Northeast Fisheries Science Center Reference Document 05-10

41st Northeast Regional Stock Assessment Workshop (41st SAW)

41st SAW Assessment Summary Report

August 2005

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A Report of the 41st Northeast Regional Stock Assessment Workshop (41st SAW)

41st SAW Assessment Summary Report

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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The stock assessments which are the subject of this document were peer reviewed by a panel of assessment experts known as the Stock Assessment Review Committee (SARC). Panelists were provided by the Center for Independent Experts (CIE), University of Miami. Reports from the SARC panelists and a summary report from the SARC Chairman can be found at *http://www.nefsc.noaa.gov/nefsc/saw*.

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SAW-41 ASSESSMENT SUMMARY REPORT
INTRODUCTION

The 41st SAW Assessment Summary Report contains summary and detailed technical information on the three assessments reviewed in June 2005 at the Stock Assessment Workshop (SAW) by the 41st Stock Assessment Review Committee (SARC-41): summer flounder (*Paralichthys dentatus*), bluefish (*Pomatomus saltatrix*) and tilefish (*Lopholatilus chamaeleonticeps*).

The SARC-41 consisted of three external, independent reviewers and a SARC chairman, all appointed by the Center for Independent Experts. The reviewers' reports for SAW/SARC-41 are available at website: http://www.nefsc.noaa.gov/nefsc/saw/ under the heading "Recent Reports". The SARC-41 reviewers all accepted the summer flounder and tilefish assessments as sufficient to serve as a basis for providing scientific advice to managers. For the bluefish assessment, however, the SARC members were divided as to the acceptability of the assessment. One reviewer rejected the bluefish assessment. The other two reviewers felt that the bluefish assessment was adequate, but that the assessment results needed to be treated with great caution. All three reviewers felt that the bluefish assessment was weak with respect to the quality of input data, certain aspects of the modeling, and lack of progress on Research Recommendations from the previous SARC. The reviewers spent considerable time discussing the weaknesses of the bluefish assessment; as a consequence, little time was spent discussing whether the updated biological reference points, the estimates of current biomass and fishing mortality rate, and the determination of bluefish stock status were correct. All reviewers believe that this assessment could be improved. Bluefish were also reviewed in June, 2004 by SARC-39, and that assessment was rejected.

An important aspect of any assessment is the determination of current stock status. The status of the stock relates to both the rate of removal of fish from the population – the exploitation rate – and the current stock size. The exploitation rate is the proportion of the stock alive at the beginning of the year that is caught during the year. When that proportion exceeds the amount specified in an overfishing definition, overfishing is occurring. Fishery removal rates are usually expressed in terms of the instantaneous fishing mortality rate, F, and the maximum removal rate is denoted as $F_{THRESHOLD}$.

Another important factor for classifying the status of a resource is the current stock level, for example, spawning stock biomass (SSB) or total stock biomass (TSB). Overfishing definitions, therefore, characteristically include specification of a minimum biomass threshold as well as a maximum fishing threshold. If a stock's biomass falls below the biomass threshold ($B_{THRESHOLD}$) the stock is in an overfished condition. The Sustainable Fisheries Act mandates that a plan be developed for stock rebuilding should this situation arise.

Since there are two dimensions to the status of the stock– the rate of removal and the biomass level – it is possible that a stock not currently subject to overfishing in terms of exploitation rates is in an overfished condition, that is, has a biomass level less than the threshold level. This may be due to heavy exploitation in the past, or a result of other factors such as unfavorable environmental conditions. In this case, future recruitment to the stock is very important and the probability of improvement is increased greatly by increasing the stock size. Conversely, fishing down a stock that is at a high biomass level should generally increase the long-term sustainable

		BIOMASS		
		$B < B_{THRESHOLD}$	$B_{THRESHOLD} < B < B_{MSY}$	$B > B_{MSY}$
EXPLOITATION	$F > F_{THRESHOLD}$	Overfished, overfishing is occurring; reduce F, adopt and follow rebuilding plan	Not overfished, overfishing is occurring; reduce F, rebuild stock	$F = F_{TARGET} <= F_{MSY}$
RATE	$F < F_{THRESHOLD}$	Overfished, overfishing is not occurring; adopt and follow rebuilding plan	Not overfished, overfishing is not occurring; rebuild stock	$F = F_{TARGET} <= F_{MSY}$

yield. This philosophy is embodied in the Sustainable Fisheries Act — stocks should be managed on the basis of maximum sustainable yield (MSY). The biomass that produces this yield is called B_{MSY} and the fishing mortality rate that produces MSY is called F_{MSY}.

Given this, stocks under review are classified with respect to current overfishing definitions. A stock is overfished if its current biomass is below $B_{THRESHOLD}$ and overfishing is occurring if current F is greater than $F_{THRESHOLD}$. The schematic below depicts how status criteria are interpreted in this context.

Overfishing guidelines are based on the precautionary approach to fisheries management and encourage the inclusion of a control rule in the overfishing definition. Control rules, when they exist, are discussed in the chapter for the stock under consideration. Generically, the control rules suggest actions at various levels of stock biomass and incorporate an assessment of risk, in that F targets are set so as to avoid exceeding F thresholds.

GLOSSARY

ADAPT. A commonly used form of computer program used to optimally fit a Virtual Population Assessment (VPA) to abundance data.

ASPM. Age-structured production models, also known as statistical catch-at-age (SCAA) models, are a technique of stock assessment that integrate fishery catch and fishery-independent sampling information. The procedures are flexible, allowing for uncertainty in the absolute magnitudes of catches as part of the estimation. Unlike virtual population analysis (VPA) that tracks the cumulative catches of various year classes as they age, ASPM is a forward projection simulation of the exploited population.

Availability. Refers to the distribution of fish of different ages or sizes relative to that taken in the fishery.

Biological reference points. Specific values for the variables that describe the state of a fishery system which are used to evaluate its status. Reference points are most often specified in terms of fishing mortality rate and/or spawning stock biomass. The reference points may indicate 1) a desired state of the fishery, such as a fishing mortality rate that will achieve a high level of sustainable yield, or 2) a state of the fishery that should be avoided, such as a high fishing mortality rate which risks a stock collapse and long-term loss of potential yield. The former type of reference points are referred to as "target reference points" and the latter are referred to as "limit reference points" or "thresholds". Some common examples of reference points are $F_{0.1}$, F_{MAX}, and F_{MSY}, which are defined later in this glossary.

B_0. Virgin stock biomass, i.e., the long-term average biomass value expected in the absence of fishing mortality.

B_{MSY}. Long-term average biomass that would be achieved if fishing at a constant fishing mortality rate equal to F_{MSY}.

Biomass Dynamics Model. A simple stock assessment model that tracks changes in stock using assumptions about growth and can be tuned to abundance data such as commercial catch rates, research survey trends or biomass estimates.

Catchability. Proportion of the stock removed by one unit of effective fishing effort (typically age-specific due to differences in selectivity and availability by age).

Control Rule. Describes a plan for pre-agreed management actions as a function of variables related to the status of the stock. For example, a control rule can specify how F or yield should vary with biomass. In the National Standard Guidelines (NSG), the "MSY control rule" is used to determine the limit fishing mortality, or Maximum Fishing Mortality Threshold (MFMT). Control rules are also known as "decision rules" or "harvest control laws."

Catch per Unit of Effort (CPUE). Measures the relative success of fishing operations, but also can be used as a proxy for relative abundance based on the assumption that CPUE is linearly related to stock size. The use of CPUE that has not been properly standardized for temporal-spatial changes in catchability should be avoided.

Exploitation pattern. The fishing mortality on each age (or group of adjacent ages) of a stock relative to the highest mortality on any age. The exploitation pattern is expressed as a series of values ranging from 0.0 to 1.0. The pattern is referred to as “flat-topped” when the values for all the oldest ages are about 1.0, and “dome-shaped” when the values for some intermediate ages are about 1.0 and those for the oldest ages are significantly lower. This pattern often varies by type of fishing gear, area, and seasonal distribution of fishing, and the growth and migration of the fish. The pattern can be changed by modifications to fishing gear, for example, increasing mesh or hook size, or by changing the proportion of harvest by gear type.

Mortality rates. Populations of animals decline exponentially. This means that the number of animals that die in an "instant" is at all times proportional to the number present. The decline is defined by survival curves such as:

$$N_{t+1} = N_t e^{-z}$$

where N_t is the number of animals in the population at time t and N_{t+1} is the number present in the next time period; Z is the total instantaneous mortality rate which can be separated into deaths due to fishing (fishing mortality or F) and deaths due to all other causes (natural mortality or M) and e is the base of the natural logarithm (2.71828).

To better understand the concept of an instantaneous mortality rate, consider the following example. Suppose the instantaneous total mortality rate is 2 (i.e., Z = 2) and we want to know how many animals out of an initial population of 1 million fish will be alive at the end of one year. If the year is apportioned into 365 days (that is, the 'instant' of time is one day), then 2/365 or 0.548% of the population will die each day. On the first day of the year, 5,480 fish will die (1,000,000 x 0.00548), leaving 994,520 alive. On day 2, another 5,450 fish die (994,520 x 0.00548) leaving 989,070 alive. At the end of the year, 134,593 fish [$1,000,000 \times (1 - 0.00548)^{365}$] remain alive. If, we had instead selected a smaller 'instant' of time, say an hour, 0.0228% of the population would have died by the end of the first time interval (an hour), leaving 135,304 fish alive at the end of the year [$1,000,000 \times (1 - 0.00228)^{8760}$]. As the instant of time becomes shorter and shorter, the exact answer to the number of animals surviving is given by the survival curve mentioned above, or, in this example:

$$N_{t+1} = 1,000,000e^{-2} = 135,335 \text{ fish}$$

Exploitation rate. The proportion of a population alive at the beginning of the year that is caught during the year. That is, if 1 million fish were alive on January 1 and 200,000 were caught during the year, the exploitation rate is 0.20 (200,000 / 1,000,000) or 20%.

F_{MAX}. The rate of fishing mortality that produces the maximum level of yield per recruit. This is the point beyond which growth overfishing begins.

$F_{0.1}$. The fishing mortality rate where the increase in yield per recruit for an increase in a unit of effort is only 10% of the yield per recruit produced by the first unit of effort on the unexploited stock (i.e., the slope of the yield-per-recruit curve for the $F_{0.1}$ rate is only one-tenth the slope of the curve at its origin).

$F_{10\%}$. The fishing mortality rate which reduces the spawning stock biomass per recruit (SSB/R) to 10% of the amount present in the absence of fishing. More generally, Fx%, is the fishing mortality rate that reduces the SSB/R to x% of the level that would exist in the absence of fishing.

F_{MSY}. The fishing mortality rate that produces the maximum sustainable yield.

Fishery Management Plan (FMP). Plan containing conservation and management measures for fishery resources, and other provisions required by the MSFCMA, developed by Fishery Management Councils or the Secretary of Commerce.

Generation Time. In the context of the National Standard Guidelines, generation time is a measure of the time required for a female to produce a reproductively-active female offspring for use in setting maximum allowable rebuilding time periods.

Growth overfishing. The situation existing when the rate of fishing mortality is above F_{MAX} and when fish are harvested before they reach their growth potential.

Limit Reference Points. Benchmarks used to indicate when harvests should be constrained substantially so that the stock remains within safe biological limits. The probability of exceeding limits should be low. In the National Standard Guidelines, limits are referred to as thresholds. In much of the international literature (e.g., FAO documents), "thresholds" are used as buffer points that signal when a limit is being approached.

Landings per Unit of Effort (LPUE). Analogous to CPUE and measures the relative success of fishing operations, but is also sometimes used a proxy for relative abundance based on the assumption that CPUE is linearly related to stock size.

MSFCMA. (Magnuson-Stevens Fishery Conservation and Management Act). U.S. Public Law 94-265, as amended through October 11, 1996. Available as NOAA Technical Memorandum NMFS-F/SPO-23, 1996.

Maximum Fishing Mortality Threshold (MFMT, $F_{THRESHOLD}$). One of the Status Determination Criteria (SDC) for determining if overfishing is occurring. It will usually be equivalent to the F corresponding to the MSY Control Rule. If current fishing mortality rates are above $F_{threshold,}$ overfishing is occurring.

Minimum Stock Size Threshold (MSST, $B_{threshold}$). Another of the Status Determination Criteria. The greater of (a) ½B_{MSY}, or (b) the minimum stock size at which rebuilding to B_{MSY} will occur within 10 years of fishing at the MFMT. MSST should be measured in terms of spawning biomass or other appropriate measures of productive capacity. If current stock size is below $B_{THRESHOLD}$, the stock is overfished.

Maximum Spawning Potential (MSP). This type of reference point is used in some fishery management plans to define overfishing. The MSP is the spawning stock biomass per recruit (SSB/ R) when fishing mortality is zero. The degree to which fishing reduces the SSB/R is expressed as a percentage of the MSP (i.e., %MSP). A stock is considered overfished when the fishery reduces the %MSP below the level specified in the overfishing definition. The values of %MSP used to define overfishing can be derived from stock-recruitment data or chosen by analogy using available information on the level required to sustain the stock.

Maximum Sustainable Yield (MSY). The largest average catch that can be taken from a stock under existing environmental conditions.

Overfishing. According to the National Standard Guidelines, "overfishing occurs whenever a stock or stock complex is subjected to a rate or level of fishing mortality that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis." Overfishing is occurring if the MFMT is exceeded for 1 year or more.

Optimum Yield (OY). The amount of fish that will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities and taking into account the protection of marine ecosystems. MSY constitutes a "ceiling" for OY. OY may be lower than MSY, depending on relevant economic, social, or ecological factors. In the case of an overfished fishery, OY should provide for rebuilding to B_{MSY}.

Partial Recruitment. Patterns of relative vulnerability of fish of different sizes or ages due to the combined effects of selectivity and availability.

Rebuilding Plan. A plan that must be designed to recover stocks to the B_{MSY} level within 10 years when they are overfished (i.e. when B < MSST). Normally, the 10 years would refer to an expected time to rebuilding in a probabilistic sense.

Recruitment. This is the number of young fish that survive (from birth) to a specific age or grow to a specific size. The specific age or size at which recruitment is measured may correspond to when the young fish become vulnerable to capture in a fishery or when the number of fish in a cohort can be reliably estimated by a stock assessment.

Recruitment overfishing. The situation existing when the fishing mortality rate is so high as to cause a reduction in spawning stock which causes recruitment to become impaired.

Recruitment per spawning stock biomass (R/SSB). The number of fishery recruits (usually age 1 or 2) produced from a given weight of spawners, usually expressed as numbers of recruits per kilogram of mature fish in the stock. This ratio can be computed for each year class and is often used as an index of pre-recruit survival, since a high R/SSB ratio in one year indicates above-average numbers resulting from a given spawning biomass for a particular year class, and vice versa.

Reference Points. Values of parameters (e.g. B_{MSY}, F_{MSY}, $F_{0.1}$) that are useful benchmarks for guiding management decisions. Biological reference points are typically limits that should not be exceeded with significant probability (e.g., MSST) or targets for management (e.g., OY).

Risk. The probability of an event times the cost associated with the event (loss function). Sometimes "risk" is simply used to denote the probability of an undesirable result (e.g. the risk of biomass falling below MSST).

Status Determination Criteria (SDC). Objective and measurable criteria used to determine if a stock is being overfished or is in an overfished state according to the National Standard Guidelines.

Selectivity. Measures the relative vulnerability of different age (size) classes to the fishing gears(s).

Spawning Stock Biomass (SSB). The total weight of all sexually mature fish in a stock.

Spawning stock biomass per recruit (SSB/R or SBR). The expected lifetime contribution to the spawning stock biomass for each recruit. SSB/R is calculated assuming that F is constant over the life span of a year class. The calculated value is also dependent on the exploitation pattern and rates of growth and natural mortality, all of which are also assumed to be constant.

Survival Ratios. Ratios of recruits to spawners (or spawning biomass) in a stock-recruitment analysis. The same as the recruitment per spawning stock biomass (R/SSB), see above.

TAC. Total allowable catch is the total regulated catch from a stock in a given time period, usually a year.

Target Reference Points. Benchmarks used to guide management objectives for achieving a desirable outcome (e.g., OY). Target reference points should not be exceeded on average.

Uncertainty. Uncertainty results from a lack of perfect knowledge of many factors that affect stock assessments, estimation of reference points, and management. Rosenberg and Restrepo (1994) identify 5 types: measurement error (in observed quantities), process error (or natural population variability), model error (mis-specification of assumed values or model structure), estimation error (in population parameters or reference points, due to any of the preceding types of errors), and implementation error (or the inability to achieve targets exactly for whatever reason).

Virtual population analysis (VPA) (or cohort analysis). A retrospective analysis of the catches from a given year class which provides estimates of fishing mortality and stock size at each age over its life in the fishery. This technique is used extensively in fishery assessments.

Year class (or cohort). Fish born in a given year. For example, the 1987 year class of cod includes all cod born in 1987. This year class would be age 1 in 1988, age 2 in 1989, and so on.

Yield per recruit (Y/R or YPR). The average expected yield in weight from a single recruit. Y/R is calculated assuming that F is constant over the life span of a year class. The calculated value is also dependent on the exploitation pattern, rate of growth, and natural mortality rate, all of which are assumed to be constant.

A. SUMMER FLOUNDER ASSESSMENT SUMMARY FOR 2005

State of Stock: The summer flounder stock is not overfished, but overfishing is occurring relative to the biological reference points. The fishing mortality rate has declined from 1.32 in 1994 to 0.40 in 2004 (Figure A1). The 80% confidence interval for F in 2004 ranges from 0.34 to 0.49. Retrospective analysis shows that the current assessment method tends to underestimate recent fishing mortality rates (Figure A4). The overfishing reference point $F_{threshold}$ (= F_{max}) was previously estimated to be 0.263 (Terceiro 1999; MAFMC 1999) (Figures A1, A3). For the present assessment, the updated estimate of $F_{threshold}$ (= F_{max}) is 0.276 (Figures A1, A3) .

Total stock biomass (TSB) has increased substantially since 1989, and was estimated to be 54,900 mt on January 1, 2005. The 80% confidence interval for total stock biomass on January 1, 2005 ranged from 49,300 to 62,100 mt. The biomass threshold reference point (½TSB_{MSY}) was previously estimated to be 53,200 mt (Terceiro 1999; MAFMC 1999) (Figures A2, A3). For the present assessment, the updated estimate of the biomass threshold (½TSB_{MSY}) is 46,323 mt (Figures A2, A3).

Spawning stock biomass (SSB; Age 0+) declined 72% from 1983 to 1989 (18,800 mt to 5,200 mt), but with improved recruitment and decreased fishing mortality has increased to 38,600 mt in 2004 (Figure A2). Retrospective analysis shows a tendency to overestimate the SSB in the most recent years (Figure A4). The age structure of the spawning stock has expanded, with 75% at ages 2 and older, and 16% at ages 5 and older (Figure A5).

The arithmetic average recruitment from 1982 to 2004 is 38 million fish at age 0, with a median of 33 million fish. The 2004 year class is currently estimated to be at the median of 33 million fish (Figure A2, A6). Retrospective analysis shows that the current assessment method tends to overestimate the abundance of age 0 fish in the most recent years (Figure A4).

Forecasts for 2005-2006: Stochastic forecasts were conducted, incorporated uncertainty in 2005 stock sizes from survey variability, and assumed current discard to landings proportions. If landings in 2005 are 13,744 mt (30.2 million lbs) and discards are 1,269 mt (2.8 million lbs), the forecasts estimate a median F in 2005 = 0.40 and a median total stock biomass on January 1, 2006 of 59,900 mt, above the biomass threshold of ½TSB_{MSY} = 53,200 mt. (Figure A3). Landings of 14,969 mt (33.0 million lbs) and discards of 1,400 mt (3.1 million lbs) in 2006 provide a median F in 2006 = 0.41 and a median total stock biomass level on January 1, 2007 of 63,800 mt (Figure A3). A subsequent reduction in fishing mortality in 2007 to F = 0.263, the reference point, is forecast to yield landings of 10,853 mt (23.9 million lbs).

Forecast Table: 2005 Landings = 13,744 mt
2005-2007 median recruitment from 1982-2004 VPA estimates (33.1million)

Forecast medians (landings, discards, and total stock biomass (TSB) in '000 mt)

2005				2006				2007			
TSB	F	Land	Disc	TSB	F	Land	Disc	TSB	F	Land	Disc
54.9	0.40	13.7	1.3	59.9	0.41	15.0	1.4	63.8	0.26	10.9	1.0

Catch and Status Table (weights in '000 mt, recruitment in millions, arithmetic means): Summer Flounder

Year	1998	1999	2000	2001	2002	2003	2004	Max[2]	Min[2]	Mean[2]
Commercial landings	5.1	4.8	5.1	5.0	6.6	6.5	7.8	17.1	4.0	8.3
Commercial discards	0.4	1.5	0.7	0.5	0.4	0.5	0.2	1.5	0.2	0.7
Recreational landings	5.7	3.8	7.1	5.3	3.6	5.3	4.8	12.7	1.4	5.3
Recreational discards	0.5	0.7	0.9	1.2	0.7	0.7	1.0	1.2	0.1	0.5
Catch used in assessment	11.7	10.8	13.8	12.0	11.3	13.0	13.8	26.5	8.0	14.6
Commercial quota	4.9	4.9	4.9	4.6	6.6	6.3	7.6			
Recreational harvest limit	3.4	3.4	3.4	3.3	4.4	4.2	5.1			
Spawning stock biomass[1]	17.8	16.5	19.4	25.5	29.4	36.4	38.6	38.6	5.2	16.5
Recruitment (age 0)	31.0	29.4	35.9	32.8	38.1	27.5	33.1	80.3	13.0	38.0
Total stock biomass[3]	32.0	29.1	27.9	31.4	39.5	46.4	53.1	53.1	16.1	32.7
F (ages 3-5)	0.97	0.99	0.86	0.65	0.46	0.43	0.40	2.07	0.40	1.32
Exploitation rate	57%	58%	53%	44%	34%	33%	30%	82%	23%	68%

[1]At the peak of the spawning season (i.e., on November 1), ages 0-7+ . [2]Over period 1982-2004 [3]On January 1

Stock Distribution and Identification: The Mid-Atlantic Fishery Management Council (MAFMC) and Atlantic States Marine Fisheries Commission (ASMFC) Fishery Management Plan for summer flounder defines the management unit as all summer flounder from the southern border of North Carolina northeast to the US-Canada border. For assessment purposes, the definition of Wilk et al. (1980) of a unit stock extending from Cape Hatteras north to New England has been accepted in this and previous assessments (NEFSC 2002). A recent summer flounder genetics study, which revealed no population subdivision at Cape Hatteras (Jones and Quattro 1999), is consistent with the definition of the current management unit. A recent consideration of summer flounder stock structure incorporating new tagging data concluded that evidence supported the existence of stocks north and south of Cape Hatteras, with the stock north of Cape Hatteras possibly composed of two distinct spawning aggregations, off New Jersey and Virginia-North Carolina (Kraus and Musick, 2003). The conclusions of Kraus and Musick (2003) are consistent with the current assessment unit.

Catches: Total landings peaked in 1983 at 26,100 mt. During the late 1980s and into 1990, landings declined markedly, reaching 4,200 mt in the commercial fishery in 1990 and 1,400 mt in the recreational fishery in 1989. Total landings were only 6,500 mt in 1990. Reported 2004 landings in the commercial fishery were 7,748 mt, about 2% over the adjusted commercial quota. Commercial discard losses are estimated from fishery observer data and have recently constituted 5%-10% of the total commercial catch, assuming a discard mortality rate of 80%. Estimated 2004 landings in the recreational fishery were 4,841 mt, about 5% under the recreational harvest limit. Recreational discard losses have recently comprised 10%-15% of the total recreational catch, assuming a discard mortality rate of 10%. Total commercial and recreational landings in 2004 were 12,589 mt, and total catch was estimated at 13,832 mt (Figure A1).

Data and Assessment: An analytical assessment (VPA) of commercial and recreational total catch at age (landings plus discards) was conducted. The natural mortality rate (M) was assumed to be 0.2. Indices of recruitment and stock abundance from NEFSC winter, spring, and autumn; Massachusetts spring and autumn; Rhode Island; Connecticut spring and autumn; Delaware; and New Jersey trawl surveys were used in VPA tuning in an ADAPT framework (NFT 2005). Recruitment indices from surveys conducted by the states of North Carolina, Virginia, and Maryland were also used in the VPA tuning. The current VPA tuning configuration is the same as that in the 2002 SAW 35 (NEFSC 2002) and in the 2003 and 2004 SAW Southern Demersal Working Group assessments (Terceiro 2003, SDWG 2004).

Biological Reference Points: Biological reference points for summer flounder are based on a yield per recruit model (Thompson and Bell 1934). The yield per recruit analysis conducted for the 1999 assessment (Terceiro 1999) indicated that F_{max} = 0.263, which was used as a proxy for $F_{threshold}$ (Figure A3). No value for F_{target} has been defined for summer flounder. The current Fishery Management Plan (FMP) Amendment 12 stock biomass reference points were estimated as the product of yield per recruit (0.552 kg per recruit) and total stock biomass per recruit (2.813 kg per recruit) at F_{max} = 0.263, and median recruitment of 37.8 million fish per year (1982-1998; from Terceiro (1999)). Yield at F_{max}, used as a proxy for MSY, was estimated to be 20,900 mt (46 million lbs), and the corresponding stock biomass, used as a proxy for $B_{MSY,}$ was estimated to be 106,400 mt (235 million lbs; Figure A3). In the review of the 2002 stock assessment, SARC 35 concluded that updating these reference points was not warranted at that time (NEFSC 2002).

For present assessment, updated input data (1992-2004 average mean weights, maturities, and partial recruitment) were used to revise the yield and biomass per recruit analysis. The updated 1982-2004 VPA provided an estimate of median recruitment for summer flounder of 33.1 million age 0 fish. The revised estimates of the biological reference points are $F_{MSY} = F_{max}$ = 0.276, MSY = 19,072 mt (42.0 million lbs), and TSB_{MSY} = 92,645 mt (204.2 million lbs). The revised estimate of the biomass threshold, ½$TSB_{MSY,}$ is 46,323 mt (102.1 million lbs).

Fishing Mortality: Fishing mortality calculated from the average of the currently fully recruited ages (3-5) was high during 1982-1997, varying between 0.9 and 2.2 (55%-83% exploitation), far in excess of the Amendment 12 overfishing definition, $F_{threshold} = F_{max}$ = 0.26 (21% exploitation; Figure A1). The fishing mortality rate has declined substantially since 1997 and was estimated to be 0.40 (30% exploitation) in 2004. The 80% confidence interval for F in 2004 ranged from 0.34 to 0.49. Retrospective analysis shows that the current assessment method tends to underestimate recent fishing mortality rates (Figure A4).

Total Stock Biomass: Total stock biomass has increased substantially since 1989, and in 2005 total stock biomass was estimated to be 54,900 mt, slightly above the Amendment 12 biomass threshold (Figures A2, A3). The 80% confidence interval for total stock biomass in 2005 ranged from 49,300 to 62,100 mt.

Recruitment: The arithmetic average recruitment from 1982 to 2004 is 38 million fish at age 0, with a median of 33 million fish. The 1982 and 1983 year classes are the largest in the VPA time series, at 74 and 80 million fish. Recruitment declined from 1983 to 1988, with the 1988 year class the weakest at only 13 million fish. Recruitment since 1988 has generally improved. The 2003 year class is currently estimated to be below average at 27 million fish. The 2004 year class is currently estimated to be at the median of 33 million fish (Figures A2, A6). Retrospective analysis shows that the current assessment method tends to overestimate the abundance of age 0 fish in the most recent years (Figure A4).

Spawning Stock Biomass: Spawning stock biomass (SSB; Age 0+) declined 72% from 1983 to 1989 (18,800 mt to 5,200 mt), but with improved recruitment and decreased fishing mortality has increased to 38,600 mt in 2004 (Figure A2). Retrospective analysis shows a tendency to overestimate the SSB in the most recent years (Figure A4). The age structure of the spawning stock has expanded, with 75% at ages 2 and older, and 16% at ages 5 and older (Figure A5). Under equilibrium conditions and at F_{max} = 0.263 from Amendment 12, about 85% of the spawning stock biomass would be expected to be ages 2 and older, with 50% at ages 5 and older (Figure A5). Similar results for the long-term population structure are derived using the updated F_{max} = 0.276.

Special comments: Major sources of assessment uncertainty

1) There is persistent retrospective underestimation of fishing mortality in the assessment.

2) The landings from the commercial fisheries used in this assessment assume no under reporting of summer flounder landings. Therefore, reported landings from the commercial fisheries should be considered minimal estimates.

3) The recreational fishery landings and discards used in the assessment are estimates developed from the Marine Recreational Fishery Statistics Survey (MRFSS). While the estimates of summer flounder catch are among the most precise produced by the MRFSS, they are subject to possible error. The proportional standard error (PSE) of estimates of summer flounder total landings in numbers has averaged 7%, ranging from 26% in 1982 to 3% in 1996, during 1982-2004.

4) The length and age composition of the recreational discards are based on data from a limited geographic area (Long Island, New York, 1988-1992; Connecticut, 1997-2004, New York party boats 2000-2004, ALS releases focused in New York and New Jersey, 1999-2004). Sampling of recreational fishery discards on an annual, synoptic basis is needed.

5) The allocation of commercial landings to water area and the measure of commercial fishing effort used in the estimate of discards both rely on information self-reported by commercial fishermen in Vessel Trip Reports (VTR), which are subject to possible error.

Sources of Information:

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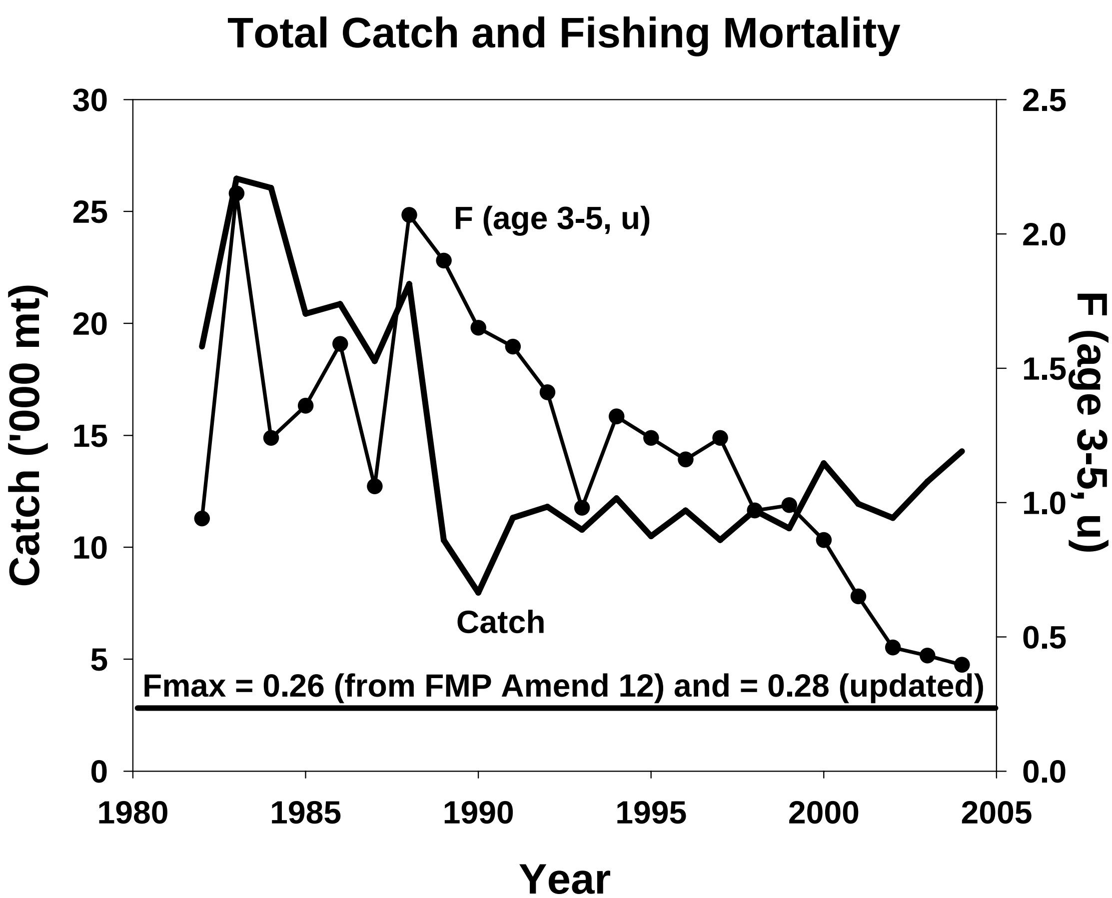
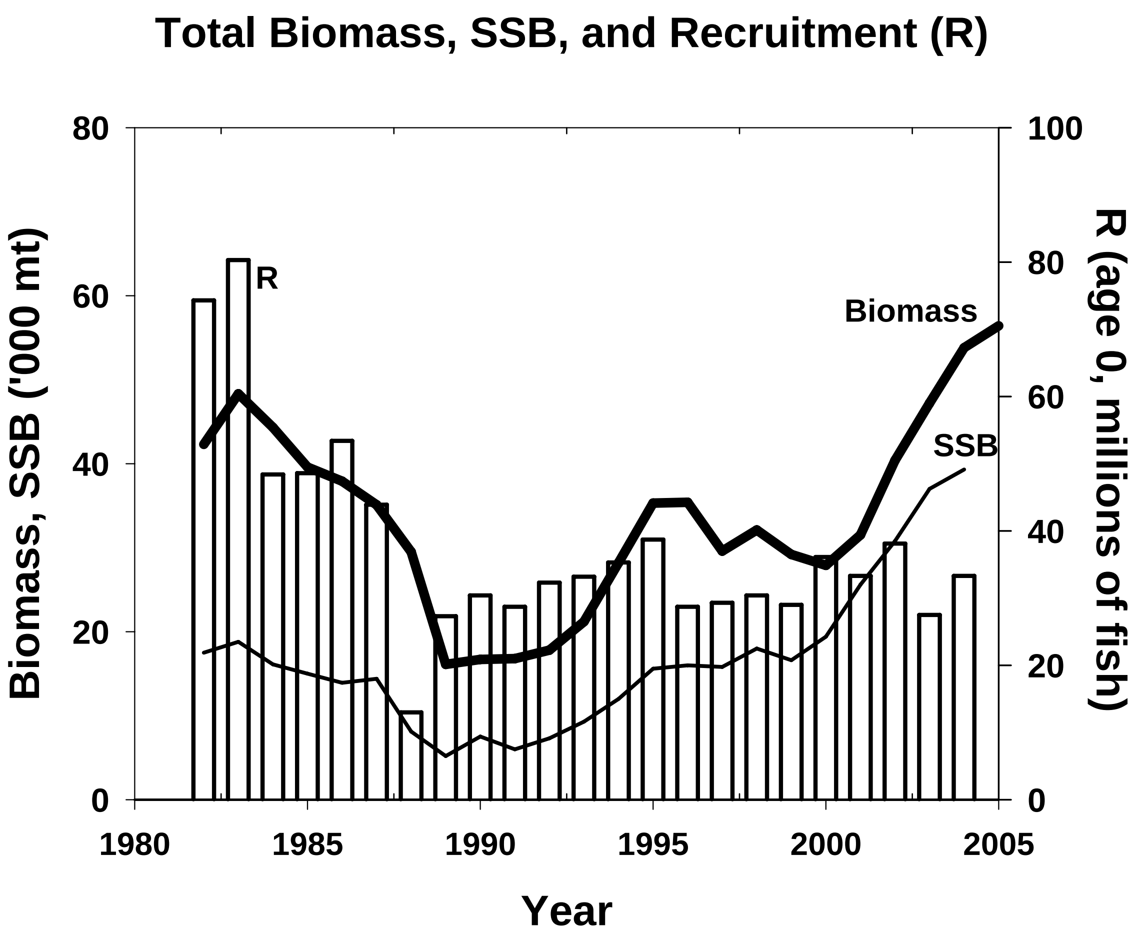
Wilk, S.J., W. G. Smith, D.E. Ralph and J. Sibunka. 1980. The population structure of summer flounder between New York and Florida based on linear discriminant analysis. Trans. Am. Fish. Soc. 109:265-271.

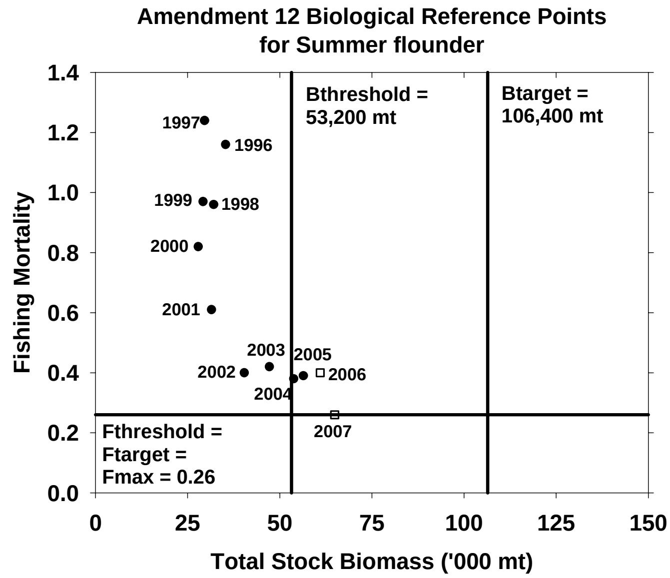
A1. Total catch (landings and discards, thousands of metric tons) and fishing mortality rate (F, ages 3-5, unweighted) for summer flounder.

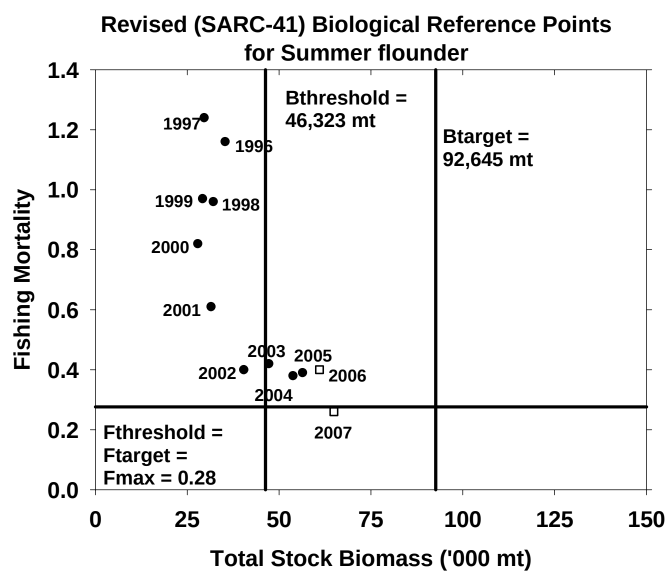


A2. Total stock biomass ('000 mt; thick line), spawning stock biomass (SSB, '000 mt; thin line), and recruitment (millions of fish at age-0; bars) for summer flounder by year.

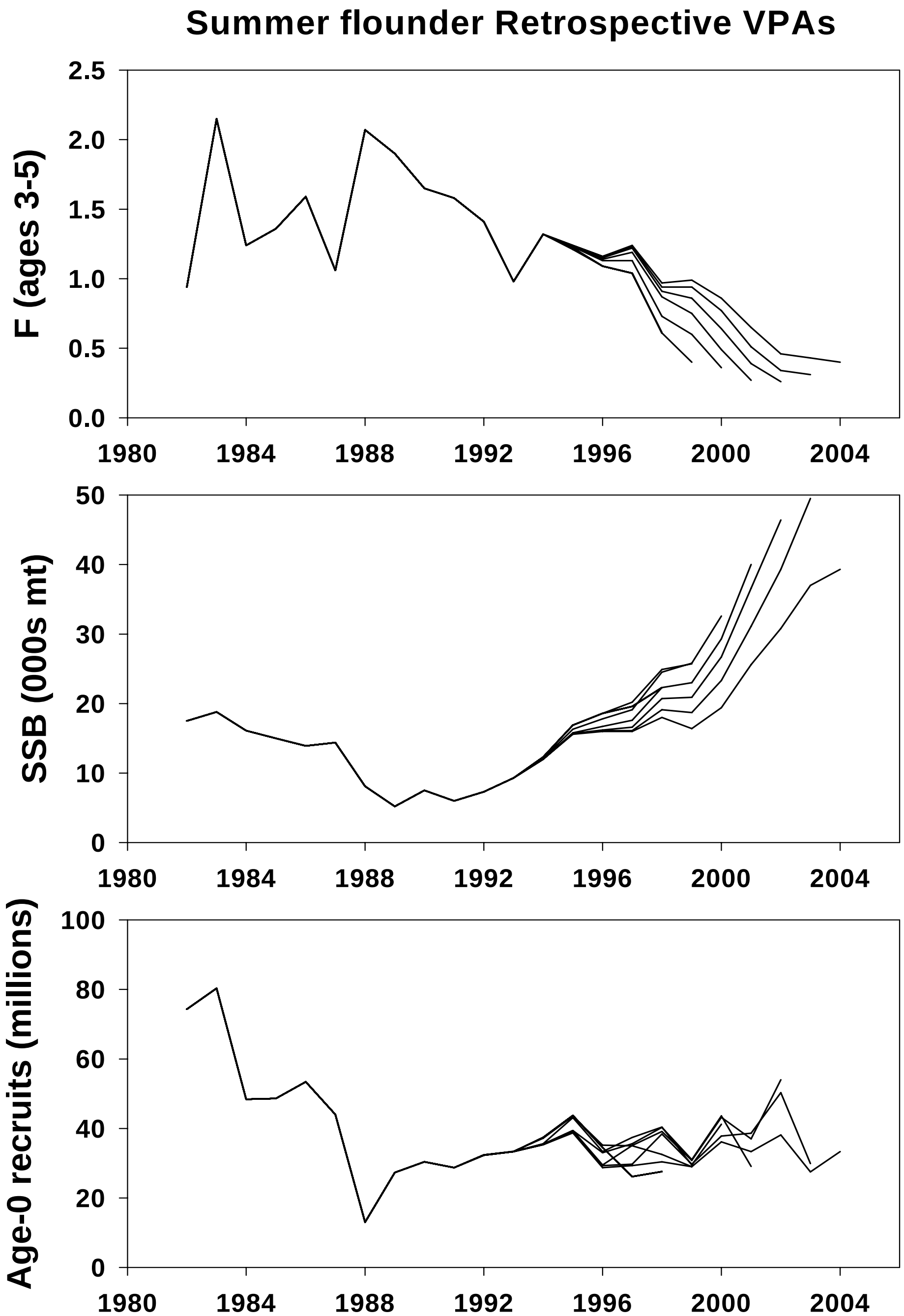


A3. Estimates of Biological Reference Points, biomass and F.

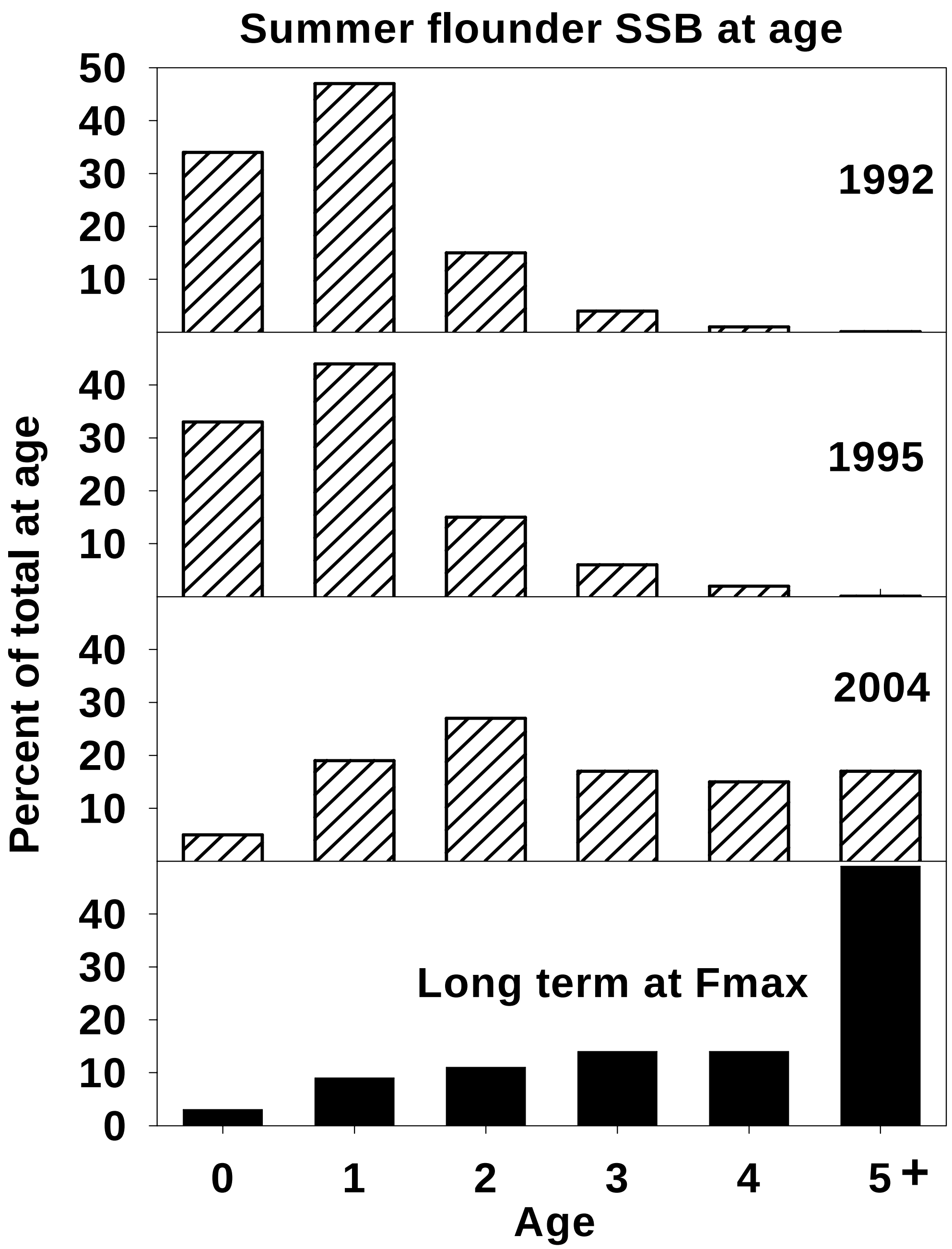




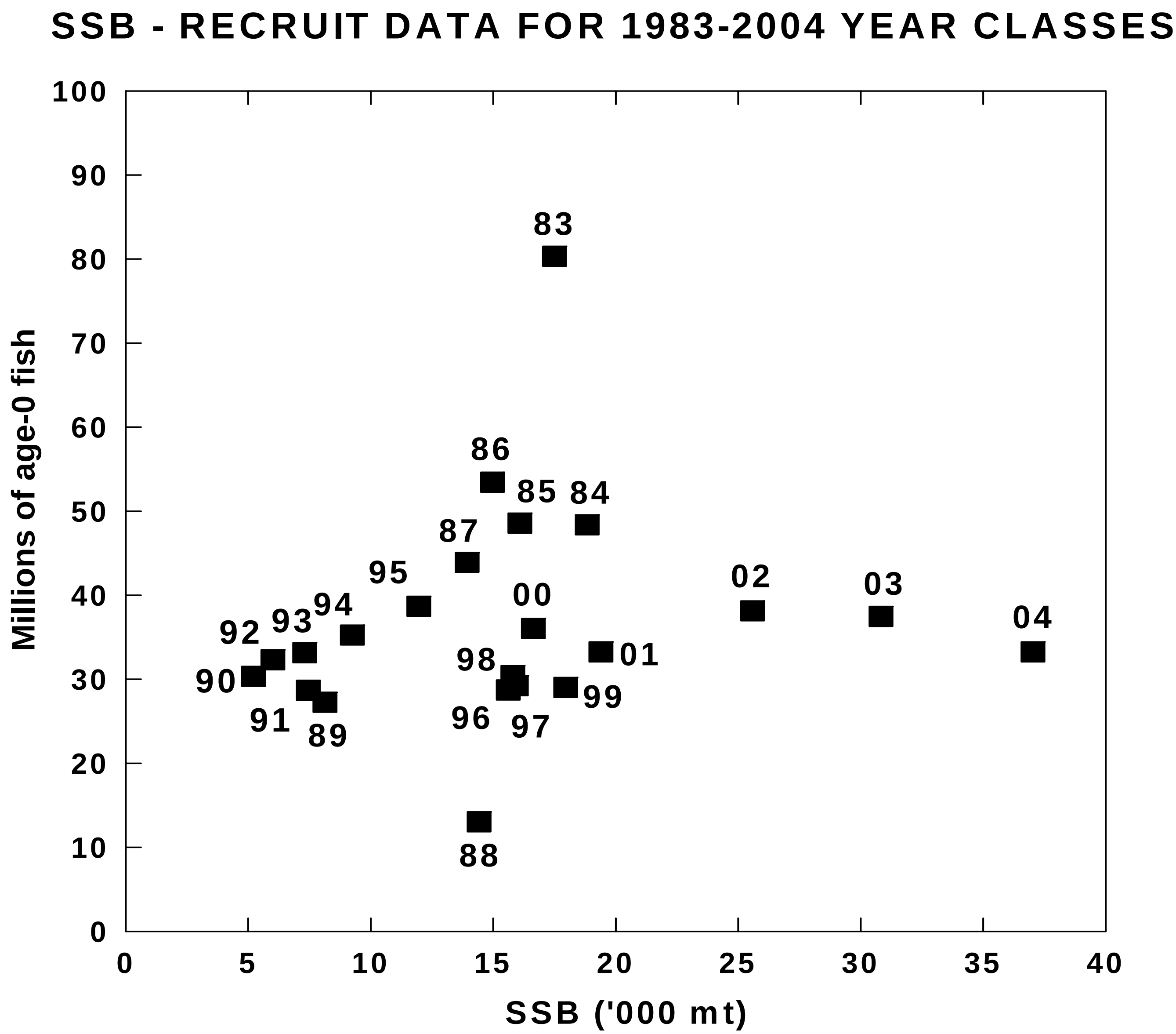
A4. Retrospective VPAs for summer flounder.



A5. Percent of summer flounder spawning stock biomass (SSB) at age in 1992, 1995, 2004 and long-term at Fmax = 0.263. Similar long-term results are derived using updated Fmax = 0.276.



A6. VPA spawning stock biomass and recruitment estimates for summer flounder.



B. BLUEFISH ASSESSMENT SUMMARY

State of Stock: The bluefish biological reference points (BRP) listed in Amendment 1 to the Bluefish Fishery Management Plan, implemented in 2000, are ½B_{MSY} = 53,751 mt (118.5 million lbs) and F_{MSY} = 0.40. The updated estimates of these reference points, from the present assessment, are ½B_{MSY} = 33,351 mt (73.5 million lbs) and F_{MSY} = 0.19. Based on the present assessment's ASAP model, bluefish biomass in 2004 was estimated to be 47,235 mt (104 million lbs) (Figure B3) and fishing mortality rate in 2004 was estimated to be F = 0.15.

Based on the Amendment 1 BRPs, the bluefish stock is considered overfished but overfishing is not occurring. Based on the new biological reference point estimates, the bluefish resource is not considered overfished and overfishing is not occurring.

Fishing mortality rates show a decreasing trend in F, an increasing trend in population biomass, and an increasing trend in population numbers. Population abundance estimates have increased since 1997 (Figure B2). Abundance peaked in 1982 at 176 million fish, declined to 57 million in the mid-1990s and has since increased to 92 million fish (Figure B2).

Forecast for 2005: No forecast was made.

Catch and Status Table (weights in '000 mt): Bluefish

Year	1998	1999	2000	2001	2002	2003	2004	Max	Min	Mean
USA Commercial landings[1]	3.7	3.3	3.7	3.9	3.1	3.4	3.8	7.5	0.8	3.7
USA Recreational landings[2]	6.6	5.4	6.2	7.5	6.6	8.0	6.9	43.6	5.4	16.7
USA Recreational discards[2]	1.2	1.7	2.2	2.3	1.9	1.8	1.7	2.3	0.6	1.4
Total Catch[2]	11.5	10.4	12.0	13.8	11.6	13.1	12.4	51.9	10.4	23.1
Total Stock Biomass[2]	32.1	33.1	36.4	39.8	40.0	41.8	47.2	103.9	29.4	49.6
F[2]	0.23	0.20	0.20	0.22	0.18	0.19	0.15	0.46	0.15	0.29

[1] Min, max and mean since 1950.
[2] Min, max and mean since 1982.

Stock Distribution and Identification: Bluefish is a highly migratory, pelagic species found along the U.S. Atlantic coast from Maine to Florida, but generally are found north of the Carolinas only in warmer months (Beaumariage 1969; Lund and Maltezos 1970). Bluefish in the western North Atlantic are managed as a single stock (NEFSC 1997; Fahay et al. 1999). Genetic data support a unit stock hypothesis (Graves et al. 1992; Goodbred and Graves 1996; Davidson 2002). For management purposes, the ASMFC and MAFMC define the management unit as the portion of the stock occurring along the Atlantic Coast from Maine to the east coast of Florida.

Catches: Bluefish are one of the most sought after species by recreational fishers along the Atlantic Coast. In 2004, recreational anglers along the Atlantic Coast harvested over 6,900 mt of bluefish (Figure B1). Recreational landings have ranged from a low of 5,379 mt in 1999 to a high of 43,607 mt in 1986 (Figure B1). Landings from the commercial fishery have been consistently lower than in the recreational fishery. Regional variations in commercial fishing activity are linked to the seasonal migration of bluefish. Commercial landings decreased from

7,500 mt in 1981 to 3,100 mt in 2002. Commercial landings have been regulated by quota since the implementation of Amendment 1 in 2000. In 2004, commercial landings were 3,800 mt (Figure B1). Gill nets are the dominant commercial gear used to target bluefish and account for over 40% of the bluefish commercial landings from 1950 to 2003. Other commercial gears including hook and line, pound nets, seines, and trawls, which collectively account for about 50% of the commercial landings.

Data and Assessment: The Bluefish Technical Committee evaluated the quality of the commercial, recreational data, and aging information for use in an analytical model. Most of the commercial sampling since 1997 has occurred in North Carolina and Virginia, where a large proportion of the landings is taken. The committee determined that the amount of sampling by gear and market grade adequately represented the length distribution of Atlantic coast bluefish landings. Recreational landings data, length data, and discard estimates were obtained from the MRFSS survey. Age data were used from Virginia's cooperative aging program and North Carolina age data were available from 1983 to 1996. Most state agencies between Massachusetts and Florida conduct annual marine finfish surveys. These survey indices were evaluated for their appropriateness in the bluefish assessment. The approach was to evaluate the utility of each survey index based on their performance within the modelling framework.

The Bluefish Technical Committee decided that an age-based model such as a catch-at-age model or VPA model was appropriate for a bluefish assessment. The bluefish data were truncated to an age-6+ category to reduce the influence of ageing error and to reduce the bimodality of catch-at-age distributions. The NFT ADAPT version of VPA was used as an initial model. The Committee concluded that although the VPA produced satisfactory results, the assumption of no error in the catch-at-age matrix and the way ADAPT handles selectivity may produce misleading results. Therefore, a catch-at-age model, ASAP from the NFT models, was chosen as the primary assessment tool. The ASAP model allows error in the catch-at-age as well as the assumption of separability into year and age components making it better at handling the selectivity patterns and catch data from the bluefish fishery.

Biological Reference Points: The biological reference points in the FMP for Atlantic coast bluefish, $\frac{1}{2}B_{MSY}$ = 53,750 mt (118.5 million lbs) and F_{MSY} = 0.4, were based on a surplus production model that was rejected at the SAW-39 review in 2004. New biological reference points developed for the present assessment using an ASAP model are $\frac{1}{2}B_{MSY}$ = 33,351 mt (73.5 million lbs), F_{MSY} = 0.19, F_{MAX} = 0.28, $F_{0.1}$ = 0.18 and $F_{30\%}$ = 0.28.

Alternative reference point values were also calculated using an age-based Thompson-Bell yield-per-recruit model and gave estimates of F_{MAX} = 0.25, $F_{0.1}$ = 0.17 and $F_{30\%}$ = 0.26. In the Y/R model, partial recruitment values were based on the average 1982-2003 ASAP selectivity estimates. The model was extended to age-7+ with a selectivity of 1.0.

The estimated F in 2004 of 0.15 is below both the old and new estimates of F_{MSY} and below the alternative F reference points. Therefore, it is concluded that bluefish is not experiencing overfishing.

Recruitment and spawning stock biomass were estimated in the ASAP model and these values were used to fit a Beverton-Holt S/R relationship. The parameters for bluefish were alpha = 35426.6 and beta = 41159.4 with a steepness of 0.74 (Figure B4). Spawning stock biomass (SSB) at MSY was estimated equal to be 64,455 mt (142.1 million lbs). Using the SSB/R and B/R estimates from the Thompson-Bell model, the Shepherd/Sissenwine approach estimated B_{MSY} = 66,701 mt (147.05 million lbs).

The current FMP defines overfished condition as a biomass level below ½ $B_{MSY.}$ The biomass reference point (½ B_{MSY}) in the current FMP equals 53,751 mt (118.5 million lbs) whereas the new proposed estimate is 33,351 mt (73.5 million lbs). The current estimate of biomass, B_{2004}, is 47,235 mt (104.1 million lbs), which would be considered overfished under the FMP definition and not overfished according to the new proposed value of ½B_{MSY}.

Fishing Mortality: Fishing mortality estimates in ASAP are based on a separability assumption involving year and age. The 2004 F_{MULT} value equals 0.15, which is the estimate of full F. F has steadily declined since 1991 when F reached 0.41 (Figure B2).

Total Stock Biomass: Biomass estimates peaked in 1982 at 99,790 mt (220 million lbs), declined to 29,483 mt (65 million lbs) in 1997, and has since increased to 47,235 mt (104 million lbs) in 2004.

Recruitment & Spawning Stock Biomass: Between 1982 and 2004, the number of age 0 recruits ranged from about 10,000,000 to 70,000,000 per year. During the same period, annual spawning stock biomass ranged from about 25,000 – 105,000 mt. Recruitment and spawning stock biomass, both estimated in the ASAP model, were positively related and were fit to a Beverton-Holt S/R relationship (Figure B4).

Special Comments:
1) All of the SARC-41 external reviewers expressed the view that this bluefish assessment had several significant weaknesses. For more details, see the "Introduction" of this report and see the external reviewers' reports at website: http://www.nefsc.noaa.gov/nefsc/saw/ under the heading "Recent Reports".

2) The highly migratory nature of bluefish populations and the recruitment dynamics of the species create a challenging modelling situation. Migration creates seasonal fisheries with unique selectivity patterns which a bimodal partial recruitment pattern.

3) The migratory pattern of bluefish results in several recruitment events. A spring cohort, originating south of Cape Hatteras, NC during spring migrations, and a summer cohort originating in the offshore Mid-Atlantic Bight together generate a bimodal age-0 size distribution. It has been hypothesized that the success of the spring cohort controls the abundance of adult bluefish. The variable intra-annual recruitment pattern is a source of uncertainty in the assessment.

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Fahay, M.P., P.L. Berrien, D.L. Johnson and W.W. Morse. 1999. Essential Fish Habitat Source Document: Bluefish, *Pomatomus saltatrix*, Life History and Habitat Characteristics. NOAA Technical Memorandum, NMFS-NE-144:78.

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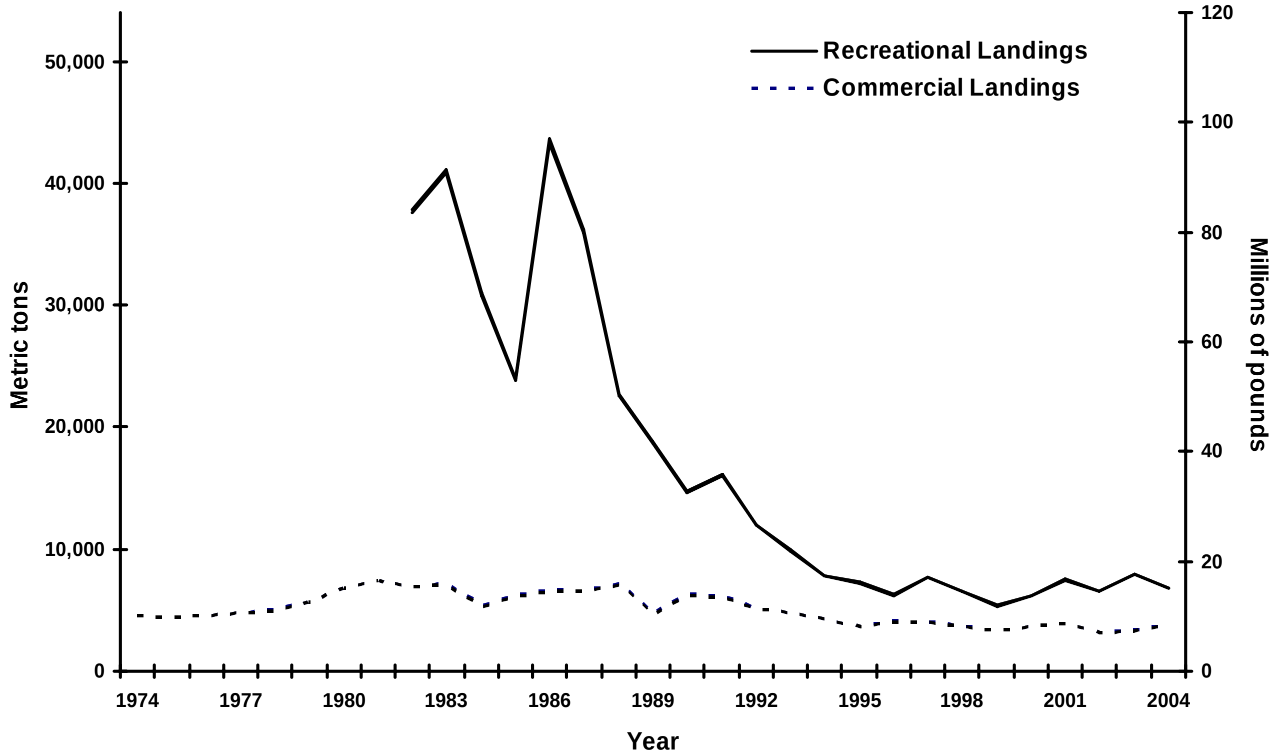
Graves, J.E., J.R. McDowell, A.M. Beardsley and D.R. Scoles. 1992. Stock structure of the bluefish *Pomatomus saltatrix* along the Mid-Atlantic coast. Fishery Bulletin 90:703-710.

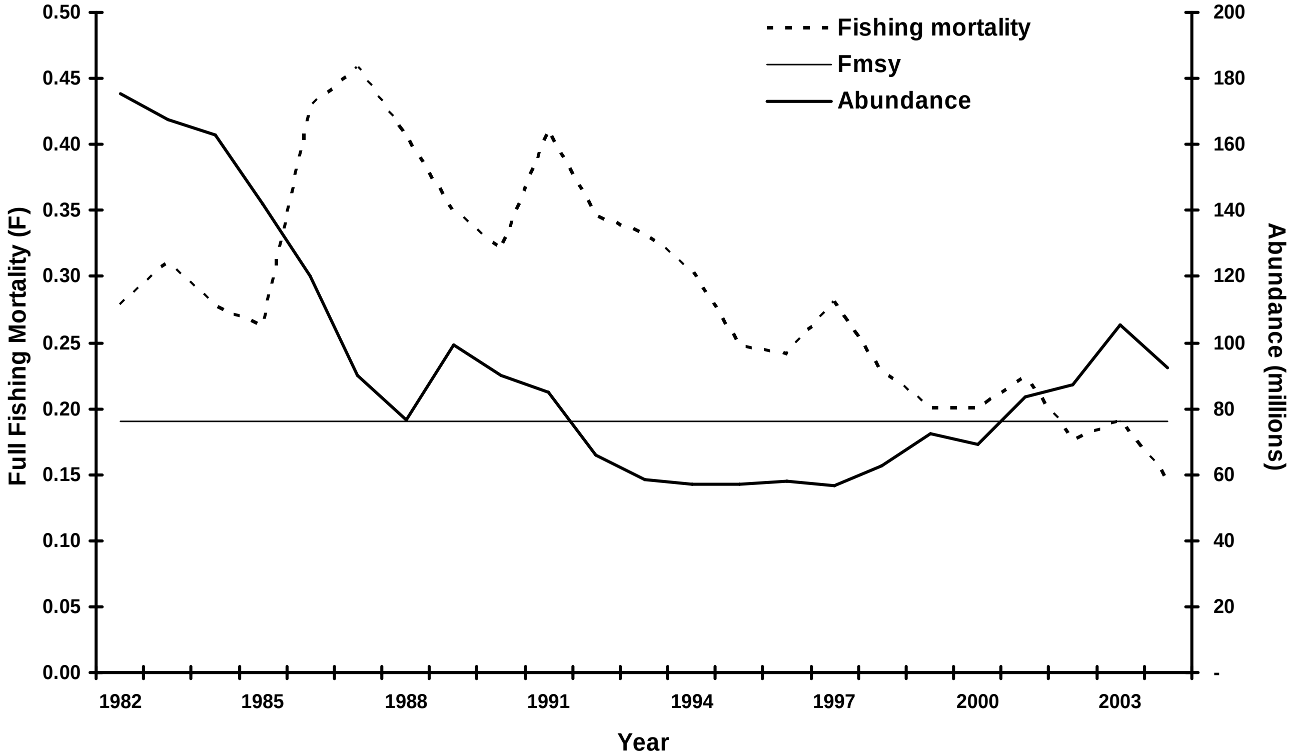
Lund, W.A. and G.C. Maltezos. 1970. Movements and migrations of the bluefish, *Pomatomus saltatrix*, tagged in waters of New York and Southern New England. Transactions of the American Fisheries Society 99:719-725.

Northeast Fisheries Science Center. 1997. Report of the 23rd Northeast Regional Stock Assessment Workshop (23rd SAW): Stock Assessment Review Committee (SARC) consensus summary of assessments. NEFSC Reference Document 97-05.

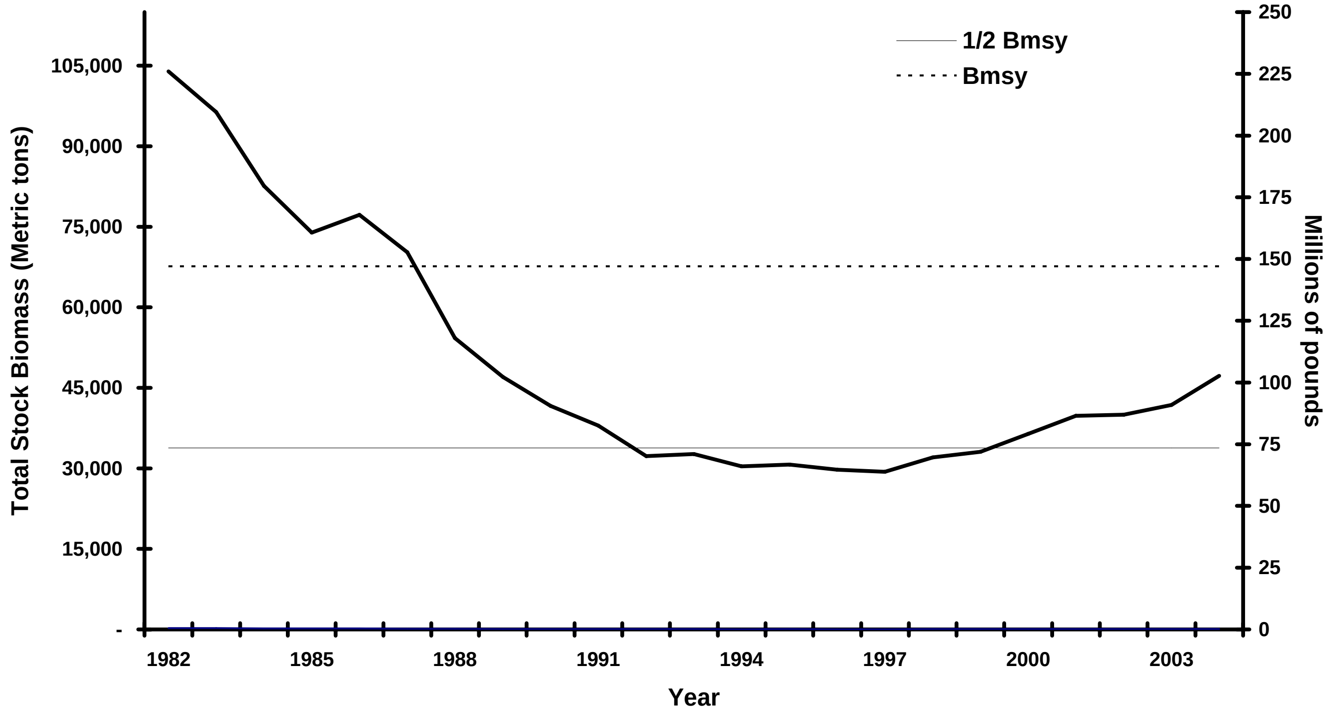
B1. Recreational and commercial landings of bluefish, Maine to Florida. Recreational series begins in 1982.



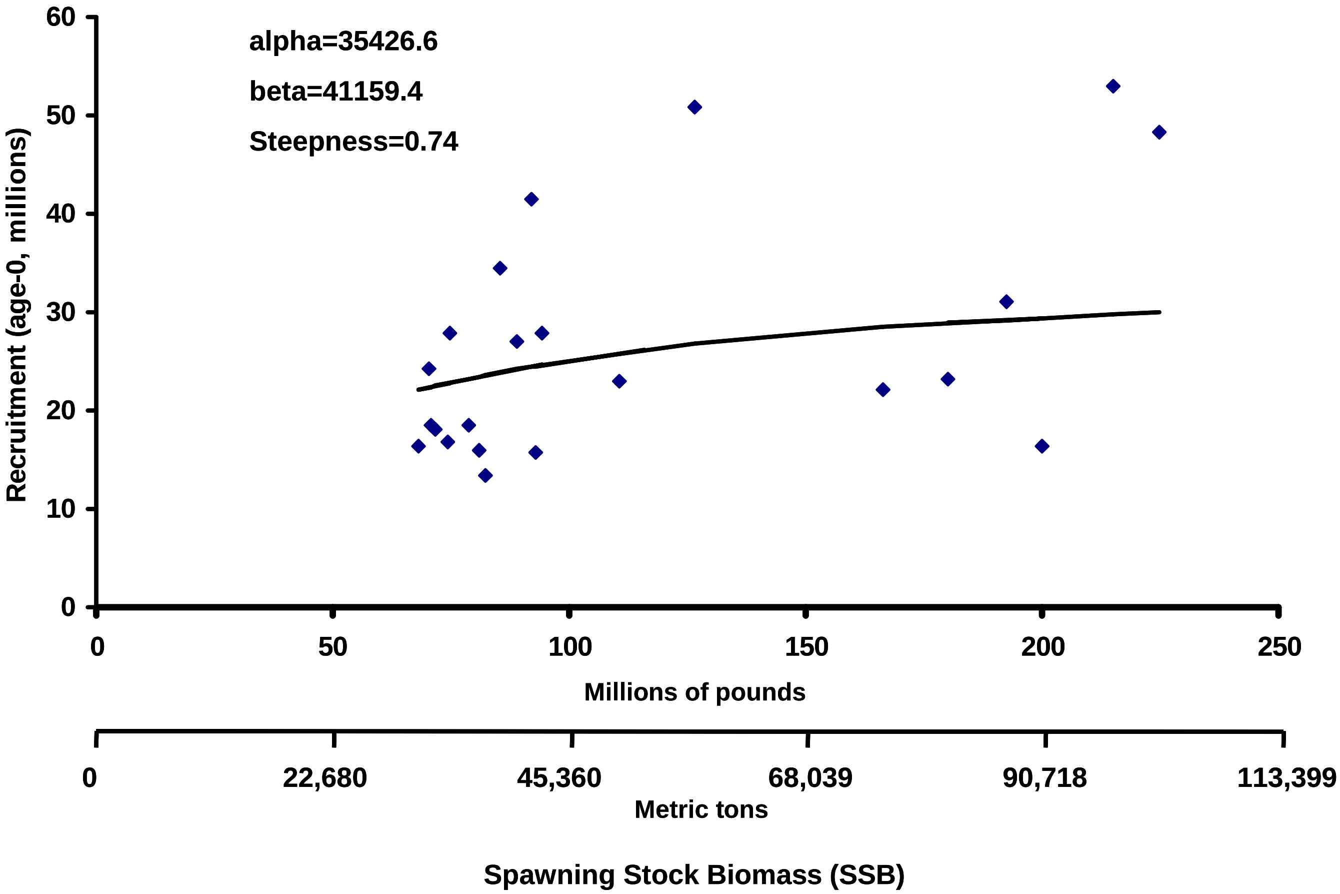
B2. Fishing mortality and total stock abundance estimates of bluefish along the Atlantic coast estimated from the ASAP model. Proposed F_{msy} reference point also from the ASAP results.



B3. Atlantic coast bluefish biomass and proposed biological reference points from ASAP model.



B4. Bluefish stock-recruitment relationship from data estimated in ASAP model.



C. GOLDEN TILEFISH ASSESSMENT SUMMARY FOR 2005

State of Stock: The Golden tilefish stock is not overfished and overfishing is not occurring (Figure C1). Fishing mortality in 2004 was estimated to be 87% of F_{msy} (Figure C1),and total biomass in 2005 was estimated to be 72% of B_{msy}. Stock biomass in 2005 is above that projected for 2005 in the 1998 assessment (59% of B_{msy}). However high variability exists in the terminal year ratio estimates. The 80% confidence interval for the 2004 F/F_{msy} ratio is between 0.5 and 1.3 and for the 2005 B/B_{msy} ratio is between 0.5 and 1.2 (Figure C2).

Forecast: Given the high variance associated with the terminal year estimates of 2004 F/F_{msy} and 2005 B/B_{msy} ratios, projections were not conducted as these were considered too uncertain to form the basis for evaluating likely biomass recovery schedules relative to B_{msy} under various TAC strategies.

Landings and Status Table (weights in '000 mt live): Golden tilefish

Year	1998	1999	2000	2001	2002	2003	2004	2005	Max[1]	Min[1]	Mean[1]
Commercial landings	1.3	0.5	0.5	0.9	0.9	1.1	1.2	-	4.0	0.4	1.6
B/B_{msy} ratios	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.7	1.5	0.3	0.7
F/F_{msy} ratios	2.1	0.8	0.6	0.9	0.8	0.9	0.9	-	4.0	0.2	1.4
Total biomass	3.1	2.9	3.4	4.2	4.8	5.5	6.1	6.7	13.9	2.5	6.2
Total fishing mortality	0.45	0.17	0.13	0.19	0.17	0.19	0.18	-	0.86	0.04	0.29

[1] Over period 1973-2004.

Stock Distribution and Identification: Golden tilefish, *Lopholatilus chamaeleonticeps*, inhabit the outer continental shelf from Nova Scotia to South America, and are relatively abundant in the Southern New England to Mid-Atlantic region at depths from 80 to 440 m. Tilefish have a narrow temperature preference of 9 to 14 °C. The Virginia-North Carolina border, defines the stock boundary between the northern and southern stocks.

Catches: Total commercial landings (live weight) increased from less than 125 mt during 1967-1972 to more than 3,900 mt in 1979 and 1980 (Figure C3). Landings stabilized at about 2,000 mt during 1982-1986. Landings increased in 1987 to 3,200 mt but subsequently declined to 450 mt in 1989. During 1988 to 1998, annual landings ranged between 454 and 1,838 mt. Landings during 1999 to 2002 were below 900 mt (ranging from 506 to 874 mt). An annual quota of 905 mt was implemented in November 2001. Landings in 2003 and 2004 exceeded the quota at 1,130 and 1,182 mt respectively. Since the 1980s, over 85% of the commercial landings of tilefish have been taken in the longline fishery. Recreational catches have been low for the last 25 years (i.e., less than 1 mt caught annually).

Data and Assessment: The MAFMC Science and Statistical committee last reviewed the Golden tilefish assessment in 1998. A surplus production model (ASPIC) was the basis for rebuilding of the tilefish stock in the Tilefish Fishery Management Plan implemented in November 2001. The updated assessment used the ASPIC model with three separate CPUE series (Turner, weighout, and VTR) (Figure C4). The biomass-based models AIM (An Index Method; NFT 2005) and lagged-recruitment survival growth (LRSG) produced results similar to ASPIC.

Biological Reference Points: Updated estimates of biological reference points from the ASPIC model (B_{msy} = 9,384 mt, F_{msy} = 0.21, and MSY = 1,988 mt) did not change greatly from the 1998 assessment (B_{msy} = 8,448 mt, F_{msy} = 0.22, and MSY = 1,888 mt used in the tilefish fishery management plan). F_{max} was the same in both assessments, 0.14.

Fishing Mortality: During 1978-1987, fishing mortality was above F_{msy} (Figure C1). Fishing mortality fluctuated below and above F_{msy} from 1989 to 1998. Since 1999, F has been below F_{msy} (Figure C1). The 2004 F to F_{msy} ratio was 0.87 (F_{2004} = 0.18, F_{msy} = 0.21). The 80% confidence interval for the 2004 F/F_{msy} ratio is between 0.5 and 1.3 (Figure C2).

Biomass: During 1974-1980, stock biomass was above B_{msy}, but has since been below B_{msy} (Figure C1). Biomass was below ½ B_{msy} from 1988 through 2001, but has since increased to 72% of B_{msy} in 2005 (B_{2005} = 6,712 mt, B_{msy} = 9,384 mt). The 80% confidence interval for the 2005 B/B_{msy} ratio is between 0.5 and 1.2 (Figure C2).

Recruitment: Estimates of recruitment do not exist. However strong recruitment events are evident in the size composition of the commercial landings. Most of the catch between 2002 and 2004 appears to have been from the 1999 year class with no signs of recruitment after this cohort (Figure C5).

Special Comments:
1) The partial recruitment pattern is unknown for the tilefish longline fishery because targeting of year classes to increase catch rates and market conditions will influence the size of fish landed. The price on the large market category in this fishery is particularly sensitive to the quantity of large fish landed. There is concern that fishing mortality may be higher than estimated by the surplus production model due to the relative lack of larger/older fish in the catches.

2) The inability to characterize the partial recruitment pattern, the possibility of unknown refuge effects due to conflicts with lobster and trawl gear and effects of the targeting of incoming year classes by the fishery introduce considerable uncertainty in interpreting CPUE from this fishery as a measure of stock abundance. Concerns exist that recent CPUE values have been increasing faster than stock biomass. CPUE and catch length frequency data in this fishery may be as much a reflection of changes in fishing practices and the spatial distribution of the fish rather than fluctuations in population size.

Sources of Information:

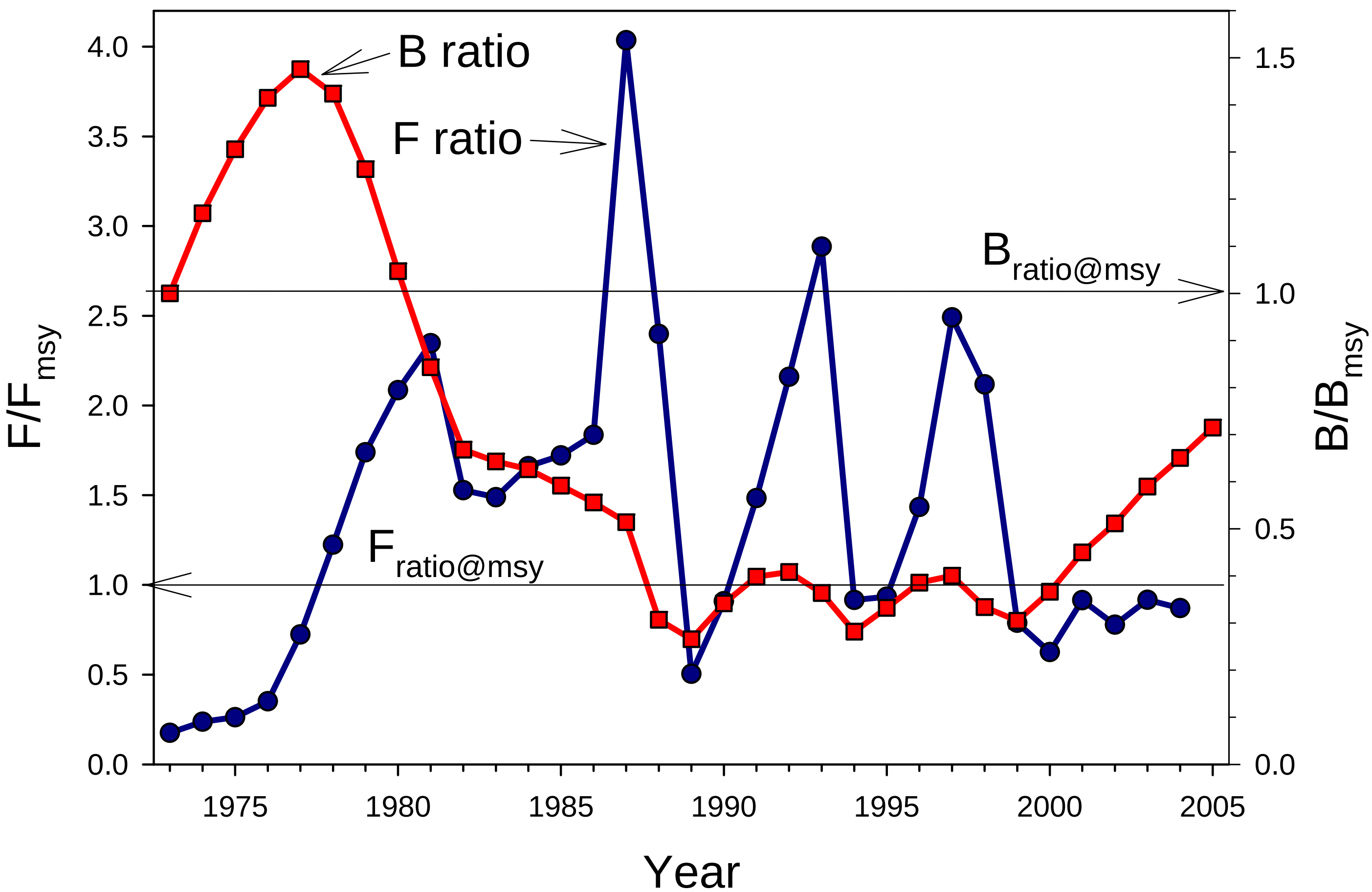
Assessment of Golden Tilefish, *Lopholatilus chamaeleonticeps*, in the Middle Atlantic-Southern New England Region. Report of the Southern Demersal Working Group, SAW 41 Working Paper C1.

Mid-Atlantic Fishery Management Council. 2000. Tilefish fishery management plan.

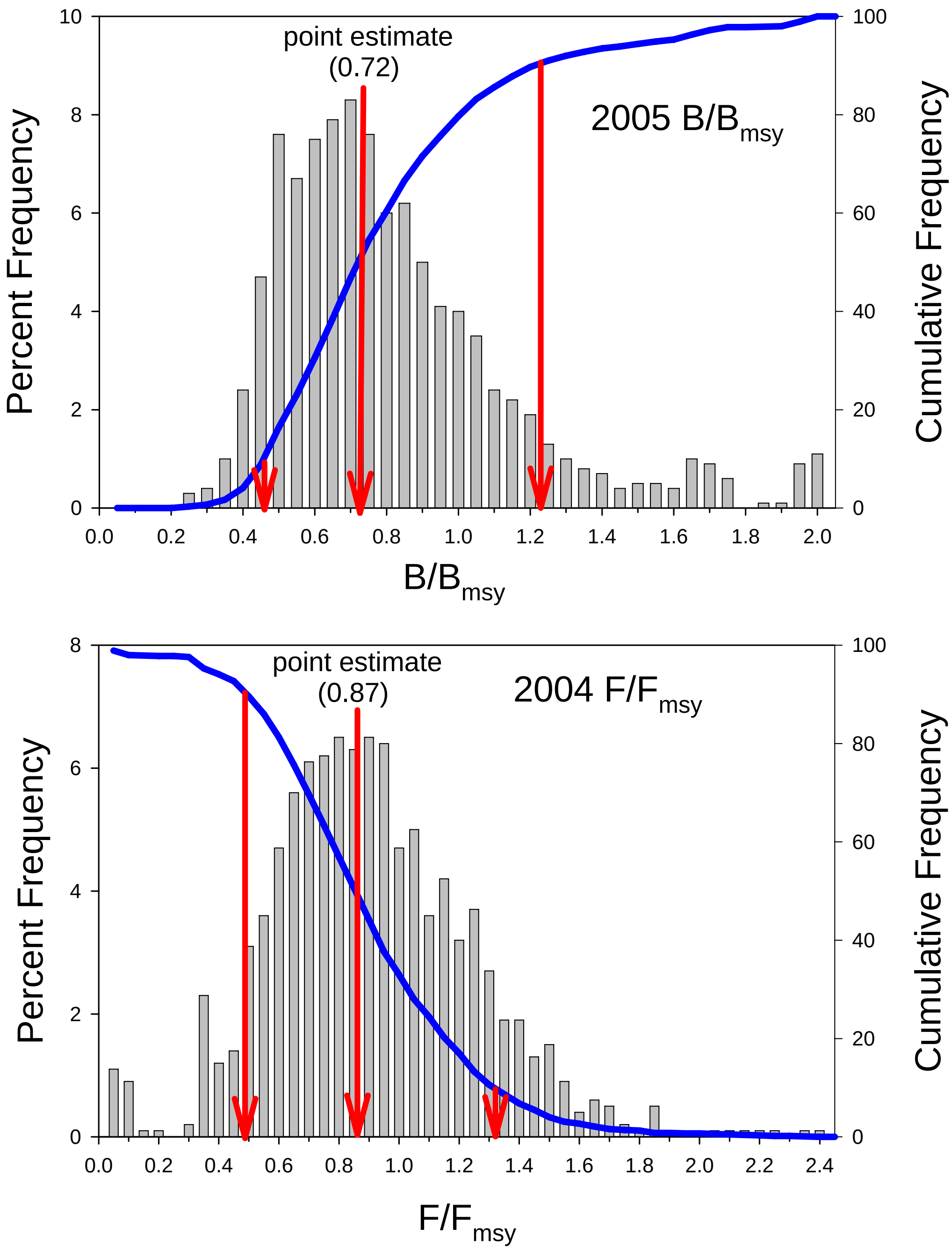
Nitschke, P., G. Shepherd, and M. Terceiro. 1998. Assessment of tilefish in the middle Atlantic – southern New England region. 12 pp. (unpublished report from NEFSC, reviewed by the MAFMC Science and Statistical Committee).

NOAA Fisheries Toolbox Version 2.6. (NFT). 2005. AIM (Internet address: http://nft.nefsc.noaa.gov).

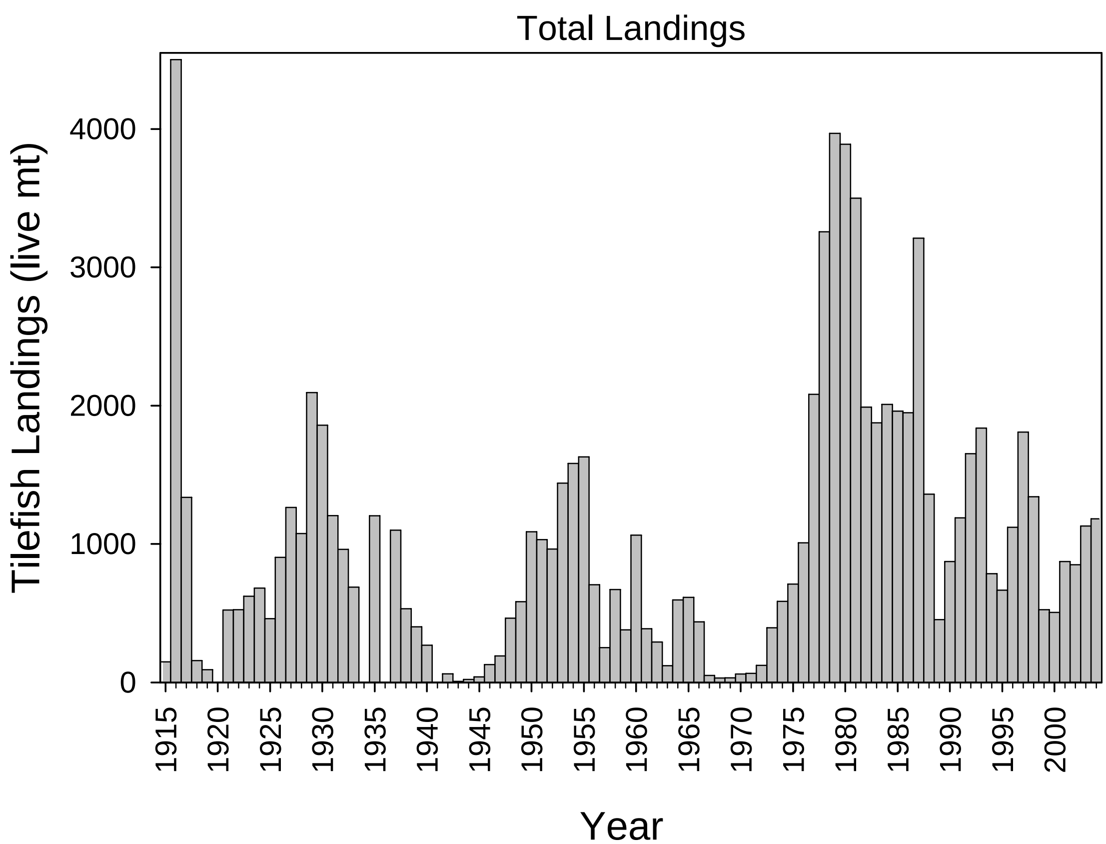
Turner, S.C. 1986. Population dynamics of and, impact of fishing on tilefish, *Lopholatilus chamaeleonticeps*, in the Middle Atlantic-Southern New England region during the 1970's and early 1980's. New Brunswick, N.J. Rutgers University. Ph.D. dissertation.



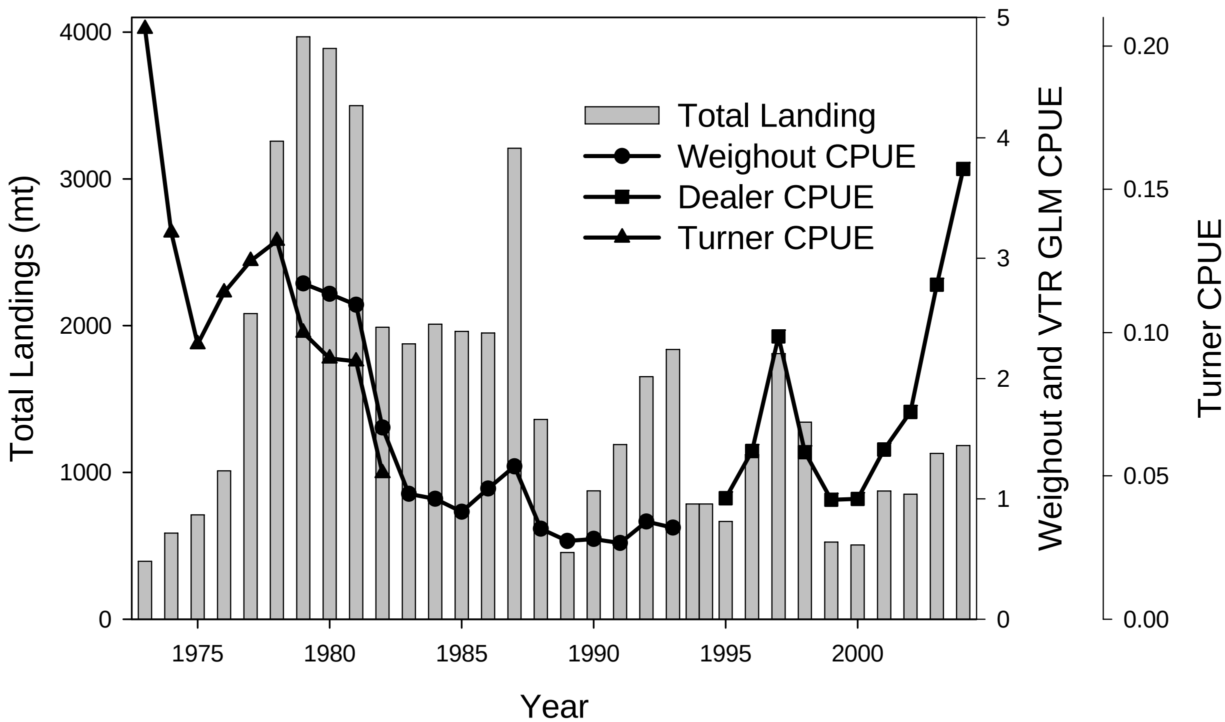
C1. Tilefish. Trends in F/F_{msy} and B/B_{msy} ratios for the base ASPIC run 13 which fixed the $B1/B_{msy}$ ratio at 1 and used three CPUE series (Turner, weighout, and VTR).



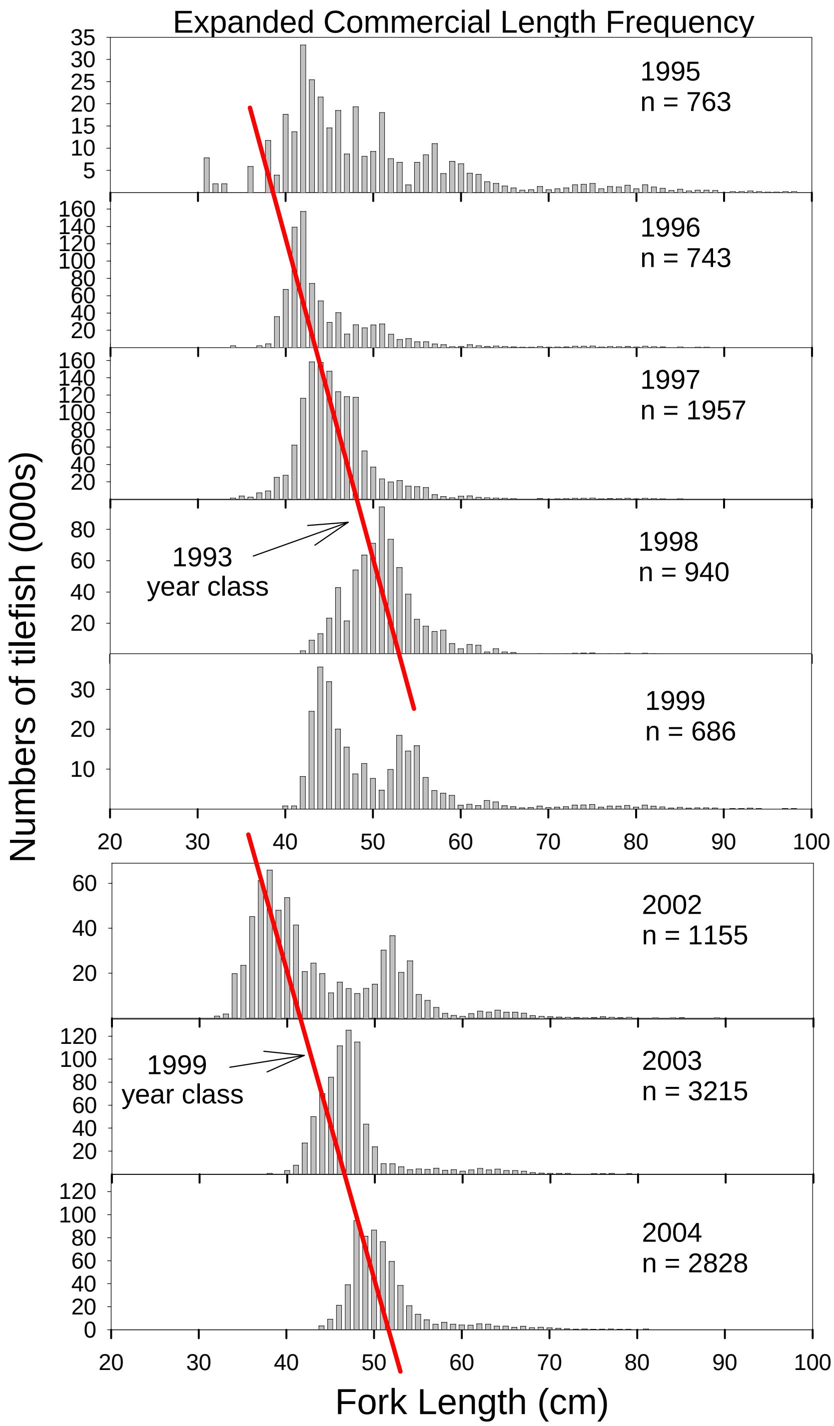
C2. Precision of estimates of total stock biomass to B_{msy} ratios and fishing mortality to F_{msy} ratios for Golden tilefish. Vertical bars display the range of the boostrap estimates. The percent confidence limits can be taken off the cumulative frequency curve.



C3. Landings of Golden tilefish from 1915-2004.



C4. Tilefish. GLM CPUE for the weighout and VTR data split into two series. Four years of overlap between Turner (1986) and the weighout CPUE series can be seen. Total Dealer landings are also shown.



C5. Expanded tilefish catch length frequency distributions by year.

APPENDIX. TERMS OF REFERENCE

Terms of Reference for the 41st Northeast Stock Assessment Workshop

(approved: March 18, 2005)

SAW/SARC 41
June 6-10, 2005
NEFSC, Woods Hole, MA

A. Summer Flounder - SAW Southern Demersal Working Group

1. Update the summer flounder assessment models (i.e. ADAPT VPA and AGEPRO projection) using the same configurations as those used in the 2004 SAW Southern Demersal Working Group (WG) assessment update.

2. Estimate biological reference points derived by yield and SSB per recruit analysis and by stock-recruitment modeling, following the procedures adopted by the 2002 Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish.

3. Consider the recommendations of the MAFMC Science and Statistical Committee (SSC) 2001 peer review of the summer flounder Overfishing Definition in developing the analyses described in TOR 2. The major recommendations were to explore other proxies (besides F_{max}) to F_{MSY}, to continue stock-recruitment model development as additional stock-recruit estimates become available, and to monitor and utilize new data on the population dynamics of summer flounder (e.g., age, growth, and maturity) as they become available.

4. Review, evaluate and report on the status of the SARC/Working Group research recommendations offered in previous SARC and WG reviewed assessments.

B. Bluefish - ASMFC Technical Committee/Assessment Subcommittee

1. Evaluate adequacy, appropriateness and uncertainty of fishery-dependent and fishery-independent data used in the assessment.
2. Evaluate adequacy and appropriateness of models used to assess the species and to estimate population benchmarks.
3. Evaluate and either update or re-estimate biological reference points as appropriate.
4. Estimate and evaluate stock status (biomass) and fishery status (fishing mortality rate).
    a. Is the stock overfished; is overfishing occurring?
5. Develop recommendations for improving data collection and for future research.

C. Tilefish - SAW Southern Demersal Working Group

1. Characterize the commercial catch including landings and discards. Characterize recreational landings.

2. Estimate fishing mortality and total stock biomass for the current year and characterize the uncertainty of those estimates.

3. Evaluate and either update or re-estimate biological reference points as appropriate.

4. Where appropriate, estimate a constant TAC and/or TAL based on stock status for years following the terminal assessment year.

5. If projections are possible,

    a. provide seven year projections of stock status under various TAC strategies and

    b. evaluate current and projected stock status against existing rebuilding or recovery schedules, as appropriate.

6. Review, evaluate and report on the status of the research recommendations offered in the 1999 Science and Statistical committee reviewed assessment.

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