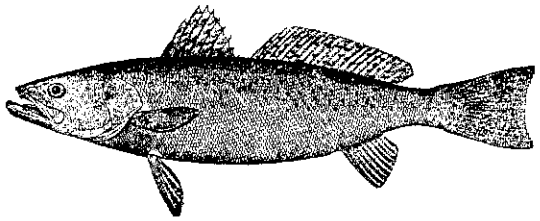

Spotted Seatrout (speckled trout)

Cynoscion nebulosus

Spotted seatrout occur along the Atlantic and Gulf coasts of the United States from Cape Cod, MA to Carmen Island in the lower Gulf of Campeche, Mexico. They are rare in and north of Delaware Bay and the center of abundance is from Florida to Texas.

The original interstate fishery management plan (FMP) for spotted seatrout was approved by the Atlantic States Marine Fisheries Commission (ASMFC) in 1984. The management unit for spotted seatrout under the FMP ranges from Maryland through the Florida Keys.

In November of 1991, the ASMFC Policy Board approved Amendment #1 to the plan which added an objective of maintaining a spawning potential ratio (SPR) of at least 20% to minimize the possibility of recruitment failure. Equilibrium spawning potential ratios (SPR) for Florida have been estimated at less than 20%. Estimates of SPR for spotted seatrout in Indian River Lagoon ranged from 10 to 15%. Recent data suggests SPR is 11 to 15% on the Florida east coast.

Fluctuations in spotted seatrout landings (both commercial and recreational) have varied considerably during the last decade. However, most of the reported landings have no meaningful effort data associated with them and are not considered useful indicators of stock abundance.

Preliminary work on developing a prerecruit index of abundance has been conducted in South Carolina. Since spotted seatrout appear to be comprised of several stocks throughout its range, prerecruit indices derived for specific geographical areas will not be transferable to other areas. Some very preliminary work has been conducted in South Carolina which suggests that with the aid of mitochondrial DNA techniques, "between-area" comparisons of spotted seatrout populations may be possible. No directed research on spotted seatrout is currently underway in Virginia or Maryland.

All states which declared an interest in spotted seatrout have established a minimum size limit of at least 12 inches as called for in the FMP. Collection of improved catch and effort data from the commercial and recreational fisheries has been initiated in all states.

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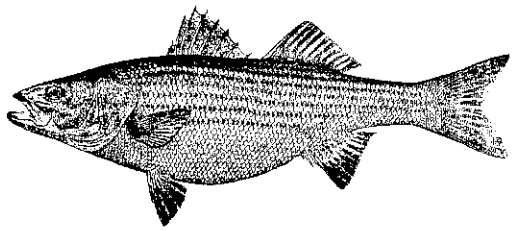

Striped bass

Morone saxatilis

Striped bass (rockfish) have supported fisheries along the Atlantic coast for centuries. The Atlantic coast migratory stock of striped bass is distributed from the Saint Lawrence estuary in Canada southward to Cape Hatteras, North Carolina. Adult striped bass migrate to spawning grounds, including the Chesapeake Bay, in the spring, descend to coastal sounds and estuaries following spawning, and migrate generally northward in the ocean in the summer, returning generally southward during the fall and winter (ASMFC 1995). A small portion (10%) of Chesapeake Bay female striped bass leave this estuary as 2-year old fish to join the coastal migratory stock Some (4%) female striped bass mature by age 4, and 40% of males mature by that age. A major portion (89% and 75%) of age 5 females and males, respectively, join the migratory stock. By age 9, all male and female striped bass are mature and part of the coastal migratory stock (Crecco 1994a). The striped bass is a long-lived species and can attain at least an age of 29 years (Merriman 1941)..

The commercial fishery peaked at almost 15 million pounds in 1973 but declined to 3.5 million pounds in 1983. Virginia and other states, except Maryland, maintained static harvest caps from 1990 through 1994, and the Virginia cap was 211,000. Maryland was able to impose a flexible quota during the same period, and the quota rose in response to increasing stock size. Since 1979 recreational harvest ranged from 28 to 65% of the total harvest and increased from 3.1 million pounds in 1990 to 6.6 million pounds in 1993 (ASMFC 1995).

Striped bass historically provided for valuable recreational and commercial fisheries in Virginia. Coast-wide estimates of the total economic impact from the 1993 fisheries for this species ranged from $53 million (commercial fishery basis) to $270 million, derived from all industries, jobs and taxes associated with striped bass recreational fisheries (Southwick and Teisl 1995). These impacts can only increase, as the Atlantic States Marine Fisheries Commission (ASMFC) provided for an increase in Atlantic coastal states' commercial quotas and recreational fishing seasons when it declared that the Chesapeake Bay stock was recovered as of January 1995 (ASMFC 1995).

This recovered status was based on the current estimated level of striped bass spawning stock biomass (in pounds) which was found to be equal to or greater than average levels of the 1960-72 period (Rugolo et al. 1994). Virginia and other Chesapeake jurisdictions may establish 1995 and 1996 commercial and recreational fisheries, in accordance with a total fishing mortality rate (F) of 0.33. This F is 33% greater than the fishing mortality rate allowed during the 1990-94 period (F = 0.25) and is 73% greater than the F for 1993 (F = 0.19) which was estimated from a mark (tag)-and-recapture study conducted in 1994. Under the provisions of Amendment - # 5 (ASMFC 1995), Virginia will be entitled to an increase in its commercial quota, from 211,00 pounds (1994) to just less than 800,000 pounds and 1.38 million pounds in 1995 and 1996, respectively. Virginia's Chesapeake Bay recreational fishery will be allowed a 107-day season in 1995 and 1996, compared to the 32-day seasons of the 1990-94 period. This F of 0.33 is considered an interim F, and by 1997 F will be set higher to correspond with the fully recovered stock status.

Objectives of the ASMFC plan include monitoring of fishery independent juvenile abundance indexes, spawning stock biomass levels and fishing mortality rates. Until 1997, state-specific mark-and-recapture studies will continue to provide the basis for estimating previous seasons' fishing mortality rates. At that time a virtual population analysis (VPA) will be implemented to derive estimates of F, especially for coastal fisheries. Another objective of Amendment #5 (ASMFC 1995) is to identify critical

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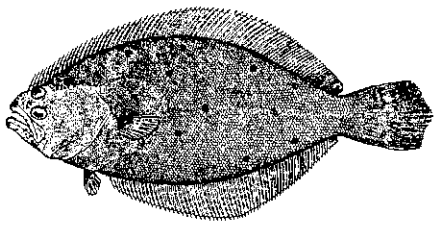

Summer Flounder (Fluke)

Paralichthys dentatus

The summer flounder *(Paralichthys dentatus)* historically has been one of the most important species in the Virginia recreational fishery, ranking second only to New Jersey in recreational landings (MAFMC 1987). Further, it is the most important component of Virginia's winter trawl fishery. While this species has been among the most important in both recreational and commercial fisheries from Massachusetts to North Carolina (MAFMC 1987), landings declined drastically in the 1980's because of overfishing and yearclass failure (Anon. 1993). Consequently, strict management regulations have been put in place through a joint Fishery Management Plan (FMP) adopted by the Atlantic States Marine Fisheries Commission and the Mid-Atlantic Fishery Management Council (see below).

Evidence was presented in the FMP that two stocks of summer flounder might exist in the Mid Atlantic Bight (MAB) (Chang and Pacheco 1976, Henderson 1979). In addition, recent flounder tagging studies conducted by the North Carolina Division of Marine Fisheries (Gilliken et al. in prep., Monaghan 1992), and here at the Virginia Institute of Marine Science (VIMS) (Desfosse et al. 1990) strongly support the existence of a northern or "offshore" stock and a southern or "inshore" stock.

A previous tagging study of adults showed that most summer flounder that spend the summer in Virginia waters migrate south in the fall, spawn inshore north of Cape Hatteras, and return to Virginia in subsequent summers (Desfosse et al. 1990). In addition, a smaller but significant proportion of flounder that summer in Virginia, particularly those on the seaside of the Eastern Shore, migrate offshore to 50-100 fm in the fall to spawn. Some tag returns in subsequent summers regularly come from areas north of Virginia to New Jersey. Thus, there is evidence that both stocks occur in Virginia waters in summer as adults.

It is hypothesized that both stocks are present as young-of-the-year (YOY), and that the northern stock may contribute a relatively higher proportion of the total YOY population that found as adults. Evidence for this hypothesis is that although occasionally during mild winters summer flounder may successfully recruit to estuarine nurseries as far north as New Jersey (Murawski 1973, Festa 1974, Able et al. 1990, Malloy and Targett 1992), young-of-the-year summer flounder usually are not found in large numbers in the estuarine nurseries north of Virginia until well into their first summer of life (Poole 1966, Murawski 1973, Festa 1974, Scarlett 1981). Consequently, if northern estuaries are only occasionally used as nurseries, many of the fish that support fisheries from as far north as Massachusetts may be derived from nurseries in Virginia and North Carolina, (Anon. 1993), or coastal areas. Dominant coastal currents in the Mid-Atlantic Bight are to the southwest and could carry pelagic summer flounder eggs and larvae from northern spawning areas to Virginia nurseries.

Development of the Management Plan

The MAFMC first considered the development of a fishery management plan for summer flounder in late 1977. During the early discussions, the fact that a significant portion of the catch was taken from state waters was considered. As a result, on 17 March 1978 a questionnaire was sent by the Council to east coast state fishery administrators seeking comment on whether the plan should be prepared by the Council or by the states acting through the Atlantic States Marine Fisheries Commission (ASMFC).

It was decided that the initial plan would be prepared by ASMFC. The Council arranged for NMFS to make some of the Council's programmatic grant funds available to finance preparation of the ASMFC plan. New Jersey was designated as the state with lead responsibility for the plan. The State/

Federal draft was adopted by the Atlantic States Marine Fisheries Commission at its annual meeting in October 1982. The original Council FMP (MAFMC 1988) was based on the ASMFC management plan. NMFS approved the original FMP on 19 September 1988.

Unfortunately, based on the results of the latest assessment conducted in 1994, the stock has not rebuilt as fast as anticipated. Stock size in 1996 will be lower than expected as the result of lower level of recruitment in 1993, a change in exploitation patterns with the fisheries killing more age 0 and age 1 summer flounder than expected, and an underestimation of landed and discarded fish by commercial and recreational fishermen.

Although the stock is rebuilding at a slower rate, stock size has increased from the low levels measured in 1989. The SSB estimates for 1993 increased 61% from the low level measured in 1989. Projected stock size estimates for 1994 and 1995 indicate that rebuilding is continuing with increasing stock sizes and greater numbers of fish available at the older ages.

Although the stock is rebuilding, projections indicate that the quota associated with the target F of 0.23 in 1996 could be approximately 11 million pounds (5.0 MT) or about one half of the quota in 1995. Because of this sharp reduction in quota from 1995 to 1996, and the associated short term negative consequences of such a drastic change, the Council and Commission initiated a reexamination of the fishing mortality rate reduction schedule for summer founder.

Because of the amount of time and effort invested in the development of the original fishing mortality rate reduction schedule, the Council and Commission were very concerned about modifying the schedule. As a policy, the Council and ASMFC do not believe that long term rate reduction schedules should be changed from one year to the next. However, after careful consideration, the Council and ASMFC currently propose a slight modification to the rate reduction schedule that will alleviate the short term economic burden associated with a reduction to F = 0.23 in 1996. This change will allow for more stable landings from one year to the next and only slow the rate of stock rebuilding slightly.

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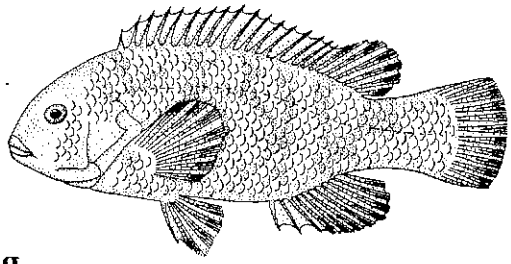

Tautog

Tautoga onitis

Tautog occur from Nova Scotia to South Carolina, and are commercially harvested in the United States between Massachusetts and Virginia. The current hook and line world record tautog, 24 lbs, was caoght off Wachapreague, Virginia in 1987. They are a slow growing territorial fish that mature at three to four years of age (~13 inches), live over 30 years, and associate with hardbottom reef and rocky environments. Therefore, they are easily located by fishermen when hardbottom is limited, such as in Virginia, and due to the slow growth rate, have a low rate of replacement. Spawning occurs daily from late April through July, with dominant males and females pair spawning, and smaller fish group spawning. Tautog are a cold water fish. Migration patterns show a seasonal inshore-offshore movement, with fish entering the Chesapeake Bay when the water temperature reaches about 40°F.

Tautog are susceptible to overfishing due to these aspects of their life history. High fishing pressure and decreased abundance throughout its range has demonstrated the need for management. ASMFC is currently working on a coastwide management plan, assuming a unit stock. Current regulations are highly variable; in Rhode Island and Connecticut a 16 inch minimum size limit is enforced, while in Maryland and Virginia, there are no size or bag limits in place.

The historical fishery for tautog has been about 85% recreational, 15% commercial. Recreational landings in Virginia peaked in 1984 at 799,006 fish, and have dropped to an average of 158,237 fish between 1990 and 1992 (MRFSS). Since 1980, tautog have become more marketable, thus commercial pressure has increased. Virginia reported commercial landings have risen steadily from 1,343 pounds in 1984 to 5,337 pounds in 1993. The primary gears for commercial harvest in the Southern region are hook and line and fish pots, while the northern fishery is dominated by trawling, although hook and line and pots have been popular recently in response to a live market.

Stocks of tautog are showing effects of fishing pressure through decreased landings. This effect is more pronounced in the northern states (MA, RI, CT, NY) where the market for tautog is more developed. Observations from Virginia fishermen indicate a slight decrease in the average size of landed fish over the past 10 years, but large fish are still available. The number of Virginia citations (fish > 9 lbs) has been relatively stable at 230 fish per year.

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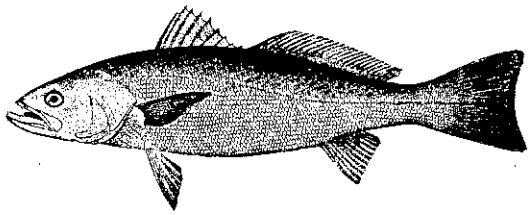

Weakfish

Cynscion regalis

Weakfish (grey trout) have supported fisheries along the Atlantic coast since at least the 1800's. Weakfish are distributed from Maine to Florida and undergo extensive seasonal migrations, moving north in spring and summer and south in fall and winter (Seagraves 1992). Weakfish attain sexual maturity at an early age (most mature by age 1), are highly fecund, and longevity extends at least to 12 years of age (Vaughan et al. 1991).

The commercial fishery accounted for roughly 87% of total (recreational and commercial) weakfish landings (in pounds) during the 1990-92 period and 70% of the 1994 total landings of 8,985,480 pounds. The principal commercial harvest area is North Carolina which accounted for 68% of the 1993 coast-wide commercial landings. Gill nets and otter trawls account for most of the commercial landings. However, by-catch of weakfish in South Atlantic shrimp fisheries is extensive (see below). The mid-Atlantic region is the major area of recreational harvest. Landings from both fisheries have been at low levels, especially since 1988. Maximum landings of 40 million pounds from both recreational and commercial fisheries occurred in 1980.

Weakfish are currently managed by the Atlantic States Marine Fisheries Commission (ASMFC) as a unit stock, based mainly on the results of a comparison of mitochondrial DNA from weakfish collected throughout many portions of their range (Graves et al. 1992). Since July 31, 1994 Atlantic coastal states have complied with a mandatory reduction in fishing mortality rate schedule, imposed by the Atlantic Coastal Fisheries Cooperative Fishery Management Act (Public law 103-206). Currently, Amendment #2 (October 1994) to the ASMFC Management Plan for Weakfish requires that states achieve at least a 33% reduction in fishing mortality rates during the April 1, 1995 through March 31, 1996 period.

The average fishing mortality rate (F) for the 1991-93 period was 1.26 (from Gibson 1994), and states must use a combination of size and possession limits and mainly seasonal closures to reduce F in recreational and commercial fisheries, respectively. An F = 1.26 is equivalent to an annual rate of weakfish removals of 71%, from fishing activities, alone. The fishing mortality rate was derived from a virtual population analysis (VPA) which used commercial and recreational catch data (fishery dependent), in conjunction with a number of sources of fishery independent data which were mainly indexes of juvenile abundance established from results of federal and state trawl surveys (Bonzek 1995; Crecco 1994; Gibson 1994).

A large portion of the catch data is attributed to the weakfish by-catch in South Atlantic shrimp trawl fisheries (Gibson 1994; Vaughan 1995). For example, the 1994 by-catch estimate was 21.6 million weakfish, whereas the estimated catch from recreational and commercial (includes scrap and bait) fisheries was 12.3 million weakfish. There is more uncertainty associated with the by-catch estimate than the estimated catch from the recreational and commercial fisheries. However, the ASMFC management plan requires that South Atlantic states reduce weakfish by-catch in shrimp fisheries by 50%, starting in 1996.

The weakfish population is at a very low level, compared to a decade ago (Vaughan 1995). At the same time, age 1 and 2 weakfish dominate the age composition, and few weakfish are greater than 4 years in age (Vaughan 1995). The spawning stock biomass is also at a very low level, however; recruitment, in terms of production of weakfish, has remained fairly stable (Crecco 1994). Since 90% of age 1 weakfish are sexually mature, and fecundity is high, most fishery scientists agree that the weakfish stock could recover fairly quickly, if F were decreased to 0.6 (Pers. Comm ASMFC Technical Committee, 1995).

A listing of reports and studies, in reference to knowledge on important stock assessment characteristics of weakfish follows.

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Scoles, D. 1990. Stock identification of weakfish, *Cynoscion regalis*, by discriminant function analysis of morphometrics. Masters Thesis. College of William and Mary, Williamsburg, VA. 51 p.

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Gibson, M. R. 1994. Alternative estimates of weakfish bycatch in shrimp trawl fisheries in the South Atlantic using shrimp effort and relative abundance data. Report to the ASMFC weakfish technical committee November 1994. 19p.

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Lowerre-Barbieri, S. K. 1994. Life history and fishery ecology of the weakfish, *Cynoscion regalis*, in the Chesapeake Bay region. Ph.D. Dissertation. The College of William and Mary. 224 p.

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Growth

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Mortality

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Population Size

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VMRC. 1991 - 1994. Collection of biological data from the commercial fishery (unpublished).

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Habitat Utilization and Water Quality

Mercer, L. P. 1985. Fishery management plan for the weakfish (*Cynoscion regalis*) fishery. Fisheries management report no. 7. Atlantic States Marine Fisheries Commission. North Carolina Dept. Natural Resource and Community Development, Division of Marine Fisheries. Special scientific report no.46, 129 p.

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Gibson, M. R. 1994. Alternative estimates of weakfish bycatch in shrimp trawl fisheries in the South Atlantic using shrimp effort and relative abundance data. Report to the ASMFC weakfish technical committee November 1994. 19p.

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