36th Northeast Regional Stock Assessment Workshop (36th SAW)

Public Review Workshop

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Public Review Workshop

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OVERVIEW

The 36th Northeast Regional Stock Assessment Workshop

The Northeast Stock Assessment Workshop (SAW) is a process for preparing, peer reviewing and presenting stock assessment information. A SAW cycle is six months; thus, twice a year, a number of fishery stock assessments are prepared and presented to a panel of assessment experts. The panel, the Stock Assessment Review Committee (SARC), prepares two reports. The first is the SAW Advisory Report; a brief summary of the stock status, management advice, short term stock forecasts, and other relevant assessment information for each stock assessed and reviewed.. The second report, the SARC Consensus Summary of Assessments, is more detailed, containing specific assessment data, results and SARC discussion and research recommendations.

The Advisory report is presented to the public in a series of Public Review Workshops, described below. Subsequent to the Workshops, the draft Advisory Report is finalized and folded into a larger document known as the Public Review Workshop Report. The Public Review Workshop (PRW) Report also includes a summary of decisions made by the Northeast Coordinating Council (consisting of the Region's executives and responsible for establishing SAW policy and scheduling assessments for review) that may have occurred during the SAW cycle.

This is the Public Review Workshop Report for SAW 36 and the 36th SARC and includes the final version of the Advisory Report.

The 36th SARC reviewed stock structure issues for yellowtail flounder, and, given decisions on stock separation for that species, reviewed assessments for southern New England / Mid-Atlantic yellowtail flounder (a newly defined stock combining the Mid-Atlantic and southern New England stock units), Cape Cod / Gulf of Maine yellowtail flounder (a redefined stock unit which extends the spatial coverage of the

Cape Cod/Massachusetts Bay stock into the Gulf of Maine), southern New England-Mid-Atlantic winter flounder, Gulf of Maine winter flounder, and northern shrimp. The panel also provided review and comment on a number of methodological aspects of the current striped bass assessment approach.

Assessments, working papers and research reports were peer reviewed by the SARC panel at its December 2 - 6, 2002 meeting in Woods Hole, MA. Presentations of the results of the SARC were presented to the Mid-Atlantic Fishery Management Council on January 23, 2003 in Atlantic City NJ; to the New England Fishery Management Council on January 28, 2003 in Portsmouth NH; and to the Atlantic States Marine Fisheries Commission on February 24, 2003 in Crystal City VA.

Copies of the 36th SAW Draft Advisory Report on Stock Status had been distributed to members of the Commission and the New England and Mid-Atlantic Regional Fishery Management Councils prior to the public presentations.
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ADVISORY REPORT ON STOCK STATUS

INTRODUCTION

The *Advisory Report on Stock Status* is one of two reports produced by the Northeast Regional Stock Assessment Workshop process. The *Advisory Report* summarizes the technical information contained in the *Stock Assessment Review Committee (SARC) Consensus Summary of Assessments* and is intended to serve as scientific advice for fishery managers on resource status.

An important aspect of scientific advice on fishery resources 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 simply 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 threshold ($B_{THRESHOLD}$) the stock is in an overfished condition. The Sustainable Fisheries Act mandates plans for rebuilding the stock 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 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 Advisory Report 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.

		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	$F = F_{MSY} <= F_{THRESHOLD}$
RATE	$F < F_{THRESHOLD}$	Overfished, overfishing is not occurring; adopt and follow rebuilding plan	Not overfished, overfishing is not occurring; rebuild stock	$F = F_{TARGET} <= F_{MSY}$
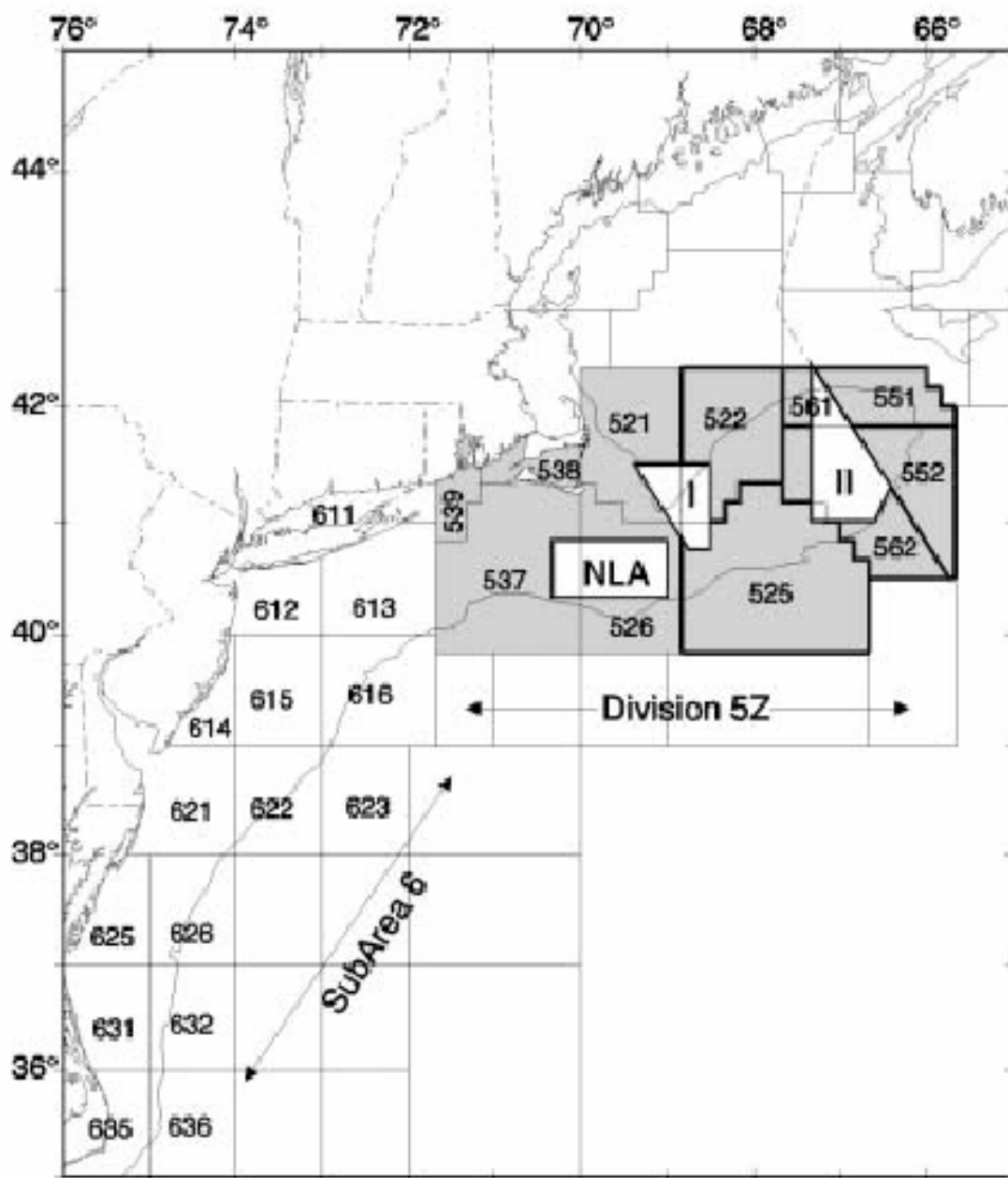
Figure 1. Statistical areas used for catch monitoring in offshore fisheries in the Northeast United States.

GLOSSARY OF TERMS

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

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 biomass rather than numbers. Biomass dynamic models employ assumptions about growth (in weight) 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" in some of the scientific literature.

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 x (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 x (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:

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

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 the 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 the loss in fish weight due to mortality exceeds the gain in fish weight due to growth.

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 reaches a level that causes a significant reduction in recruitment to the spawning stock. This is caused by a greatly reduced

spawning stock and is characterized by a decreasing proportion of older fish in the catch and generally very low recruitment year after year.

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. 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.

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. Yellowtail Flounder Stock Structure

The SARC reviewed a summary of available information on stock structure of yellowtail flounder in the Northwest Atlantic, with a focus on resources off the northeastern United States. Following an extensive review of the literature on stock identification, the SARC was presented with a summary of a series of studies covering spatial distribution patterns, geographic variation in growth and maturity, morphometric variation, and larval transport. At present, yellowtail flounder off the northeast coast of the United States are managed as four units: Georges Bank, Cape Cod, Southern New England, and Mid-Atlantic. In addition, the resource is distributed in the western Gulf of Maine, primarily in statistical area 513 adjacent to the Cape Cod management unit. Assessment of the Georges Bank, Southern New England, and Cape Cod stocks are carried out analytically through Virtual Population Analysis (VPA) and/or Biomass Dynamics Models (ASPIC), while the status of the Mid-Atlantic stock is evaluated using research survey index proxies. There has been no analytical assessment of the Gulf of Maine resource.

Most scientific evidence, including tagging studies, growth and maturity rates, and larval transport suggests that yellowtail flounder on Georges Bank are distinct from those in adjacent areas. However, there appears to be a considerable degree of mixing and similarities in biological characteristics between the southern New England and Mid-Atlantic stock units. In the past, the two units were considered to be a single stock, and were apparently split for ICNAF jurisdictional, rather than biological reasons. Although data on stock structure in the Gulf of Maine are sparse, the available information suggests that there is no basis to maintain a distinction between the Cape Cod stock unit and the remaining distribution of the resource in the Gulf of Maine.

The SARC then considered a proposal by the Southern Demersal Working Group to define three stock units: Georges Bank, Southern New England/Mid-Atlantic, and Cape Cod/Gulf of Maine.

Although the literature review and recent studies are comprehensive, there remain several areas of concern. Many conclusions were based on differences in biological characteristics that may simply reflect different environmental regimes in the various locations or changes in exploitation over time. Regardless of the mechanism, differences in growth and maturity are maintained because there is a significant degree of geographic isolation, particularly between the Georges Bank stock and those to the west. However, there are no such physical barriers between the southern New England and Mid-Atlantic areas and there appears to be substantial movement across the existing boundary between the management units for these two stocks.

The relevance of the historical tagging experiments is also an area of concern. The tag returns from these earlier studies were not adjusted for fishing effort, and the tag release sites (often on the boundary of the existing management units) and time at large was not considered in the original analyses by Royce et al. (1959) and Lux (1963) and in the recent review of stock structure. The available information on tagging is also somewhat dated and may not represent

current environmental and stock conditions. In the case of the Mid-Atlantic tagging experiment, the number of tag returns was relatively low ($n = 64$ recaptures off Southern New England), and release sites may not represent the distribution of yellowtail flounder in the Mid Atlantic region, particularly off New Jersey and Delaware.

In all cases, there must be evidence that the proposed stock units are self-sustaining. This may be problematic for the Cape Cod stock unit, whether or not it is combined with the remaining Gulf of Maine area, because there appears to be little evidence of egg and larval production in this area.

The SARC endorsed the conclusions of the Southern Demersal Working Group to conduct assessments of yellowtail flounder based on the following stock units (Figure A1):

- Georges Bank
- Southern New England/Mid-Atlantic
- Cape Cod/Gulf of Maine.

Research Recommendations to be carried forward.

Further investigation should be carried out to evaluate the degree of mixing between the Georges Bank and Cape Cod stocks of yellowtail flounder.

Several suggestions were made to refine the analysis of stock boundaries, including: 1) evaluating the spatial scale at which data are presented for distribution of life history stages, 2) incorporating information on larval size composition to better delineate possible spawning areas, and 3) performing statistical tests for differences in biological characteristics.

Figure A.1. Revised stock boundaries of yellowtail flounder off the northeastern U.S.

Cape Cod - Gulf of Maine
Georges Bank
Southern New England - Mid Atlantic
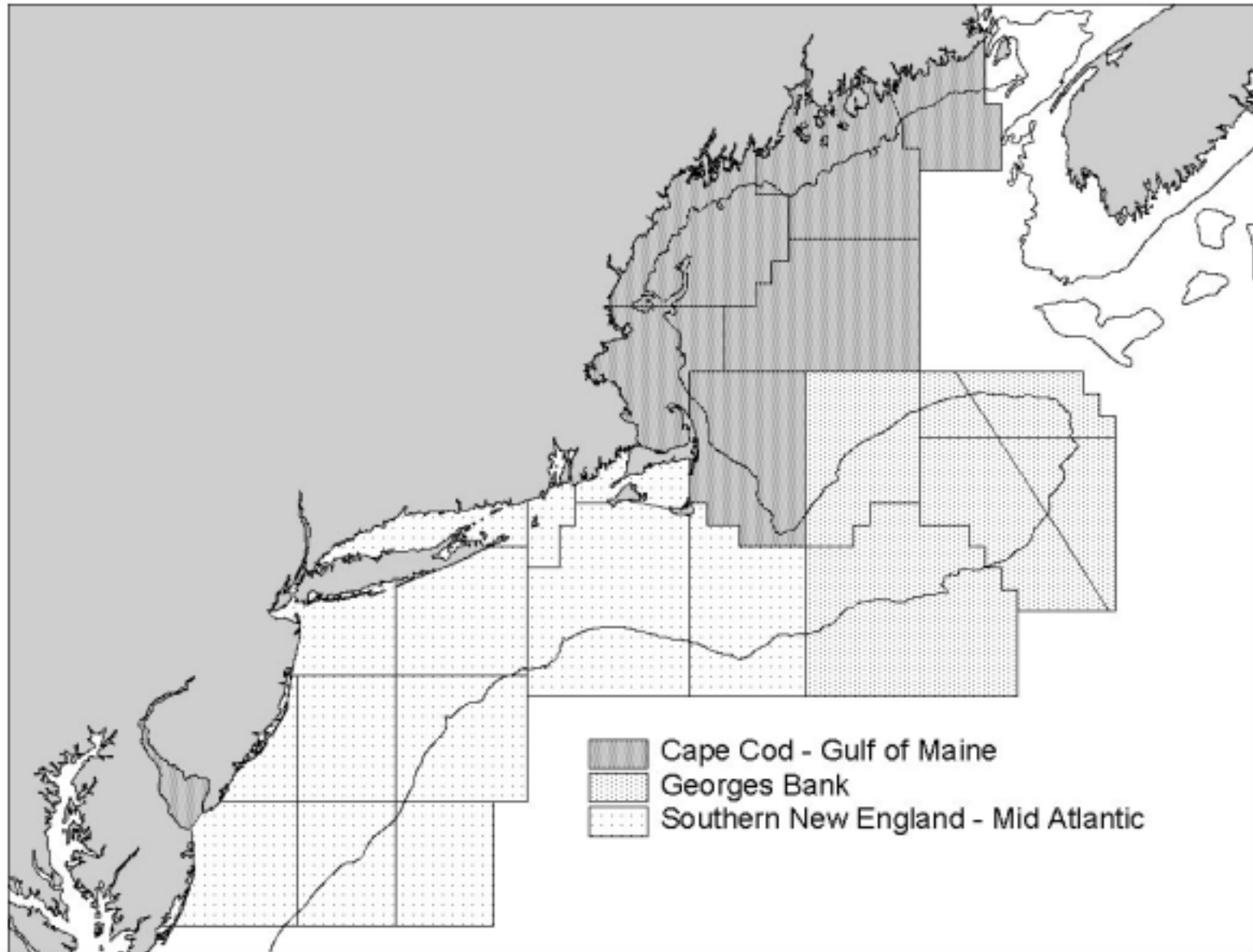
A1. SOUTHERN NEW ENGLAND – MID ATLANTIC YELLOWTAIL FLOUNDER

State of Stock: The southern New England and Mid-Atlantic stocks were previously assessed separately, but are combined for this assessment. The combined stock is overfished and overfishing is taking place. The current estimate of fishing mortality is high (2001 $F_{ages\ 4-6}$ = 0.91, Figure A1.1), much greater than the proposed F_{MSY} proxy ($F_{40\%MSP}$ = 0.26). Spawning stock biomass is low (2001 SSB = 1,900 mt, Figure A1.2), well below the proposed SSB_{MSY} proxy (69,500 mt SSB). Recruitment has been poor for more than a decade. The age structure of the stock is truncated in comparison to MSY conditions (Figure A1.10).

Management Advice: Fishing mortality should be reduced to near zero.

Forecasts for 2002-2009: Age-based, stochastic projections predict that landings and SSB decrease in 2002 at 85% of $F_{status\ quo}$ (F_{2002} = 0.77). Projections with the most optimistic recruitment assumption indicate that there is approximately a 50% probability of rebuilding to SSB_{MSY} by 2009 if 2003-2009 F is reduced to 0.08. Alternative projections that assume the same recruitment observed over the past decade indicate that rebuilding to SSB_{MSY} is not possible at F = 0.

Forecast Table: Basis: For age-based projections, F_{2002} = 0.77 (85% of status quo from VPA F_{2001}), average 1994-2001 partial recruitment, mean weights at age, and maturation. Age-1 recruitment for the period 2002-2009 was estimated from the distribution of observed age-1 stock sizes from 1963 to 2000. Landings and SSB in 1,000s of mt.

2002				2003		2004	
F	Landings	SSB	2002-2009 F	Landings	SSB	SSB	Consequences/Implications
0.77	0.7	1.6	0.00 (no fishery)	0.0	2.4	6.4	58% chance of rebuilding to SSB_{msy} by 2009
			0.08 ($F_{rebuild}$)	0.1	2.3	6.3	50% chance of rebuilding to SSB_{msy} by 2009
			0.26 (F_{msy})	0.3	2.2	5.8	29% chance of rebuilding to SSB_{msy} by 2009
			0.77 (85% of $F_{status\ quo}$)	0.7	2.0	5.1	7% chance of rebuilding to SSB_{msy} by 2009

Catch and Status Table: Southern New England – Mid Atlantic Yellowtail Flounder
(weights in '000 mt, recruitment in millions)

	1994	1995	1996	1997	1998	1999	2000	2001	Max[1]	Min[1]	Mean[1]
Landings	0.4	0.2	0.5	0.8	0.6	1.2	1.0	1.0	18.5	0.2	4.2
Discards	0.3	0.1	0.1	0.0	0.1	0.1	0.0	0.1	9.7	0.0	2.2
Total catch	0.6	0.3	0.5	0.8	0.7	1.3	1.0	1.1	22.2	0.3	6.4
Biomass	0.8	1.3	1.7	1.8	2.2	2.8	2.4	2.3	40.8	0.8	12.4
SSB	0.6	0.8	1.3	1.0	1.5	1.7	2.1	1.9	24.3	0.6	7.3
Recruitment (age 1)	3.0	3.4	2.0	6.0	3.4	5.8	1.9	3.1	138.5	1.9	25.9
F (age 4-6, unweighted average)	1.79	0.81	1.34	1.40	1.26	1.87	0.68	0.91	2.34	0.56	1.31
Exploitation Rate	78%	51%	68%	70%	66%	79%	45%	55%	85%	39%	68%

[1]Over period 1973-2001

Stock Distribution and Identification: Yellowtail flounder inhabit relatively shallow waters (20-100 m) of the continental shelf of the Northwest Atlantic from Labrador to Chesapeake Bay. An interdisciplinary evaluation of yellowtail flounder stock structure indicates that, in southern New England and Mid-Atlantic waters, yellowtail constitute a single, self-sustaining resource. The southern New England – Mid-Atlantic yellowtail flounder stock area is defined as the continental shelf from Nantucket Shoals to the southern extent of the species range (U.S. statistical reporting areas 526, 537, 538, 539, and division 6). The geographic distribution of yellowtail flounder in the southern New England – Mid-Atlantic area has been greatly reduced over the last four decades (Figure A1.9)

Catches: Landings in southern New England generally increased during the 1930s and early 1940s and the fishery expanded to the Mid-Atlantic in the early 1940s, yielding landings of 28,000 mt in 1942 and approximately 20,000 mt annually from 1963 to 1972. Landings in 1995 were a record low of just 200 mt, and the proportion of landings from the Mid-Atlantic generally increased from approximately 10% in the early 1990s to >20%. Since 1999, landings have averaged 1,000 mt annually.

The discarded catch has been considered to account for an average of 30% of total annual catch, although it seems to have decreased to approximately 10% since 1995. In 1969, discards peaked at 24,000 mt, 40% of the total catch that year. A substantial portion of recent discards is derived from the scallop dredge fishery.

Over the past three years total catch has been 66% trawl landings from southern New England, 22% trawl landings from the Mid-Atlantic, 4% dredge landings from the Mid-Atlantic, 4% discards from the southern New England dredge fishery, 2% discards from the southern New England trawl fishery, 1% discards from the Mid-Atlantic dredge fishery, and 1% discards from the Mid-Atlantic trawl fishery.

Data and Assessment: Landings from 1973 to 2001 were estimated from dealer records and interview information. For the period 1994-2001, landings were derived from dealer records based on vessel logbook data. U.S. discards at age for the period 1963-1993 were estimated from vessel interviews, survey length distributions, and at-sea sampling. Discards for the period 1994-2001 were estimated from discard-to-kept ratios reported in vessel logbooks.

A virtual population analysis (VPA) of commercial landings and discards at age was completed (assuming natural mortality, M, of 0.2). Indices of recruitment and stock abundance were obtained from NEFSC spring, autumn, and winter bottom trawl surveys, and NEFSC scallop surveys. Estimates of uncertainty include survey measurement error, but not errors in catch.

A non-equilibrium surplus production model provided auxiliary information on the status of the stock. Input data included commercial landings and discards, and NEFSC spring and fall surveys. Unlike the VPA, this approach is based on biomass and catch, but no information on age structure is required.

Biological Reference Points: F_{MSY} is approximated as $F_{40\%}$ (0.26, Figure A1.3). The SSB_{MSY} proxy is 69,500 mt, calculated as the product of 40%MSP (1.129 kg spawning biomass per recruit) and the average long-term recruitment of 61.57 million for the years 1963-2000 (which includes hindcast values for 1963-1972). The average long-term recruitment was derived as the fall survey age-1 index divided by the catchability coefficient estimated by ADAPT. The MSY proxy is 14,200 mt, derived as the product of yield per recruit at $F_{40\%}$ (0.230 kg) and average recruitment. Estimates of SSB_{MSY} and MSY are highly sensitive to the assumed level of recruitment at F_{MSY}. If historic levels of recruitment (1963-1972) are assumed, MSY reference points are three times greater, and if the VPA series of recruitment is assumed (1973-2001), MSY reference points are some 50% of the estimates using 1963-2001 recruitment. However, the entire series of recruitment (1963-2001) offers the most likely scenario, because excluding any period cannot be justified.

Fishing Mortality: Fishing mortality generally increased in the 1970s and 1980s to peak at 2.3 in 1991 and 1992, averaged 1.6 during the 1990s, but appears to have decreased to 0.68 in 2000 and then increased to 0.91 in 2001, the latter with an 80% confidence limit of 0.65-1.18 (Figure A1.6). Retrospective analysis indicates that fishing mortality was underestimated by an average of 60% for the past five years.

Recruitment: Recruitment was generally strong in the 1960s and early 1970s and moderate during the 1980s, with two relatively strong year classes in 1980 and 1987 (Figures A1.2 and A1.7). Recruitment has since been low. Hindcast estimates of recruitment from 1963 to 1972 are substantially greater than those from the VPA series.

Spawning Stock Biomass: Spawning stock biomass was high in the early 1970s, decreased in the late 1970s, and increased briefly in the early and late 1980s, with the recruitment of the 1980 and 1987 cohorts. SSB decreased to a record low 622 mt in 1994, gradually increased to 2,100 mt in 2000, but then decreased to 1,900 mt in 2001, with an 80% confidence limit of 1,500-2,300 mt (Figure A1.5). Retrospective analysis indicates that spawning stock biomass was overestimated by an average of 130% for the past five years.

Special Comments: Retrospective analysis indicates a strong pattern of underestimating F and overestimating SSB in recent years. Therefore, the current stock status and the associated projections are likely to be optimistic.

Although this assessment is the first for yellowtail flounder in the southern New England – Mid-Atlantic area since the 1960s, the state of the stock and management advice are similar to those reported for the southern New England management area by the 27th Stock Assessment Review Committee in 1998. Both components of this combined stock were previously determined to be overfished.

Source of Information: S. X. Cadrin. 2002. Stock assessment of yellowtail flounder in the southern New England – Mid-Atlantic area. NEFSC Ref. Doc. 03-02.

A1.1: Total Catch and Fishing Mortality

A1.2: Spawning Stock Biomass and Recruitment

A1.3: Yield and SSB per Recruit

A1.4: Short-Term Forecast

A1.5: Precision of 2001 Estimate of SSB

A1.6: Precision of 2001 Estimate of F

A1.7: SSB and Recruitment

A1.8: SFA Reference Points
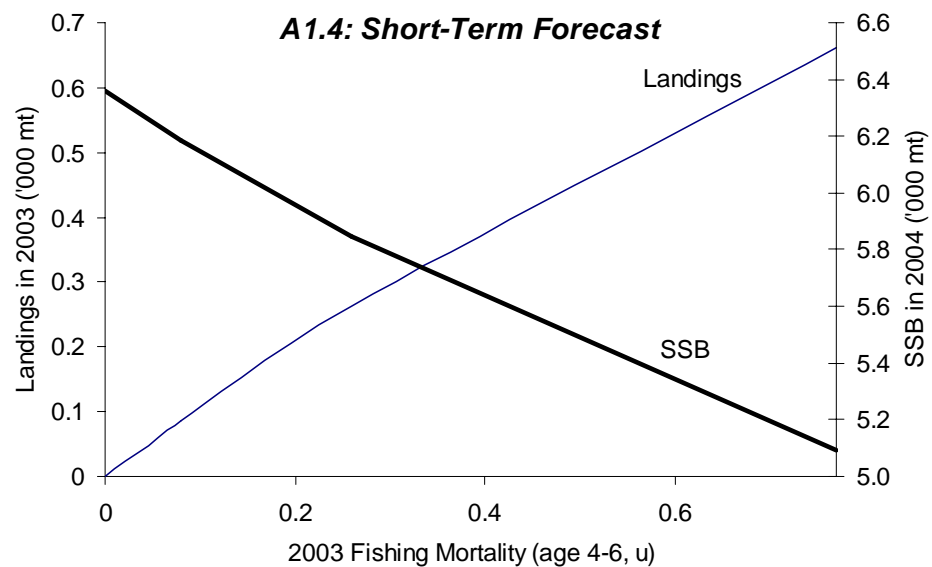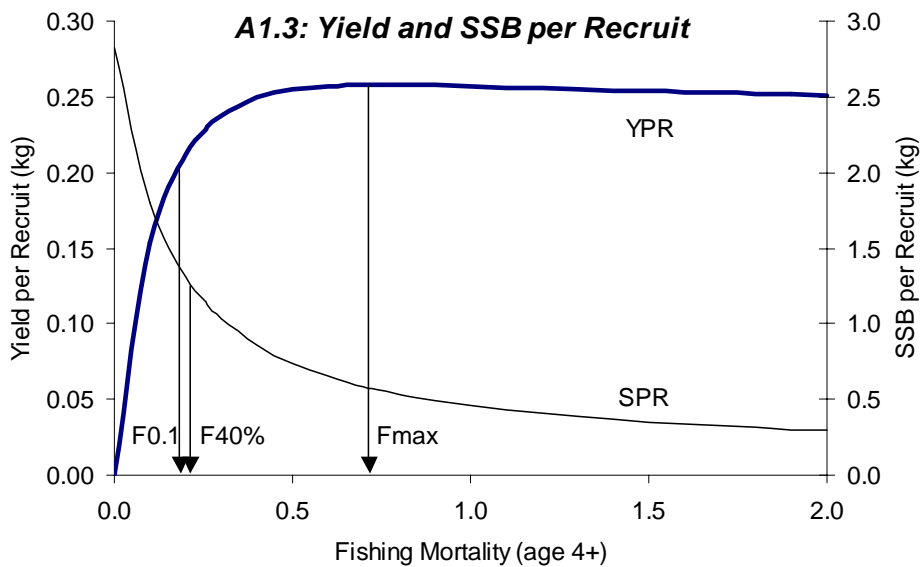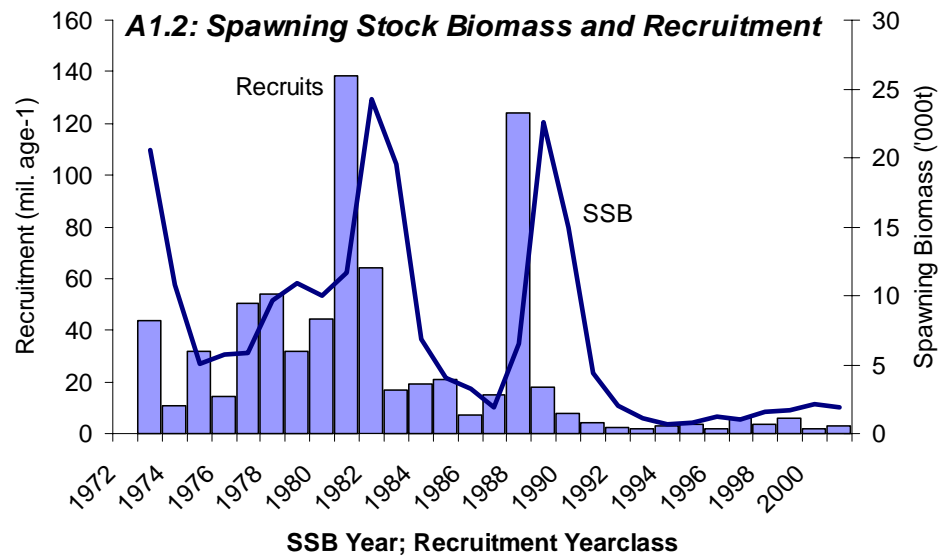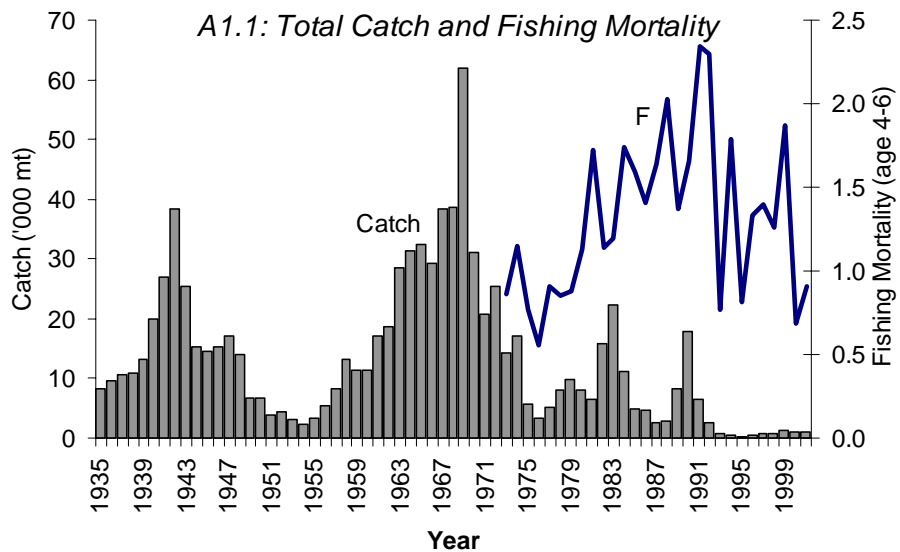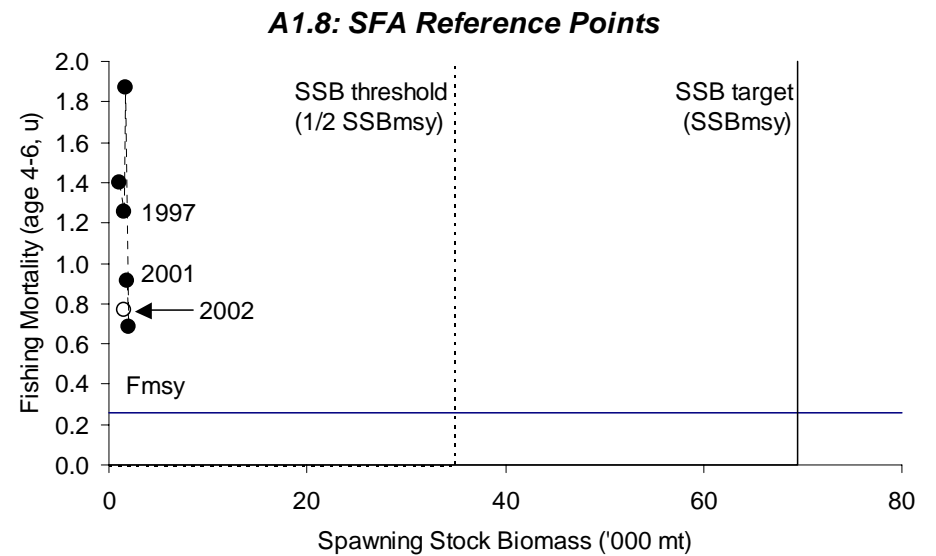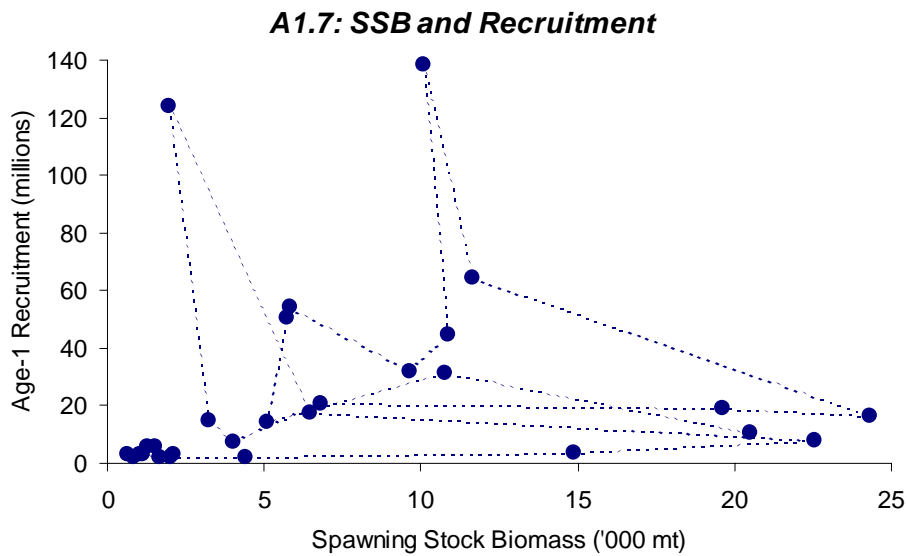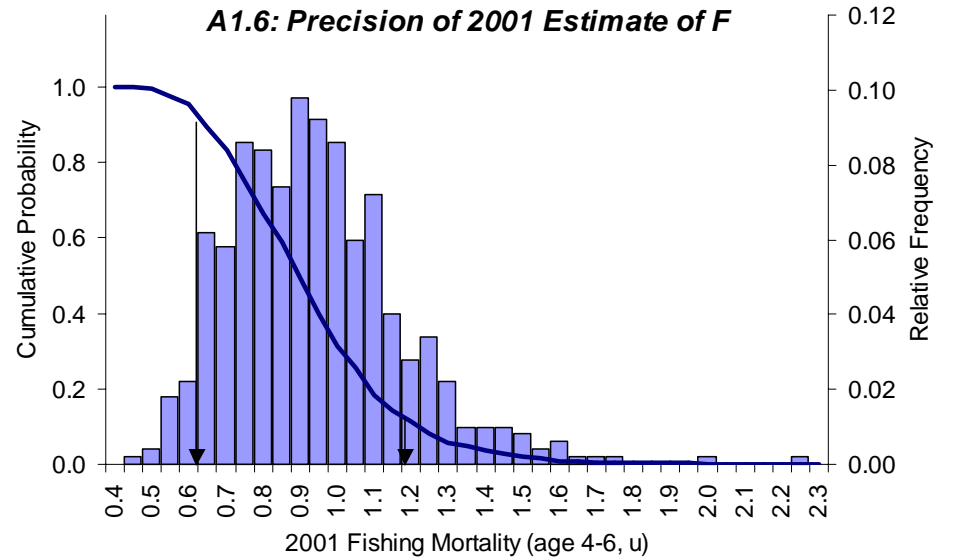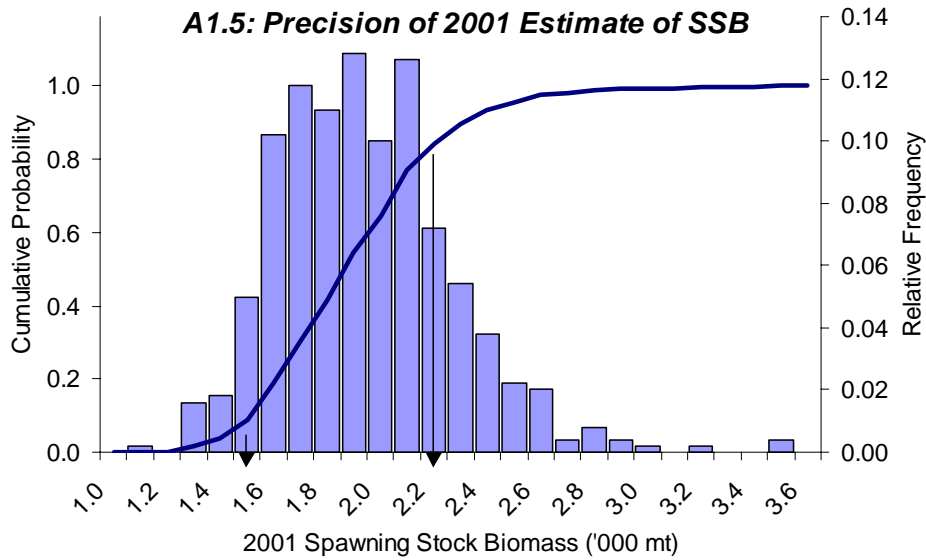
A1.9 Geographic Distribution of Yellowtail Flounder by Decade

A1.10 Observed and Expected Age Distribution of SSB

1992-1999

2000

2001

Long term at Fmsy

36th SAW Advisory
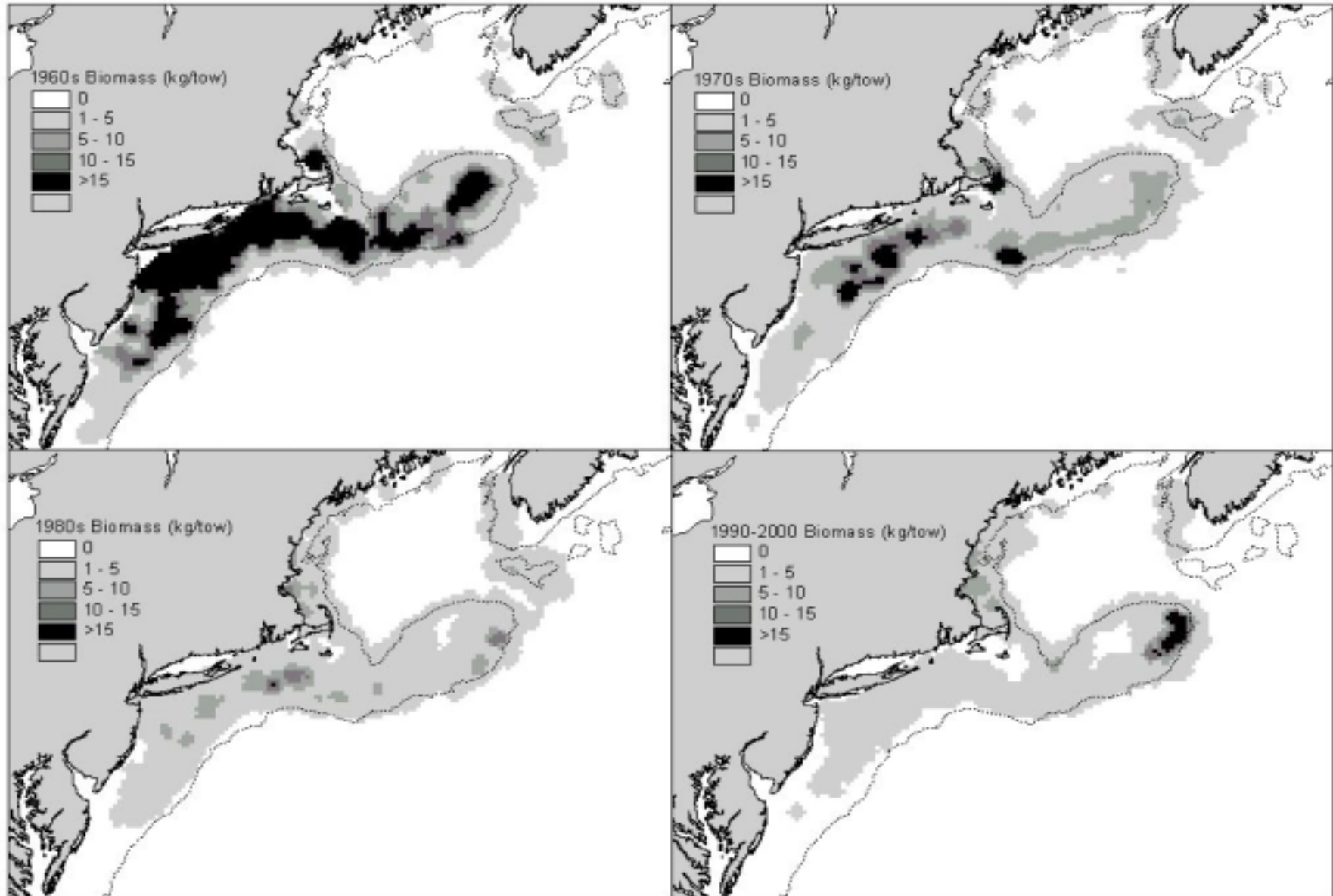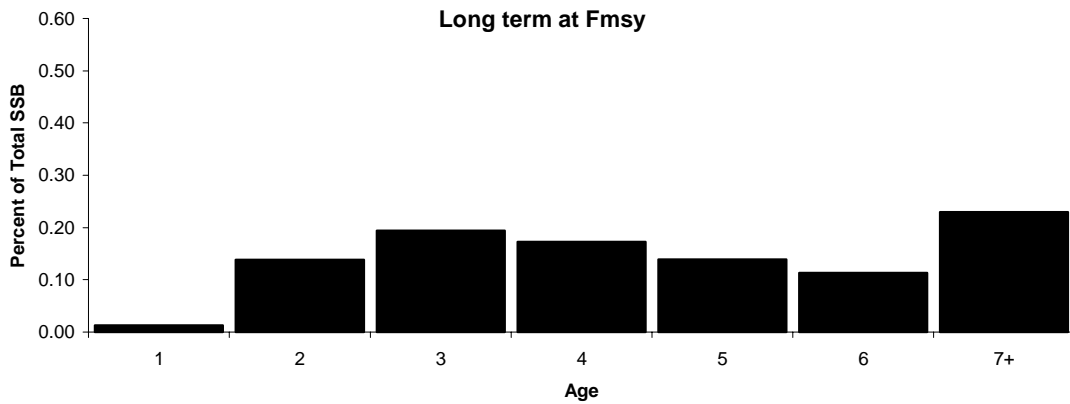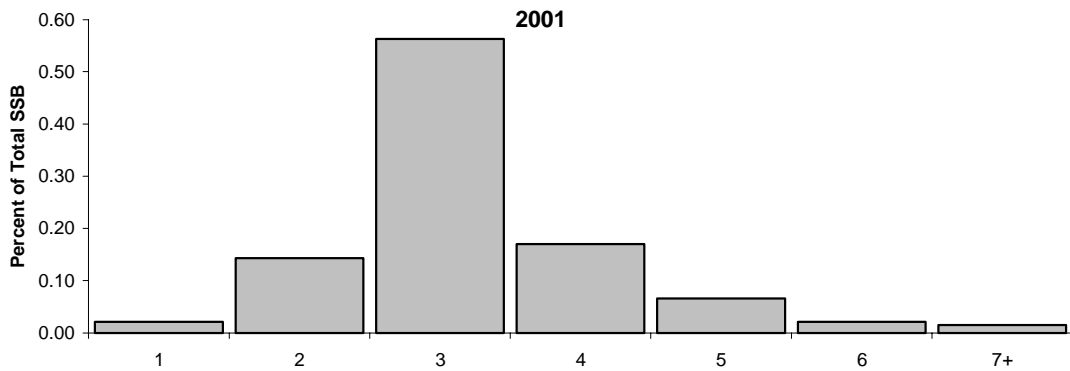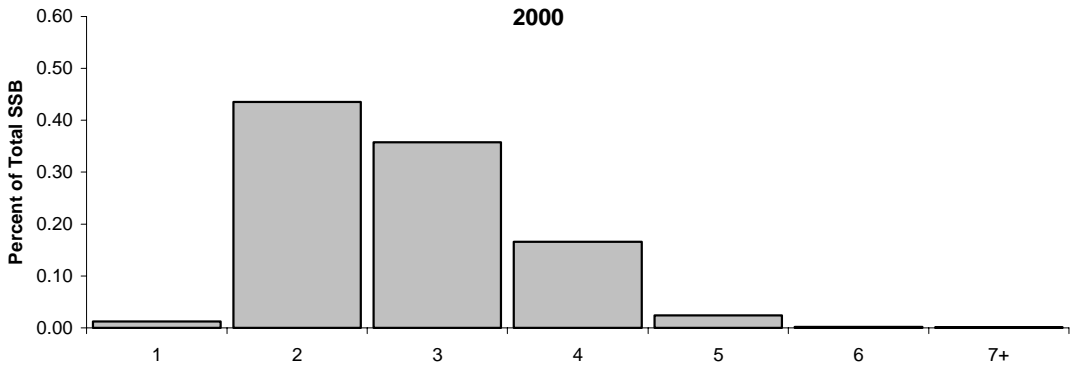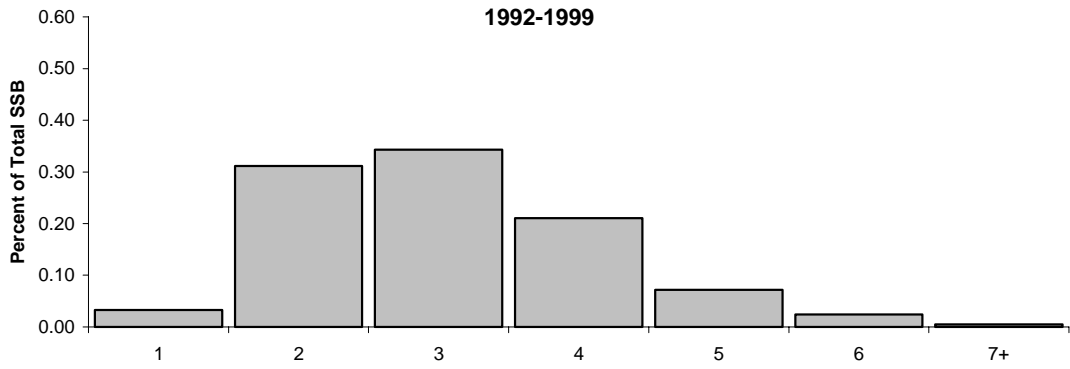
A2. CAPE COD – GULF OF MAINE YELLOWTAIL FLOUNDER

State of Stock: Cape Cod yellowtail flounder were previously assessed as a unit stock, but are now combined with those in the Gulf of Maine. The stock is overfished and overfishing is occurring. Current fishing mortality is high (2001 $F_{ages\ 3-4}$=0.75, Figure A2.1) and much greater than the proposed F_{MSY} proxy ($F_{40\%MSP}$=0.17). Spawning stock biomass declined in the early 1990s, but began increasing in 1998, to 3,200 mt in 2001 (Figure A2.2), and is much less than the proposed SSB_{MSY} proxy (12,600 mt SSB). With the exception of the strong 1987 year class, recruitment has been relatively stable, but early indications suggest that the 2000 cohort is extremely low. The age structure of the stock is truncated in comparison to MSY conditions (Figure A2.9)

Management Advice: Fishing mortality should be reduced to near zero.

Forecasts for 2003-2009: Age-based, stochastic projections predict that landings and SSB decrease in 2003 at 85% of $F_{status\ quo}$ (F_{2002} = 0.64). Stochastic projections indicate that there is approximately a 50% probability of rebuilding to SSB_{MSY} by 2009 if F for the years 2003-2009 is reduced to 0.03.

Forecast Table: Basis: For age-based projections, F_{2002}=0.64 (85% of status quo from VPA F_{2001}), geometric mean 1994-2001 partial recruitment, and average 1994-2001 mean weights at age and maturation. Age-1 recruitment for 2003-2009 was estimated from the distribution of observed age-1 stock sizes from 1985 to 2000. Landings and SSB in 1,000s of mt.

2002				2003		2004	
F	Landings	SSB	2003-2009 F	Landings	SSB	SSB	Consequences/Implications
0.64	1.7	2.9	0.00 (no fishery)	0.0	2.7	4.6	79% chance of rebuilding to SSB_{msy} by 2009
			0.03 ($F_{rebuild}$)	0.1	2.7	4.4	50% chance of rebuilding to SSB_{msy} by 2009
			0.17 (F_{msy})	0.4	2.6	3.8	1% chance of rebuilding to SSB_{msy} by 2009
			0.64 (85% of $F_{status\ quo}$)	1.2	2.1	2.4	0% chance of rebuilding to SSB_{msy} by 2009

Catch and Status Table: Cape Cod – Gulf of Maine Yellowtail Flounder
(weights in >000 mt, recruitment in millions)

	1994	1995	1996	1997	1998	1999	2000	2001	Max[1]	Min[1]	Mean[1]
Landings	1.3	1.3	1.2	1.1	1.2	1.2	2.4	2.5	3.2	0.8	1.5
Discards	0.3	0.3	0.2	0.3	0.3	0.1	0.2	0.5	1.2	0.1	0.4
Total catch	1.6	1.7	1.4	1.4	1.5	1.4	2.6	3.0	4.5	0.9	1.9
Biomass	5.2	3.8	3.4	3.8	4.1	5.6	6.7	5.4	7.6	2.4	4.8
SSB	3.1	2.3	2.3	1.6	2.2	2.9	3.1	3.2	3.8	0.7	2.3
Recruitment (age 1)	7.2	6.4	9.6	8.6	10.7	13.4	10.0	1.9	28.8	1.9	10.5
F (age 3-4)	0.48	0.65	0.57	0.72	0.60	0.41	0.72	0.75	1.34	0.28	0.73
Exploitation Rate	35%	44%	40%	47%	41%	31%	47%	48%	68%	22%	47%

[1]Over period 1985-2001

Stock Distribution and Identification: Yellowtail flounder inhabit relatively shallow waters (20-100 m) of the continental shelf of the northwest Atlantic from Labrador to Chesapeake Bay. An interdisciplinary evaluation of yellowtail flounder stock structure indicates that yellowtail in the Cape Cod – Gulf of Maine area constitute a single, self-sustaining resource. The Cape Cod – Gulf of Maine yellowtail stock area is defined as the western Gulf of Maine, from Nantucket Shoals to the mouth of the Bay of Fundy (U.S. statistical reporting areas 511-515 and 521).

Catches: Annual landings generally increased from <1,000 mt in the mid 1930s to a peak of 5,600 mt in 1980. Landings decreased to approximately 1,200 mt per year in the late 1980s, but peaked again in 1990 at 3,200 mt with recruitment of the strong 1987 year class. Landings decreased to 800 mt in 1993 and remained low through the 1990s, but rapidly increased to >2,400 mt in 2000 and 2001. Discards averaged 11% of total catch from 1985 to 2001. Discard estimates are not available for the Gulf of Maine prior to 1985.

Over the past three years, total catch has been 69% large-mesh trawl landings from the Cape Cod grounds (statistical areas 514 and 521), 13% gillnet landings in the Cape Cod area, 7% large-mesh trawl discards off Cape Cod, 5% large-mesh landings in the northern Gulf of Maine (areas 511-513 and 515), 2% discards from the scallop fishery, 1% large-mesh trawl discards in the northern Gulf of Maine, 1% gillnet landings in the northern Gulf of Maine, and 1% small-mesh trawl discards.

Data and Assessment: Landings in 1985-2001 were estimated from dealer records and interview information. Landings in 1994-2001 were prorated from dealer records according to vessel logbook data. US discards at age in 1985-2001 were estimated from sea sampling information.

A virtual population analyses (VPA) of commercial landings and discards at age was completed (assuming natural mortality, M, of 0.2). Indices of recruitment and stock abundance were obtained from NEFSC spring and autumn and Massachusetts spring and fall bottom trawl surveys. Estimates of uncertainty include survey measurement error, but not errors in catch. The VPA calibration was revised from previous VPAs of the Cape Cod stock to group older ages (age 5+) into a single age class to avoid inconsistent estimates in terminal years of the assessment and problematic patterns of F and trends in stock size. The revised calibration provides a different perspective on historical development of the stock and the fishery. However, an implicit assumption in the reconfiguration is that age-3 yellowtail in this area are fully vulnerable to fishing effort.

Biological Reference Points: The proposed F_{MSY} proxy is $F_{40\%}$ (0.17, Figure A2.3). The SSB_{MSY} proxy is 12,600 mt, calculated as the product of 40%MSP (1.192 kg spawning biomass per recruit) and average recruitment (10.5 million). The MSY proxy is 2,300 mt, derived as the product of yield per recruit at $F_{40\%}$ (0.213 kg) and average recruitment.

Fishing Mortality: Annual F declined from a peak of 1.3 in 1988 to 0.28 in 1993, then increased to an average of 0.61 from 1995 to 2000. F was 0.75 in 2001, with an 80% confidence limit of 0.59-0.95 (Figure A2.6). Retrospective analysis indicates an 18% underestimation of F in the past 5 years.

Recruitment: With the exception of the strong 1987 year class (29 million at age-1), recruitment appears to have been relatively stable, averaging 10.5 million at age 1. Recruitment approximately doubled between 1994 and 1998. However, early indications are that the 2000 year class is well below average (Figure A2.2).

Spawning Stock Biomass: SSB averaged 1,000 mt during the late 1980s, increased to 3,800 mt in 1991, and decreased to 1,600 mt in 1998. It then increased to 3,200 mt in 2001, with an 80% confidence limit of 2,500–4,000 mt (Figure A2.5). Retrospective analysis indicates a 21% overestimation of SSB in the past 5 years.

Special Comments: This assessment is the first for yellowtail flounder in the Cape Cod - Gulf of Maine area, and the VPA calibration was revised. Despite the data and methodology revisions, the current state of the stock and management advice are similar to those reported for the Cape Cod management area by the 28th Stock Assessment Review Committee in 1999. The Cape Cod component, which accounts for approximately 90% of landings from the combined area, was previously determined to be overfished.

Source of Information: S. X. Cadrin and J. King. 2002. Stock assessment of yellowtail flounder in the Cape Cod – Gulf of Maine area. NEFSC Ref. Doc. 03-03.
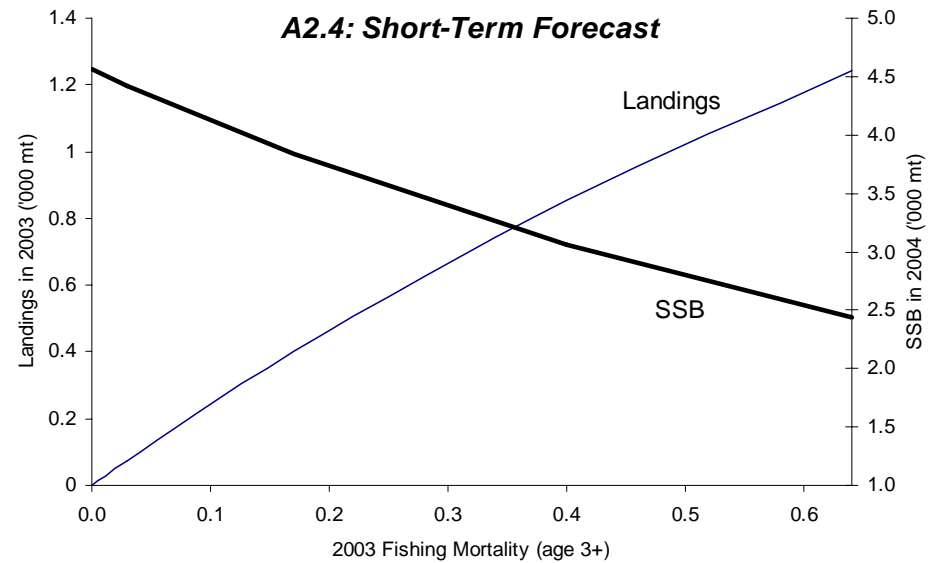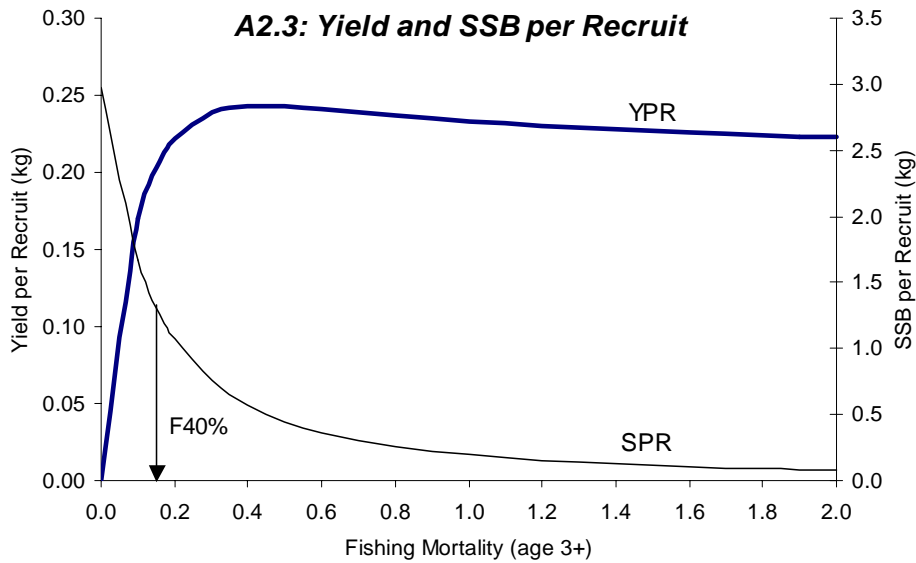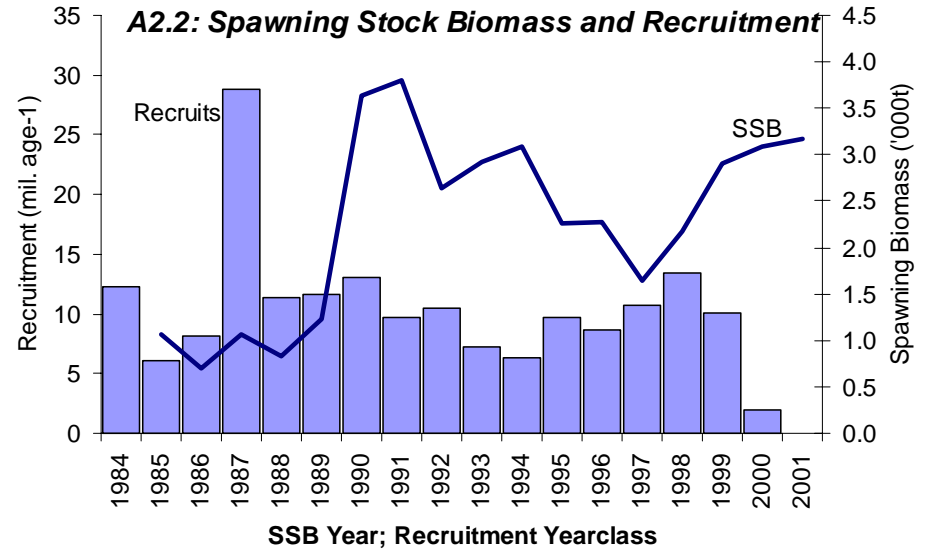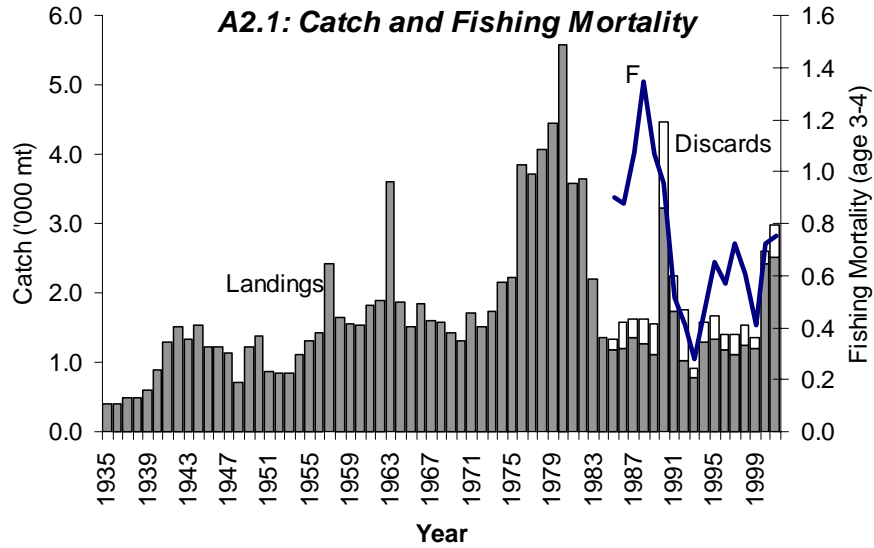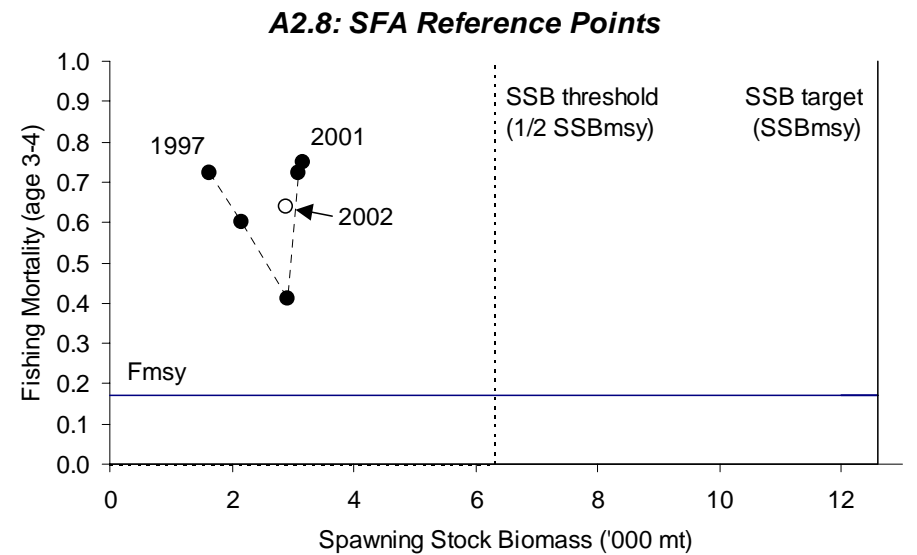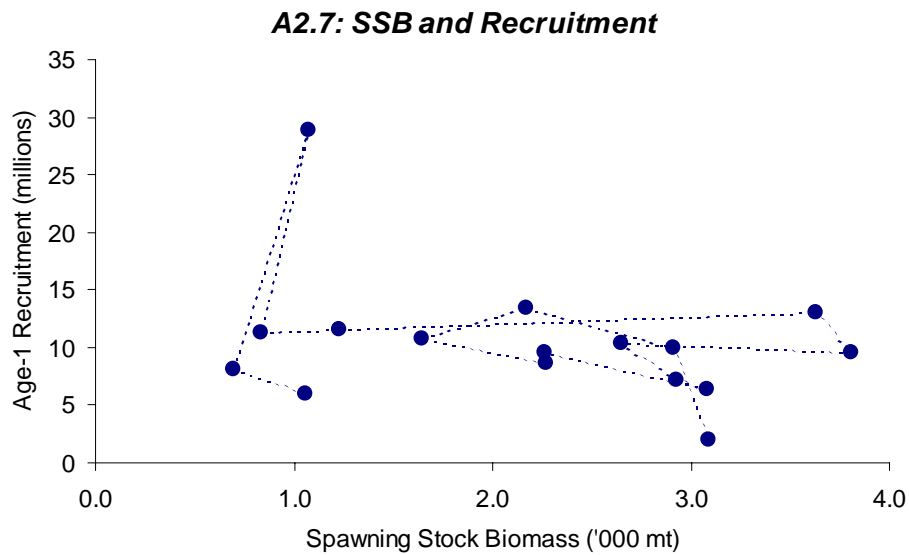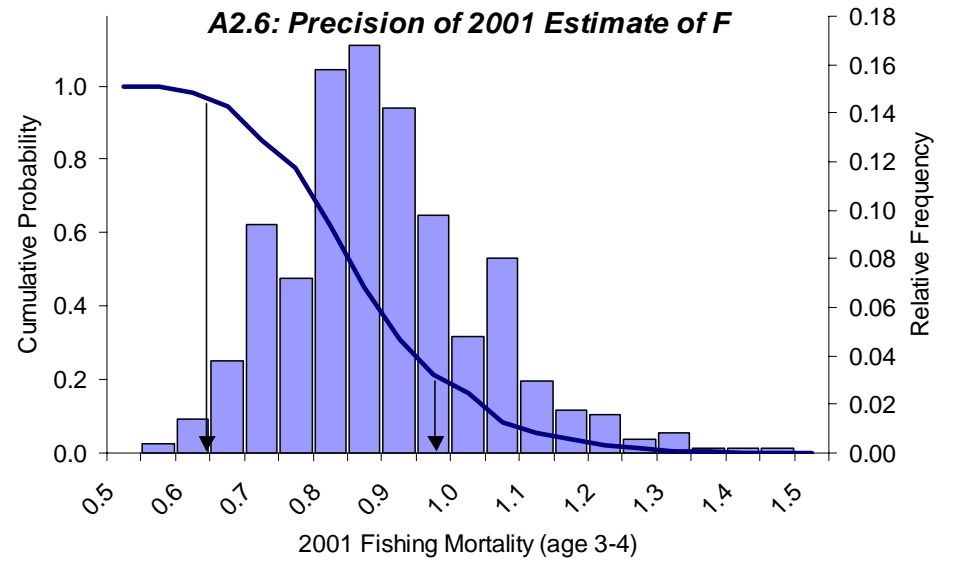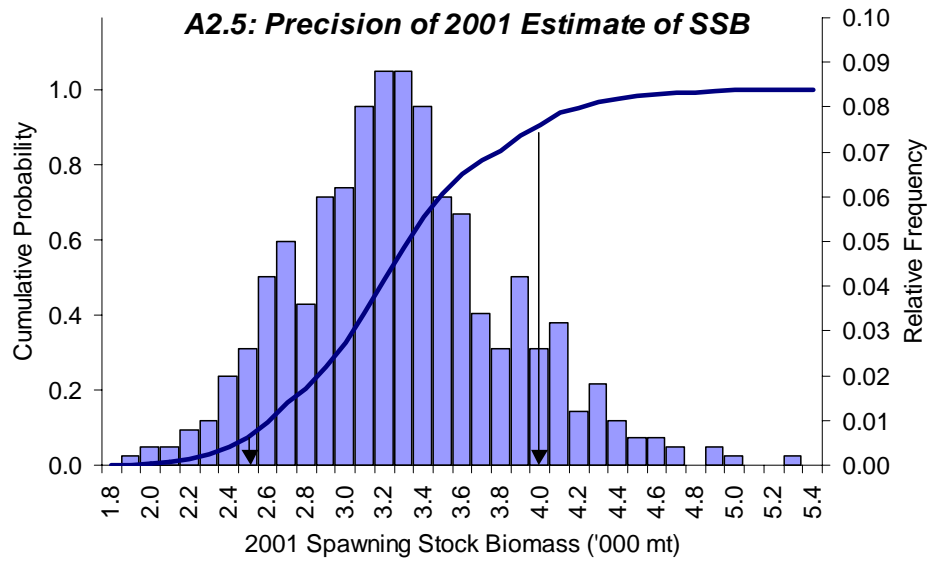
A2.1: Catch and Fishing Mortality

A2.2: Spawning Stock Biomass and Recruitment

A2.3: Yield and SSB per Recruit

A2.4: Short-Term Forecast

22

A2.5: Precision of 2001 Estimate of SSB

A2.6: Precision of 2001 Estimate of F

A2.7: SSB and Recruitment

A2.8: SFA Reference Points

A2.9 Observed and Expected Age Distribution of SSB

1992-1999

2000

2001

Long term at Fmsy
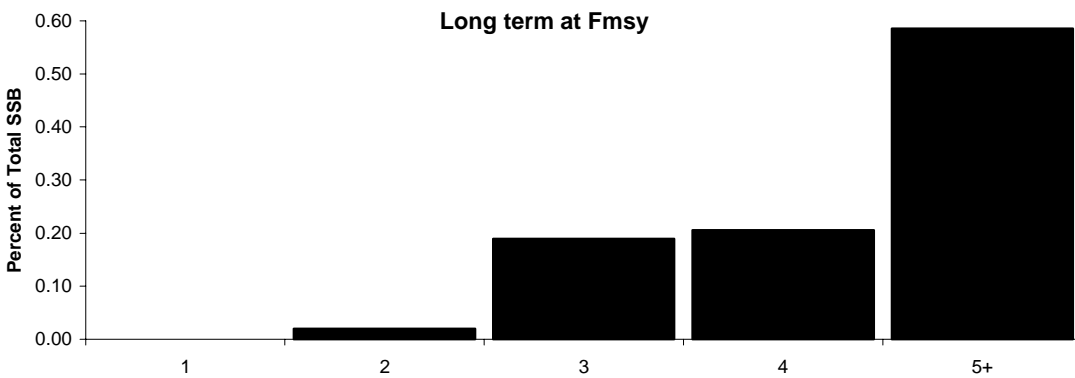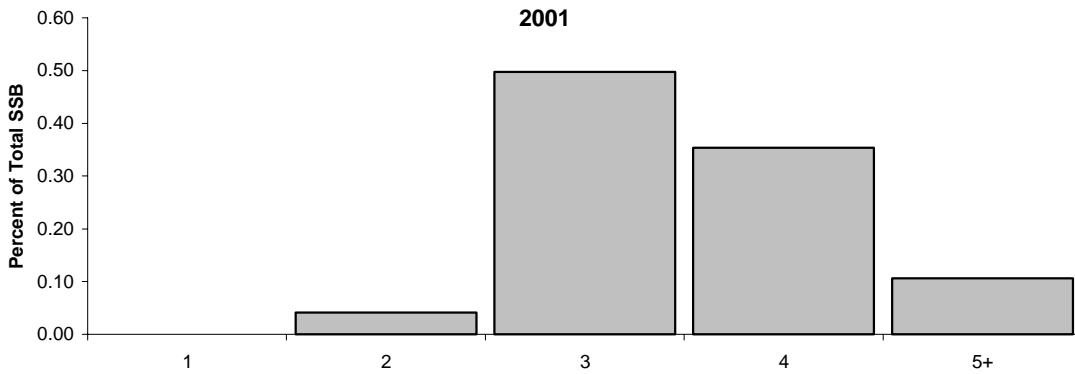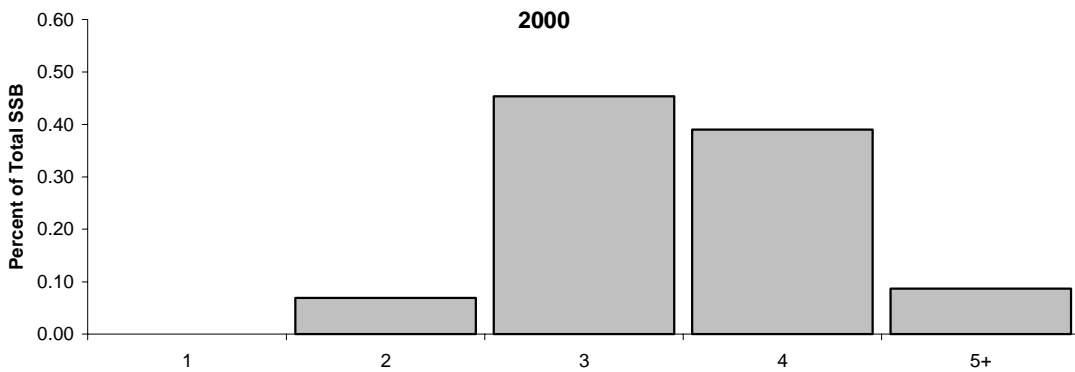
B1. Southern New England/Mid-Atlantic Winter Flounder

State of Stock: The Southern New England/Mid-Atlantic (SNE/MA) winter flounder stock complex is overfished and overfishing is occurring. Fully recruited fishing mortality in 2001 was 0.51 (exploitation rate = 37%), about 60% above F_{msy} =0.32. (Figures B1.1 and B1.5). The current VPA indicates an 80% probability that F_{2001} was between 0.44 and 0.58 (Figure B1.4). Spawning stock biomass was estimated to be 7,600 mt in 2001, about 25% of SSB_{msy} = 30,100 mt (Figures B1.2 and B1.5). There is an 80% probability that the spawning stock biomass was between 6,800 mt and 8,400 mt in 2001 (Figure B1.4).

Spawning stock biomass declined substantially from 13,000-14,000 mt during the early 1980s to 2,700 mt during the years 1994-1996. SSB has increased since the mid 1990s to about 7,600 mt in 2001 as a consequence of the reduced fishing mortality rates since 1997 (Figure B1.2). Recruitment to the stock has been below average since 1989, and early indications are that the 2001 year class is the smallest in 22 years (Figure B1.2).

Management Advice: The fishing mortality rate should be reduced to F_{reb} = 0.24 in 2003, to promote rebuilding to B_{msy} by 2013. Managers should recognize that given the estimation uncertainty in the assessment, current fishing mortality rates are likely much higher than the 2001 estimate of 0.51, potentially by nearly 100%. Current SSB may in turn be substantially overestimated.

Forecast for 2003-2013: If F_{2002} is assumed to be 85% of F_{2001} (i.e. F_{2002} = 0.43), due to the impact of management measures implemented in response to court orders during 2002, then 2002 landings are expected to be about 3,000 mt. At this reduced F, spawning stock biomass is still projected to fall to 5,900 mt in 2002 (Figure B1.6). Given this value of F_{2002}, a fishing mortality rate of F_{reb} = 0.24 will be necessary to rebuild the spawning stock to SSB_{MSY} (30,100 mt) by 2013, with 50% probability (Figure B1.6). Stochastic forecasts have not been adjusted for the retrospective pattern in stock size estimates.

Forecast Table: 2003-2013 recruitment estimated from a stochastic Beverton & Holt stock recruitment relationship (NEFSC 2002). F_{2002} is assumed $0.85*F_{2001}$ (15% decrease in F from 2001 to 2002); F during 2003-2013 as indicated.

Forecast Medians (50% probability level); 1,000s of mt

2002				2003				2013				
F	Land	Disc	SSB	F	Land	Disc	SSB	F	Land	Disc	SSB	P (%) SSB > SSB_{MSY}
0.43	3.0	0.2	5.9	F_{sq}=0.43	3.3	0.2	7.0	F_{sq}=0.43	8.0	0.5	16.4	0%
				F_{msy}=0.32	2.6	0.2	7.2	F_{msy}=0.32	8.3	0.5	23.3	6%
				F_{reb}=0.24	2.0	0.1	7.3	F_{reb}=0.24	8.1	0.4	30.1	50%

Catch and Status Table: SNE/MA winter flounder
(weights in '000 mt, recruitment in millions)

Year	1994	1995	1996	1997	1998	1999	2000	2001	Max[1]	Min[1]	Mean[1]
Commercial landings	2.2	2.6	2.8	3.4	3.2	3.4	3.8	4.4	11.2	2.2	5.0
Commercial discards[2]	0.3	0.1	0.2	0.3	0.5	0.3	0.1	0.1	1.5	0.1	0.7
Recreational landings	0.6	0.7	0.7	0.6	0.3	0.3	0.8	0.6	5.8	0.3	1.8
Recreational discards[3]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.1
Catch used in assessment	3.1	3.4	3.7	4.4	4.0	4.1	4.8	5.1	15.8	3.1	7.6
Spawning stock biomass	2.7	2.8	2.7	3.5	4.0	4.9	6.0	7.6	14.8	2.7	6.7
Recruitment (Age 1)	8.3	12.6	17.6	21.1	18.8	13.4	12.7	19.0	62.9	5.6	23.9
Fully recruited F (age 4-5)	0.43	0.72	0.93	1.23	0.98	0.58	0.55	0.51	1.38	0.42	0.85
Exploitation rate (age 4-5)	32%	47%	55%	65%	58%	40%	38%	36%	69%	31%	52%

[1]Over period 1981-2001; [2]Assuming 50% discard mortality; [3]Assuming 15% release mortality.

Stock Distribution and Identification: Winter flounder are distributed from Labrador to North Carolina. Localized stocks are found in the region⊇s estuaries. Because the fishery exploits a mixture of these stocks, for assessment purposes, a Southern New England/Mid-Atlantic (SNE/MA) stock complex has been defined as extending from the waters of outer Cape Cod to the south and west, including NEFSC statistical areas 521, 526, 533-538, and 611 to 639.

Catches: Commercial landings peaked in 1966 at 12,000 mt and then declined to 3,300 mt by 1976. Commercial landings increased in the late 1970s and early 1980s to a peak of 11,200 mt in 1981, and then declined to a record low of 2,200 mt in 1994. Commercial landings have since increased to 4,400 mt in 2001. Recreational landings peaked at 5,800 mt in 1984, and then declined to 400 mt in 1992. Recreational landings varied between 300 mt and 800 mt during the years 1993-2000, and were an estimated 550 mt in 2001. Total discards (commercial plus recreational, by weight) as a percentage of total catch peaked in 1989 at 21%, but have since declined to about 2% in 2001. Total catches (including discards) declined from 15,800 mt in 1984 to 3,100 mt in 1994, but have since increased to 5,100 mt in 2001 (Figure B1.1).

Data and Assessment: SNE/MA winter flounder was last assessed at SAW-28 in 1998. The current assessment includes estimated total catch for the period 1981-2001, survey indices through 2002, estimates of fishing mortality and stock size by VPA for 1981-2001/2002, and biological reference points estimated by yield per recruit and stock-recruitment analyses. The current VPA includes several new survey tuning series not available for the SAW-28 assessment. The SARC reviewed new information on maturity, but concluded that more analyses are needed before revisions to the maturity schedule can be adopted. The yield per recruit and stock-recruitment analyses have been updated to include information through 2002. Given the stability of the input data and the results of these analyses, the SARC elected to retain the NEFSC (2002) estimates of biological reference points for this assessment.

Biological Reference Points: NEFSC (2002) re-estimated the biological reference points for SNE/MA winter flounder in 2002 using YPR and SSB/R and stock-recruitment models. The yield and SSB per recruit analyses indicate that $F_{40\%} = 0.21$ and $F_{0.1} = 0.25$ (Figure B1.3). The parametric stock-recruitment model indicated that MSY = 10,600 mt, $F_{msy} = 0.32$, and $SSB_{msy} = 30,100$ mt (Figures B1.5 and B1.7). It is recommended that these parametric stock-recruitment model reference points be the basis for the ASMFC and NEFMC FMP overfishing definitions.

Fishing Mortality: During the years 1981-1993, fishing mortality (fully recruited F, ages 4-5) varied between 0.4 (1982) and 1.4 (1988), and was as high as 1.2 as recently as 1997. Fishing mortality has been in the range 0.5-0.6 during the period 1999-2001 (Figures B1.1 and B1.5). Accounting for the uncertainty of the 2001 estimate, there is an 80% probability that F_{2001} was between 0.44 and 0.58 (Figure B1.4). For

1995-1999, retrospective fishing mortality rates underestimate the current values by an average of 128%. The most likely cause of this pattern is a combination of factors including under-reporting of the landings, misclassification of the landings by stock area, and underestimation of the discards.

Recruitment: Recruitment declined from 62.9 million age-1 fish in 1981 to 7.8 million in 1992. It then averaged 14.7 million fish from 1993 to 2001, below the VPA time-series average of 23.9 million. The 2001 year class is estimated to be the smallest in 22 years, just 5.7 million fish (Figure B1.2).

Spawning Stock Biomass: SSB declined from 14,800 mt in 1983 to a record low of 2,700 mt in 1994. It has since increased to 7,600 mt in 2001 (Figure B1.2). Accounting for the uncertainty of the 2001 estimate, there is an 80% probability that SSB in 2001 was between 6,800 mt and 8,400 mt (Figure B1.4). For the period 1995-1999, retrospective SSB levels overestimate current values by an average of 76%.

Special Comments: The current assessment provides a much more pessimistic evaluation of stock status than the SAW-28 assessment in 1998. This is mainly due to the retrospective pattern of underestimating F and overestimating SSB in the current VPA. However, while the SNE/MA winter flounder VPA provides uncertain estimates of current F and SSB, it provides a better determination of stock status than reliance on survey indices alone.

An unusually high proportion of the commercial landings for the stock complex was reported from NEFSC statistical area 521 in 1997 and 2001 (63% in 1997 and 56% in 2001, compared with the 1989-1996 average of 43%). When considered along with the distribution of survey catches, this indicates that the commercial fishery focuses on winter flounder along the western side of the Great South Channel.

Source of Information: Report of the 36th Northeast Regional Stock Assessment Workshop (36th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments. NEFSC Ref. Doc. 02-xx. Northeast Fisheries Science Center (NEFSC). 2002. Final Report of the Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish. NEFSC Ref. Doc. 02-04, 123 pp.

B1.1: SNE/MA Winter Flounder
Total Catch and Fishing Mortality
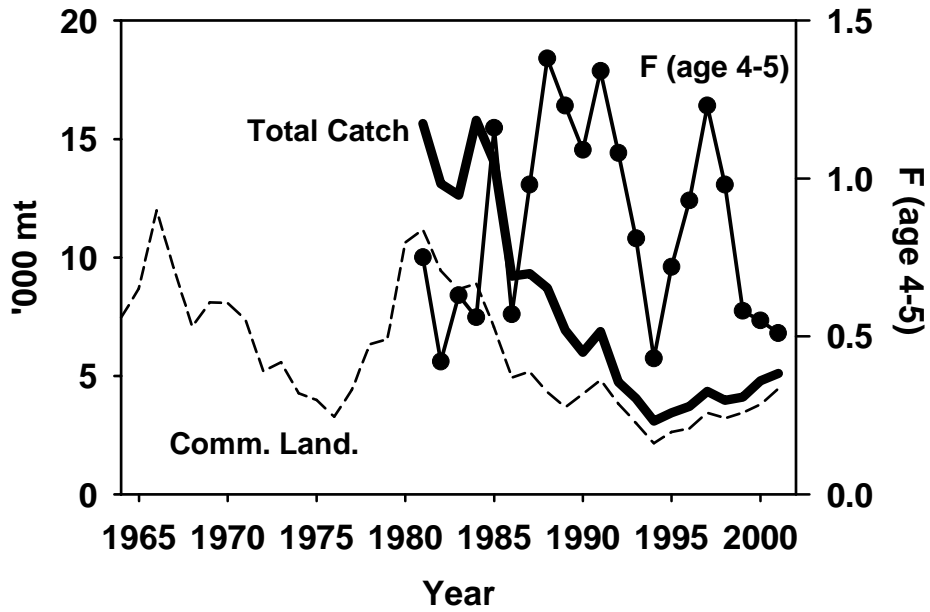
Figure B1.1. Total catch (landings and discards, '000 mt), commercial landings ('000 mt), and fishing mortality rate (F, ages 4-5, unweighted) for SNE/MA winter flounder.

B1.2: SNE/MA Winter Flounder
SSB and Recruitment
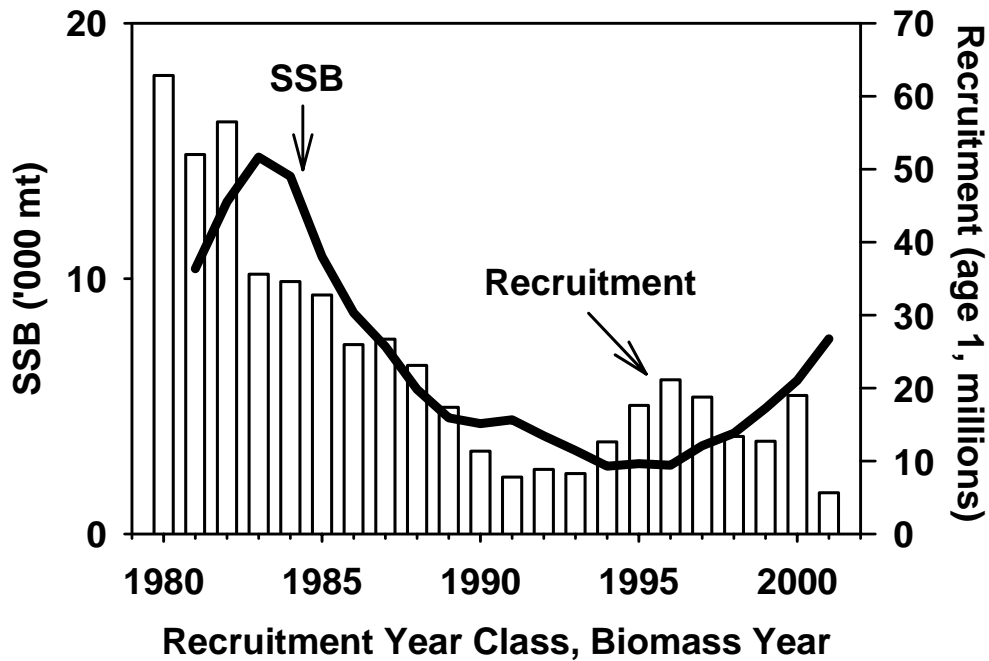
Figure B1.2. Spawning stock biomass (SSB, ages 3-7+, '000 mt) and recruitment (millions of fish at age-1) for SNE/MA winter flounder.

B1.3: SNE/MA Winter Flounder
Yield and SSB per Recruit
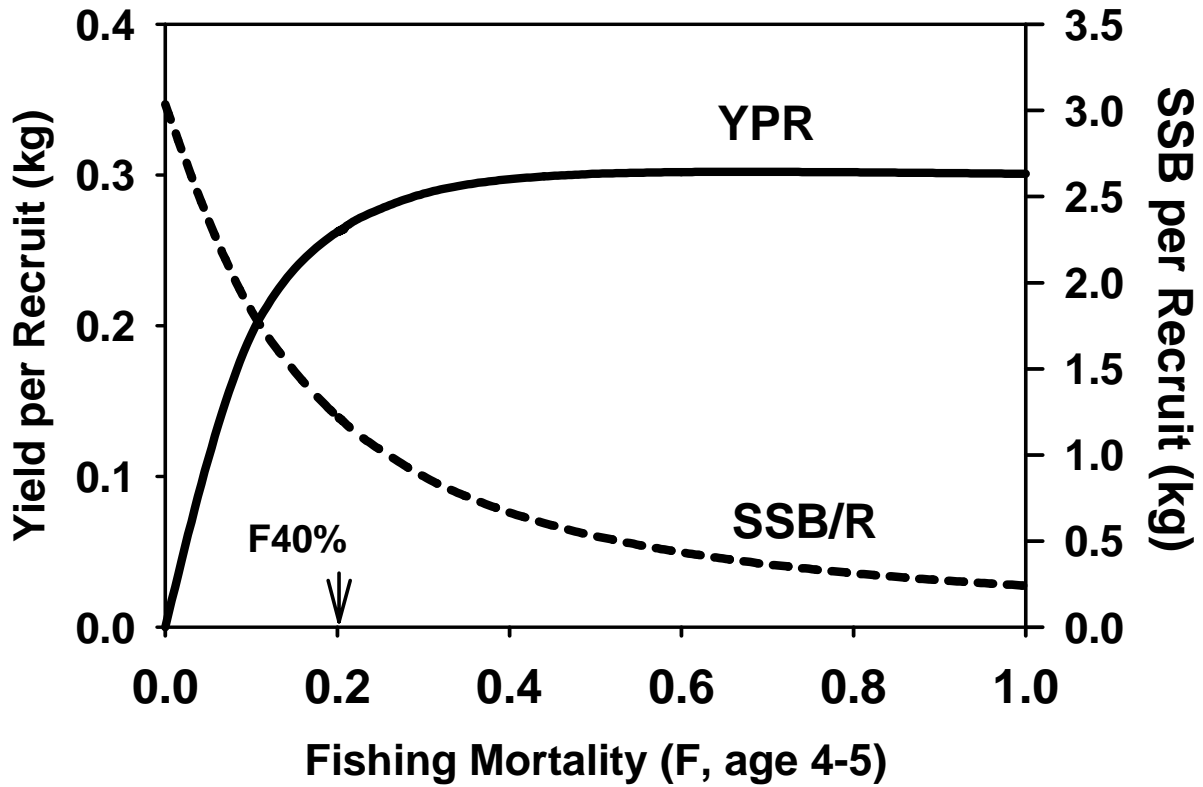
Figure B1.3. Yield per recruit (YPR) and spawning stock biomass per recruit (SSB/R) for SNE/MA winter flounder.

B1.4: SNE/MA Winter Flounder
Precision of 2001 Estimates for SSB and F
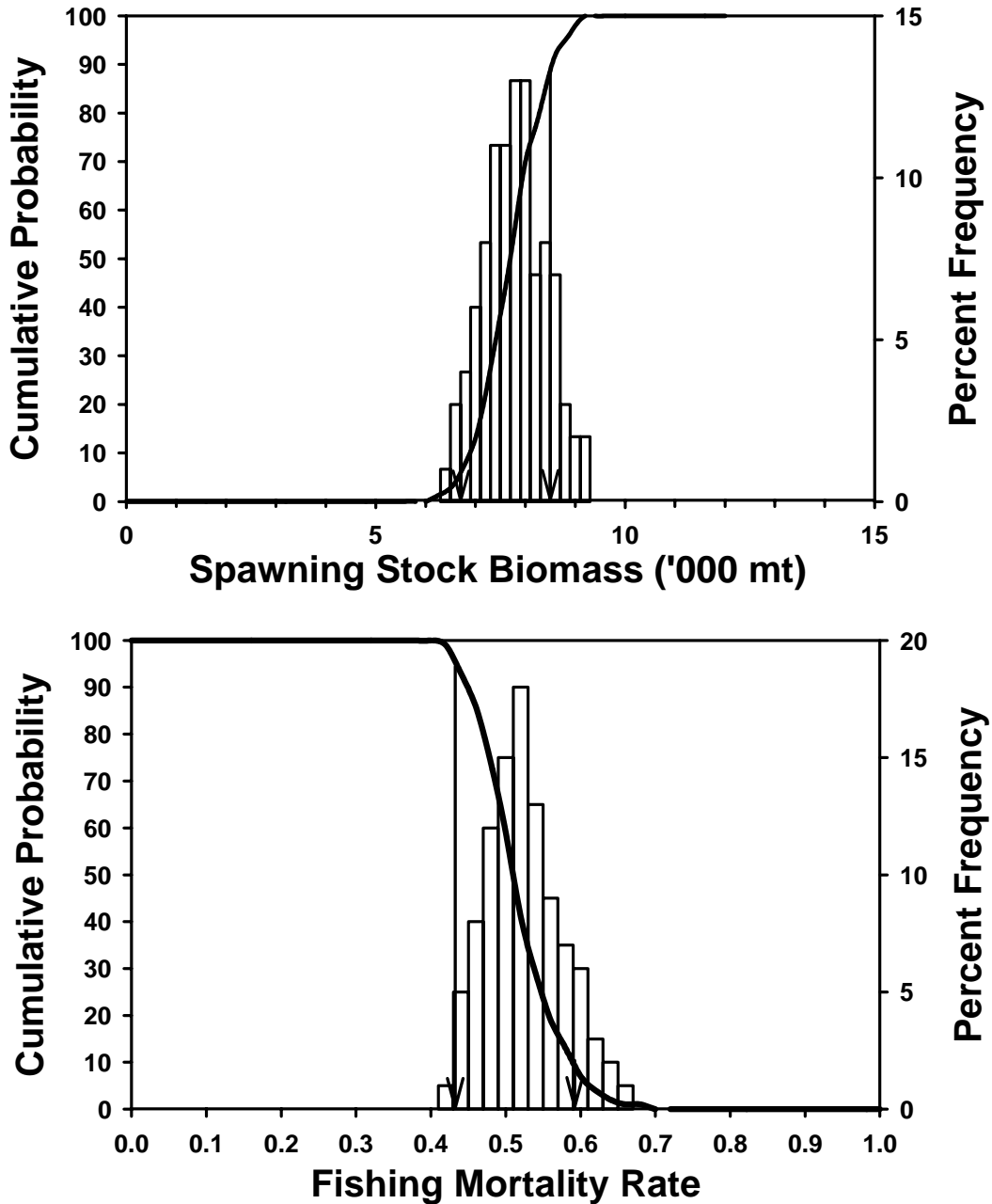
Figure B1.4. Precision of estimates of spawning stock biomass (ages 3-7+, '000 mt) and fishing mortality rate (F, ages 4-5, unweighted) in 2001 for SNE/MA winter flounder. Vertical bars display the range of the bootstrap estimates and the probability of individual values in the range. The solid curve gives the probability of SSB that is less or fishing mortality that is greater than any value along the X axis.

B1.5: SNE/MA Winter Flounder
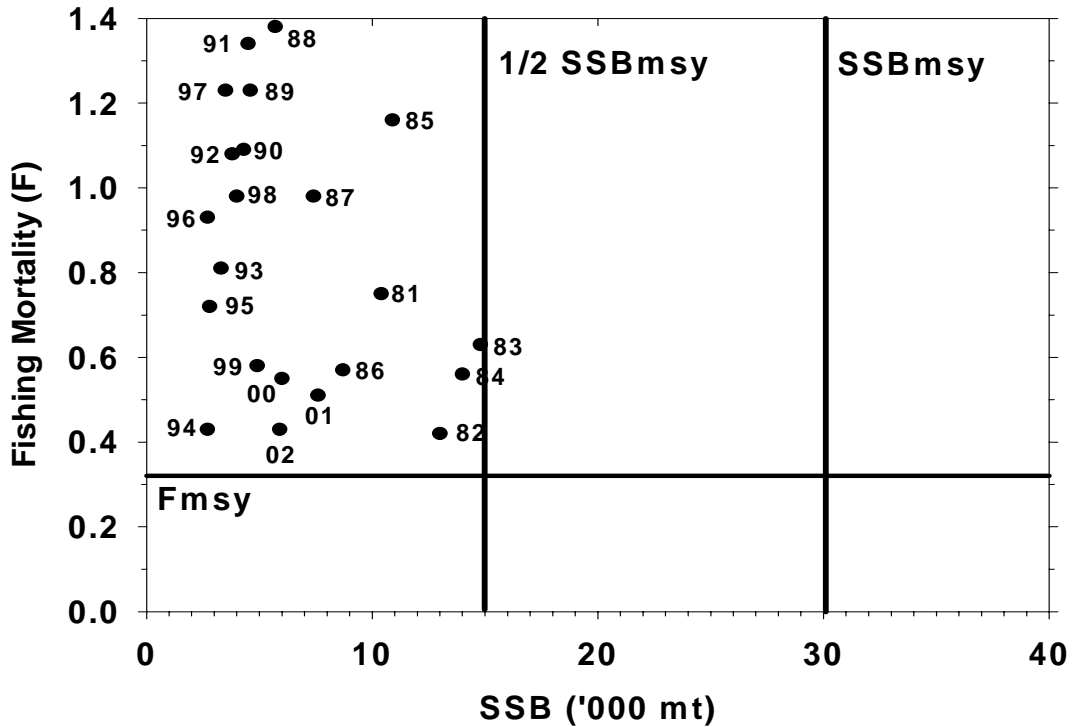
Figure B1.5. SSB and F for SNE/MA winter flounder. NEFSC (2002) biological reference points (Fmsy = 0.32, SSBmsy = 30,100 mt) are also shown.

B1.6: SNE/MA Winter Flounder
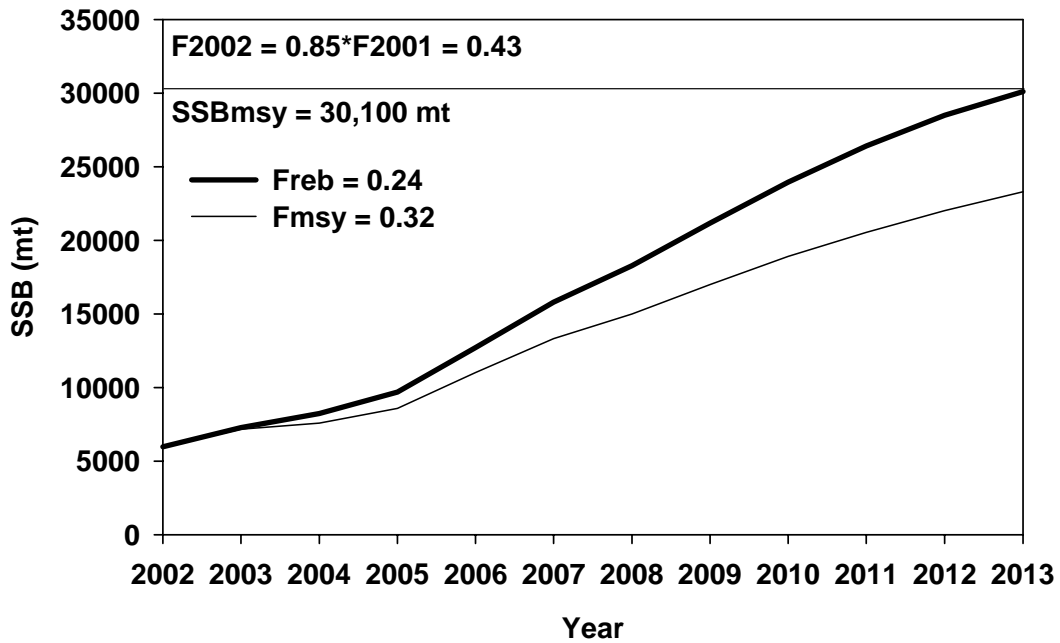
Figure B1.6. Median (50% probability) of forecast spawning stock biomass (SSB, mt) for SNE/MA winter flounder under Fmsy and Frebuild fishing mortality rates during 2003-2013. Assumes F2002 = 0.85*F2001 = 0.43.

B1.7: SNE/MA Winter Flounder
SSB - RECRUIT DATA FOR 1981-2001 YEAR CLASSES
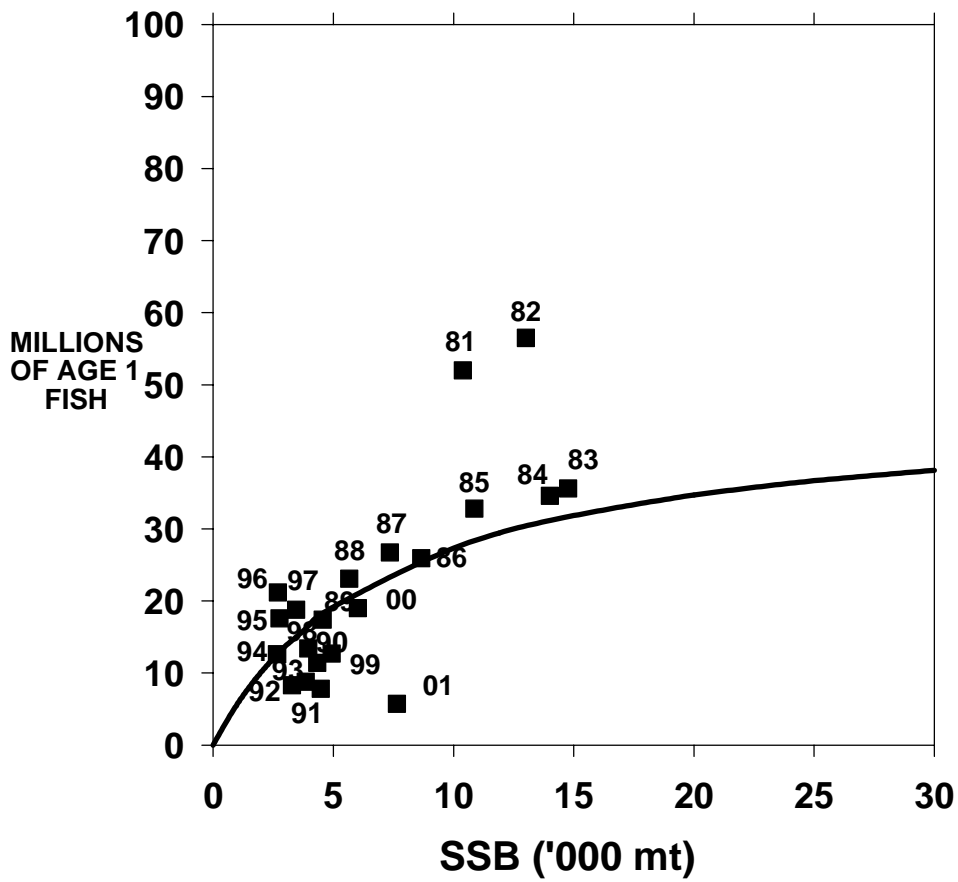
Figure B1.7. SNE/MA winter flounder SARC 36 VPA SSB and recruit data for the 1981-2001 year classes. Curved line is the S-R function estimated by NEFSC (2002).

B2. Gulf of Maine Winter Flounder

State of Stock: The Gulf of Maine winter flounder stock is not overfished and overfishing is not occurring (Figure 5). Fully recruited fishing mortality in 2001 was 0.14, about 67% below F_{msy} = 0.43 (Figures B2.1 and B2.3). There is an 80% chance that the F_{2001} was between 0.12 and 0.16 (Figure B2.4). Spawning stock biomass was estimated to be 5,900 mt in 2001, about 44% above B_{msy} = 4,100 mt (Figures B2.2 and B2.4). There is an 80% chance that the spawning stock biomass was between 5,200 mt and 6,600 mt in 2001 (Figure B2.4).

Spawning stock biomass declined substantially from 4,800 mt in 1982 to 700 mt in 1995, but has increased to about 5,900 mt in 2001 as a consequence of reduced fishing mortality since 1996 (Figure B2.2). Recruitment to the stock has been near or above average since 1995 (Figure B2.2).

Management Advice: Maintain fishing mortality at a target level below F_{msy} = 0.43 to ensure that SSB remains near B_{msy}.

Forecast for 2003-2013: If F_{2002} is assumed to be 85% of F_{2001} (F_{2002} = 0.12), due to the impact of additional management measures implemented in 2002, landings in 2002 are expected to be about 800 mt. At this reduced F, spawning stock biomass is projected to increase to 7,700 mt in 2002 (Figure B2.6).

Forecast Table: 2003-2013 recruitment estimated from a Beverton-Holt stock-recruitment relationship.

F2002 is assumed $0.85*F_{2001}$; F during 2003-2013 = Fmsy = 0.43

Forecast Medians (50% probability level); 1,000s of mt

2002				2003				2013			
F	Land	Disc	SSB	F	Land	Disc	SSB	F	Land	Disc	SSB
0.12	0.8	< 0.1	7.7	F_{msy}= 0.43	2.9	0.1	7.9	F_{msy}= 0.43	1.6	0.1	4.3

Catch and Status Table: Gulf of Maine winter flounder
(weights in '000 mt, recruitment in millions)

Year	1994	1995	1996	1997	1998	1999	2000	2001	Max[1]	Min[1]	Mean[1]
Commercial landings	0.6	0.8	0.6	0.6	0.6	0.3	0.4	0.6	2.8	0.3	1.0
Commercial discards[2]	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.4	< 0.1	0.1
Recreational landings	0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	1.9	< 0.1	0.5
Recreational discards[3]	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Catch used in assessment	0.7	0.9	0.7	0.7	0.7	0.3	0.4	0.6	5.0	0.3	1.7
Spawning stock biomass	0.8	0.7	0.8	1.4	2.2	3.3	4.3	5.9	5.9	0.7	2.3
Recruitment (Age 1)	4.5	7.5	7.6	7.2	9.0	10.1	7.5	7.4	11.8	3.2	6.7
Fully recruited F (age 5-6)	0.64	1.85	0.36	0.23	0.40	0.13	0.06	0.14	1.85	0.06	0.8
Exploitation rate (age 5-6)	43%	79%	28%	19%	30%	11%	05%	12%	79%	05%	45%

[1] Over period 1982-2001; [2] Assuming 50% discard mortality; [3] Assuming 15% release mortality.

Stock Distribution and Identification: Winter flounder are distributed from Labrador to North Carolina. Localized stocks are found in the region=s estuaries. Because the fishery exploits a mixture of these stocks, for assessment purposes a Gulf of Maine stock has been defined as extending from the waters of Cape Cod Bay and north, including NEFSC statistical areas 511-515.

Catches: Commercial landings were near 1,000 mt from 1964 to the mid 1970s,.increased to a peak of 2,800 mt in 1982 and then steadily declined to a record low of 300 mt in 1999. Landings have remained near 500 mt since 1999. Recreational landings peaked in 1981 at 2,600 mt but declined substantially thereafter. Recreational landings have been <100 mt since 1995. Total discards (commercial plus recreational, by weight) as a percentage of total catch ranged from 3 to 10% of the catch. with an average of 6%. Total catches (including discards) declined from 6,100 mt in 1981 to 300 mt in 1999 and have since increased to 600 mt in 2001 (Figure B2.1).

Data and Assessment: Gulf of Maine winter flounder were last assessed at SAW-21 in 1995, with an index-based assessment. The current assessment includes estimated total catch for the period 1982-2001, survey indices through 2002, estimates of fishing mortality and stock size by VPA for 1982-2001/2002, and biological reference points estimated by YPR and stock-recruitment analyses. The SARC reviewed new analyses on maturity, but concluded that more analyses are needed before a change in the maturity schedule is adopted.

Biological Reference Points: Biological reference points for Gulf of Maine winter flounder were estimated using empirical, non-parametric and parametric stock-recruit modeling approaches. The yield and SSB per recruit analyses indicate that $F_{40\%} = F_{0.1} = 0.26$ and $F_{max} = 0.69$ (Figure 3). A parametric stock-recruitment model estimated values of $F_{msy} = 0.43$, $B_{msy} = 4,100$, and MSY = 1,500 mt (Figure 7). The SARC recommends that the parametric model reference points be the basis for the ASMFC and NEFMC FMP overfishing definitions.

Fishing Mortality: During the years 1982-1995, fishing mortality (fully recruited F, ages 5-6, unweighted) varied between 0.5 (1983) and 1.9 (1995). Fishing mortality declined to 0.14 in 2001 (Figure B2.1). Accounting for the uncertainty of the 2001 estimate, there is an 80% probability that F_{2001} was between 0.12 and 0.16 (Figure B2.4). For the period 1993-1998, retrospective fishing mortality rates underestimate the current values by an average of 56%. The most likely cause of this pattern is a

combination of factors including under-reporting of the landings, misclassification of the landings by stock area, and underestimation of the discards.

Recruitment: Recruitment declined from 11.8 million age-1 fish in 1982 to 3.3 million in 1992. The arithmetic average recruitment from 1982 to 2001 is 6.7 million age-1 fish. Recruitment to the stock has been near or above average since 1995 (average of 7.8 million age-1 fish from 1995 to 2002; Figure B2.2)**.**

Spawning Stock Biomass: Spawning stock biomass (SSB) declined from 4,800 mt in 1982 to a record low of 700 mt in 1995, and then increased to 5,900 mt in 2001 (Figure B2.2). Accounting for the uncertainty of the 2001 estimate, there is an 80% probability that SSB in 2001 was between 5,200 mt and 6,600 mt (Figure B2.4). For the period 1993-1998, retrospective SSB levels overestimate current values by an average of 92%.

Special Comments: While the Gulf of Maine winter flounder VPA provides uncertain estimates of current F and SSB, it provides a better determination of stock status than reliance on survey indices alone. However, recent spatial distribution of both commercial landings and survey catches indicates that most of the recent stock rebuilding has taken place off the Massachusetts coast, with little evidence of rebuilding off the Maine coast.

Source of Information: NEFSC. 1996. Report of the 21th Northeast Regional Stock Assessment Workshop (21th SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments. Northeast Fisheries Science Center Ref. Doc 96-05d. Northeast Fisheries Science Center (NEFSC). 2002. Final Report of the Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish. NEFSC Ref. Doc. 02-04 123 pp. NEFSC. 2002. Report of the 36th Northeast Regional Stock Assessment Workshop (36th SAW) Stock Assessment Review Committee (SARC) consensus summary of assessments. Northeast Fisheries Science Center Ref. 03-xx.

Gulf of Maine Winter Flounder
Total Catch and Fishing Mortality
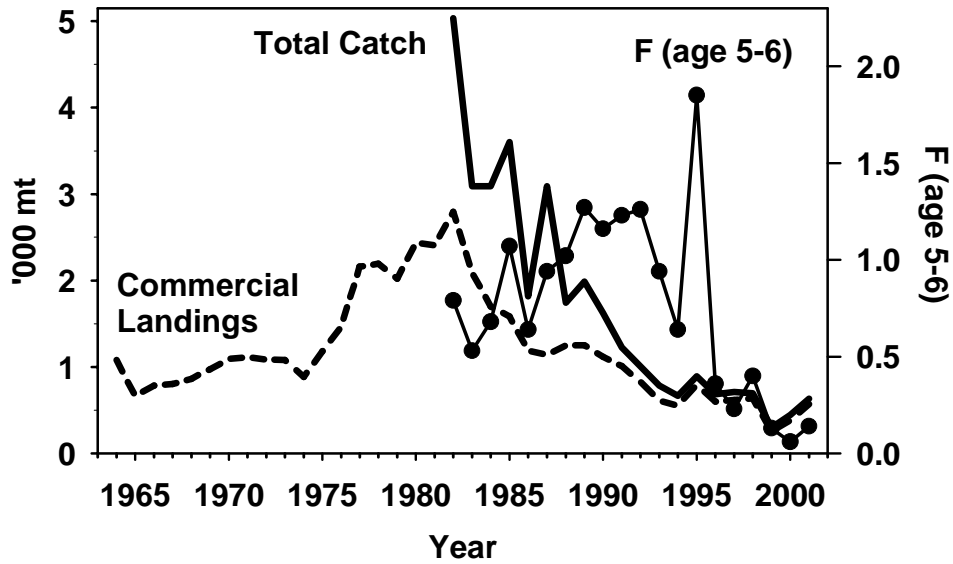
Figure B2.1. Total catch (landings and discards, '000 mt), commercial landings ('000 mt), and fishing mortality rate (F, ages 5-6, unweighted) for Gulf of Maine winter flounder.

Gulf of Maine Winter Flounder
SSB and Recruitment
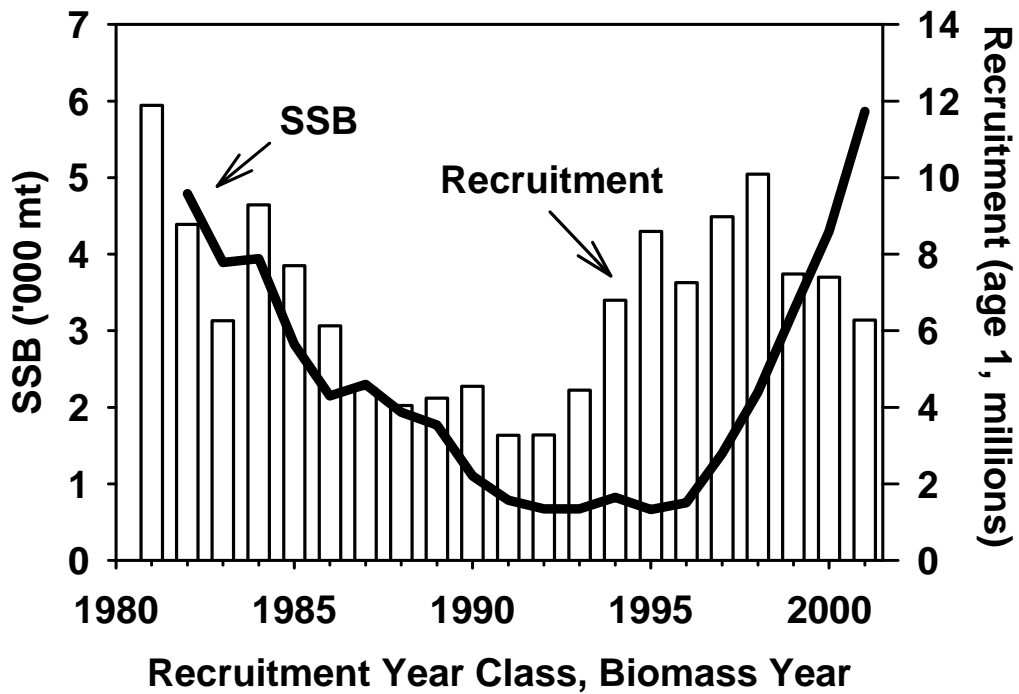
Figure B2.2. Spawning stock biomass (SSB, '000 mt) and recruitment (millions of fish at age-1) for Gulf of Maine winter flounder.
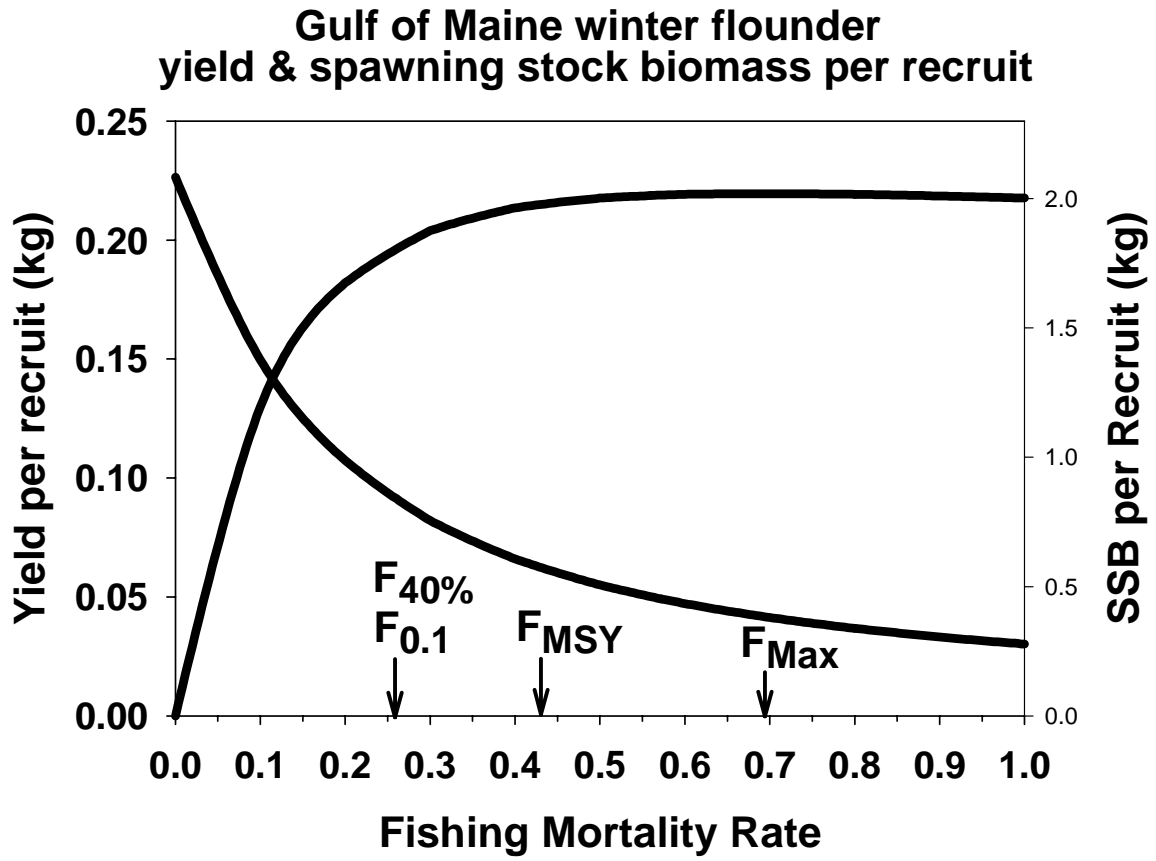
Figure B2.3. Yield and spawning stock biomass per recruit estimates for Gulf of Maine winter flounder.

Gulf of Maine Winter Flounder
Precision of 2001 Estimates for SSB and F
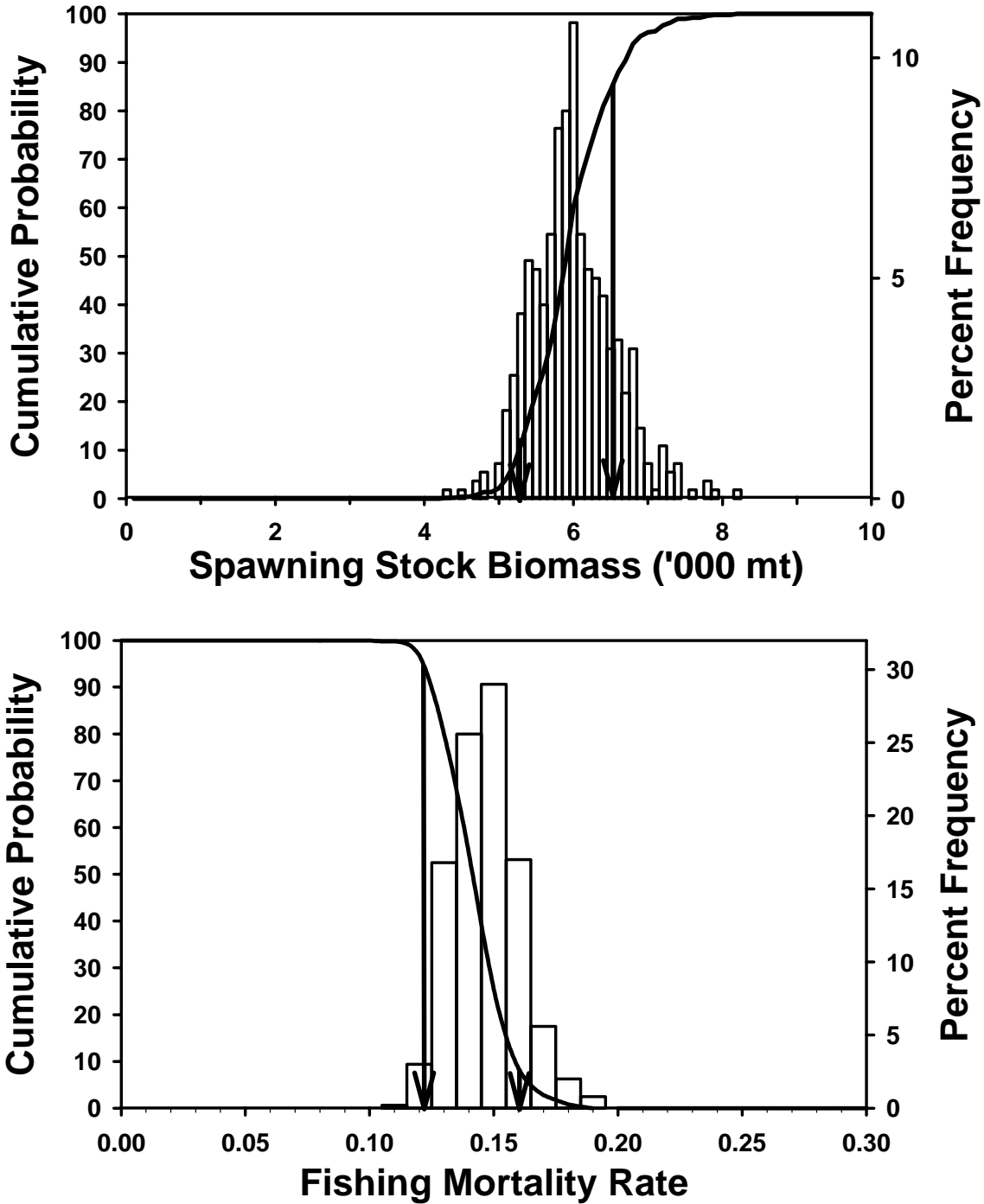
Figure B2.4. Precision of estimates of spawning stock biomass ('000 mt) and
  fishing mortality rate (F, ages 5-6, unweighted) in 2001 for Gulf of Maine winter flounder.
  Vertical bars display the range of the bootstrap estimates and the probability of
  individual values in the range. The solid curve gives the probability of SSB that is less
  or fishing mortality that is greater than any value along the X axis.
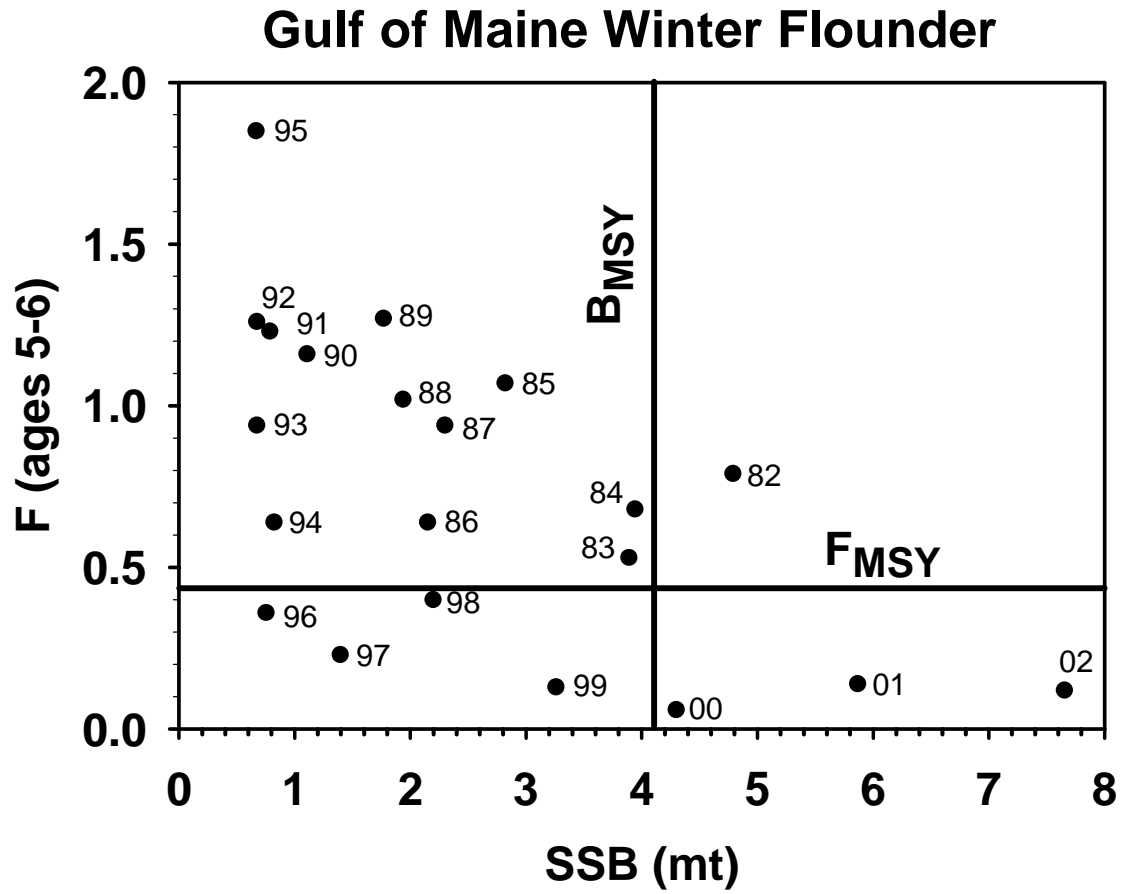
Figure B2.5. SSB and F (ages 5-6) for Gulf of Maine winter flounder. Biological references points calculated from the Beverton-Holt model are also shown.
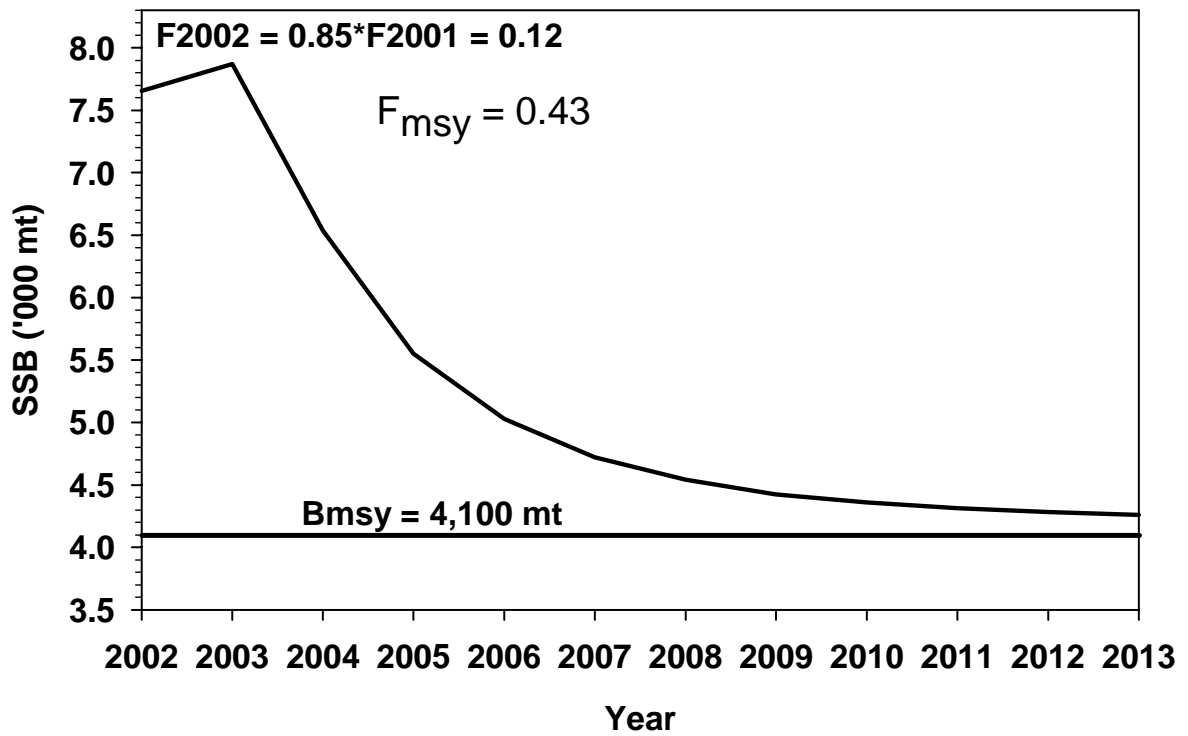
Figure B2.6. Median (50% probability) of forecast spawning stock biomass (SSB, mt) for Gulf of Maine winter flounder assuming F2002 = 0.85*F2001 = 0.12 and Fmsy fishing mortality rates during 2003-2013.

Gulf of Maine Winter Flounder
Beverton-Holt Model
SSB - RECRUIT DATA FOR 1982-2001 YEAR CLASSES
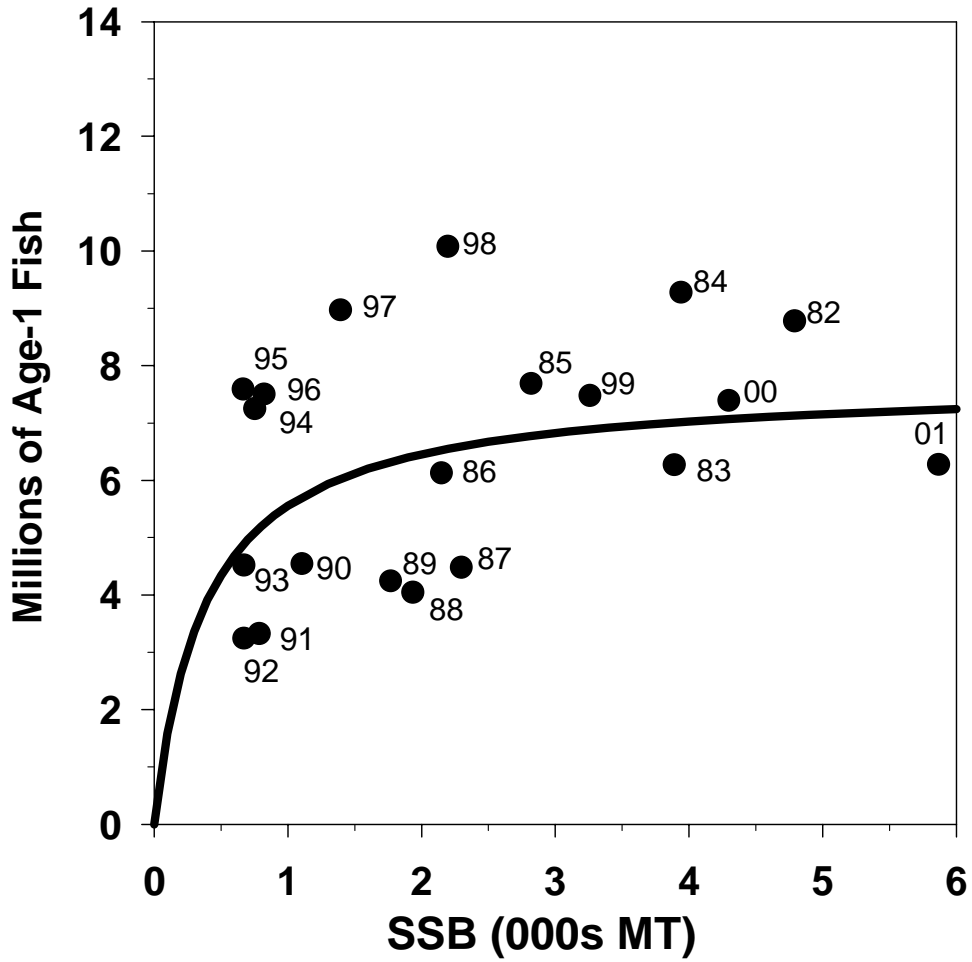
Figure B2.7. Beverton-Holt stock-recruitment model for Gulf of Maine winter flounder.

C. Northern Shrimp

State of Stock: Currently there are no quantitative status determination criteria adopted by ASMFC. The stock is below the average level of biomass, and current fishing mortality rate (F) is below all standard F reference points. For the period 1985–1995, F ranged from 0.15 to 0.57. Between 1996 and 1998, F ranged from 0.70 to 1.18, the highest values seen since the stock collapsed in the late 1970s. From 1999 to 2002, it declined from 0.42 to 0.06. For the period 1985-1995 exploitable biomass ranged from 9,200 to 22,500 mt and averaged 16,800 mt. From 1998 to 2002, biomass ranged from 5,700 to 9,200 mt, averaged 6,600 mt, and is currently about 9,200 mt. The 2001 year class is among the largest on record while the 2000 year class was among the smallest on record.

Management Advice: Fishing mortality should be kept low to minimize the risk of further decline in stock size, and to protect the 1999 and 2001 year classes. Managers should establish appropriate reference points (targets, thresholds, and limits) and consider control rules that account for the unique life history characteristics of northern shrimp.

Forecast: No projections were performed in this assessment.

Catch and Status Table: Northern Shrimp
(landings in mt, abundance in millions)

Year:	Fishing Year Estimates[2]											Summary[1]		
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Min	Max	Mean
Landings	2.1	2.9	6.5	9.2	7.1	4.2	1.8	2.4	1.3	0.4[3]		0.4	9.2	3.9
F[4]	0.20	0.28	0.57	0.76	1.18	0.70	0.42	0.48	0.24	0.06		0.06	1.18	0.37
Exploitation	16%	22%	39%	48%	63%	45%	30%	34%	19%	5%		5%	25%	63%
Recruits[5]	512	711	975	883	534	510	408	303	445	358	1001	303	1313	762
Full Recruits[5]	881	713	809	1003	764	425	391	393	409	448	634	391	1519	898
Biomass[5]	12.4	9.2	12.4	15.5	11.0	6.7	5.8	5.7	6.2	6.1	9.2	5.7	22.5	13.2

[1]Over the 1985-2003 time period
[2] Fishing year (August of previous calendar year to July of current calendar year)
[3] 2002 landings estimate is preliminary
[4]Average F for all sizes
[5]At the start of the fishing year

Stock Distribution and Identification: Northern shrimp (or pink shrimp), *Pandalus borealis*, are distributed discontinuously throughout boreal waters of the North Atlantic, North Pacific, and Arctic Oceans. In the Gulf of Maine, they are considered to constitute a single unit stock. They inhabit soft muddy bottom at depths of 10-300 m, most commonly in the cold water of the southwest Gulf of Maine.

Catches: Annual commercial landings averaged 63 mt from 1938 to 1953, and no shrimp were landed from 1954 to 1957 (Figure C1). The fishery resumed in 1958 and landings increased to peak at 12,100 mt during the 1969 season. After 1972, landings declined rapidly, and the fishery was closed in 1978. The fishery reopened in 1979 and landings increased gradually to 5,300 mt by 1987, and averaged 3,300 mt from 1988 to 1994. Landings increased to 9,200 mt in 1996, a value exceeded only by the five years of landings prior to the late 1970s stock collapse. Landings declined from 1996 to 2002 to a low of 400 mt. Sea sampling observations indicate that discards have been negligible, constituting <1% of the total catch. Therefore, discard estimates were not included in the present assessment.

Data and Assessment: Total landings and indices of abundance from the summer shrimp survey were analyzed with a Collie-Sissenwine (CSA) model to estimate abundance and mortality rates for the period 1984-2002. CSA results were corroborated by a biomass dynamics model based on 1968-2002 landings, the biomass indices from the Maine summer survey (1968-83), the NEFSC fall survey (1968-2001), and the summer shrimp survey (1984-2002). Fishing mortality rates were computed using a harvest-ratio method (Collie and Kruse, 1998).

Biological Reference Points: Overfishing criteria are not currently defined in the management plan. Several analyses were considered as potential methods for developing reference points (Figure C4). Yield-per-recruit analysis indicates that $F_{max} = 0.77$ and $F_{0.1} = 0.46$. Eggs-per-recruit analysis indicates that $F_{50\%} = 0.25$, $F_{40\%}=0.34$, $F_{30\%}=0.45$, and $F_{20\%} = 0.63$. Biomass dynamics analysis (ASPIC) suggests that $F_{MSY} = 0.17$.

Fishing Mortality: Annual estimates of F averaged 0.25 (19% exploitation) from 1985 to 1995, and averaged 0.88 (52% exploitation) from 1996 to 1998 (Figure C1). Since then, F has averaged 0.30 (22% exploitation), with a value of 0.06 in 2002. The bootstrapped estimates of 2002 fishing mortality indicated an 80% probability that F was between 0.045 and 0.074 (Figure C3).

Recruitment: Four strong year classes have dominated recruitment from 1984 to 2002, the most recent being that of 2001, among the largest on record, but not yet fully recruited to the fishery. The 2001 cohort follows the five poorest years of recruitment in the time series (1997-2001).

Stock Biomass: Estimated exploitable biomass varied between 5,000 and 22,500 mt from 1985 to 2002, with a peak in 1987 (Figure C2). These fluctuations are largely caused by the passage of the strong 1982, 1987, and 1992 year classes. The estimates suggest a generally decreasing trend over the time series to a low of 5,700 mt in 1999. The advent of the 2001 year class contributed to an increase in biomass to 9,200 mt, still less than the time-series average (13,200 mt). Results of biomass dynamics analyses indicate that biomass levels were much higher (45,000 mt) in the 1960s.

Special Comments: The current assessment estimates F based on the ratio of catch to population size at the beginning of the fishing season, slightly different from the method previously used.

Catch data are currently based exclusively on vessel trip reports. Reporting deadlines (currently end of calendar year) are inadequate under this system. A substantially earlier deadline is necessary to be able to employ accurate catch data in annual assessments.

Survival of young northern shrimp is generally lower when spring surface temperature is higher (Richards *et al*. 1992). The sensitivity of recruitment to environmental variability and the level of spawning biomass should be explicitly considered in developing management strategies.

Northern shrimp are protandric hermaphrodites, and usually mature first as males and then change to females. During the last two summer surveys female shrimp were observed at progressively smaller sizes. In 2002 the smallest females were smaller than in any previous surveys. The presence of primary females may be a response to low population densities.

Sources of Information: Report of the 36th Stock Assessment Workshop (36th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc 03-xx; Assessment Report for Gulf of Maine Northern Shrimp - 2002, ASMFC Northern Shrimp Technical Committee 2002, R. Glenn, M. Hunter, J. Idoine, C. McBane, M. Lewis; Draft Amendment 1 to the Interstate Fishery Management Plan for Northern Shrimp; ASMFC Northern shrimp Plan Development Team; Collie, J.S. and G.H. Kruse. 1998. Estimating king crab (*Paralithodes camtschaticus*) abundance from commercial catch and research survey data. In: Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and Management. Edited by G.S. Jamieson and A. Campbell. Canadian Special Publication on Fisheries and Aquatic Sciences 125. pp. 73-83; Richards, A., M. Fogarty, S. Clark, D. Schick, P. Diodati, and B. O'Gorman. 1996. Relative influence of reproductive capacity and temperature on recruitment of *Pandalus borealis* in the Gulf of Maine. ICES C.M. K:13.

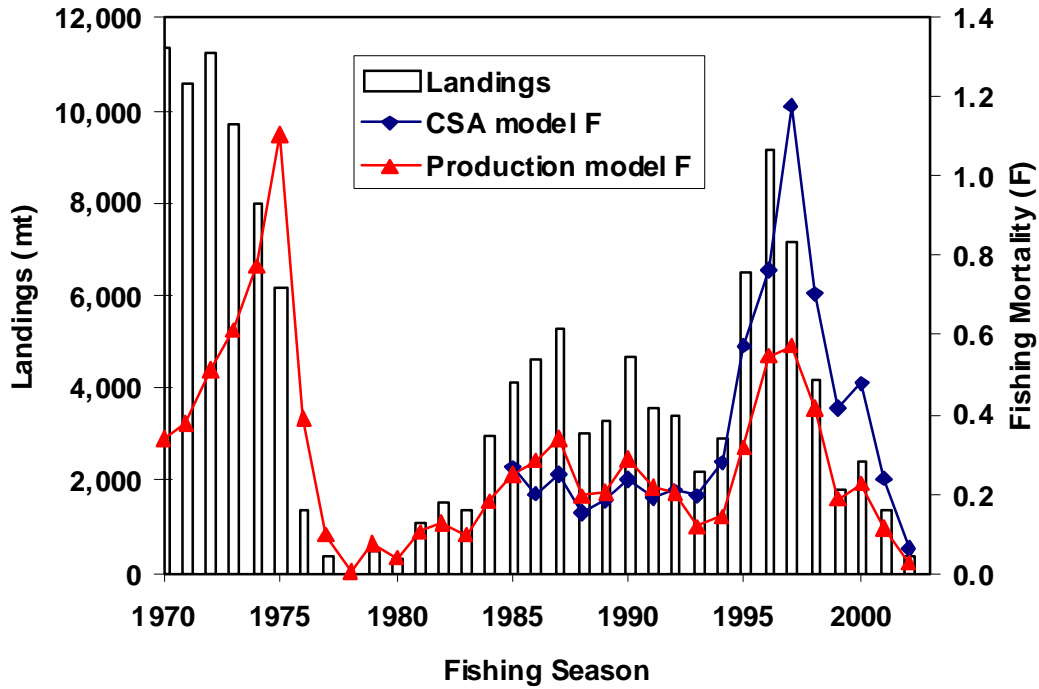**Figure C1. Trends in Landings and Fishing Mortality**

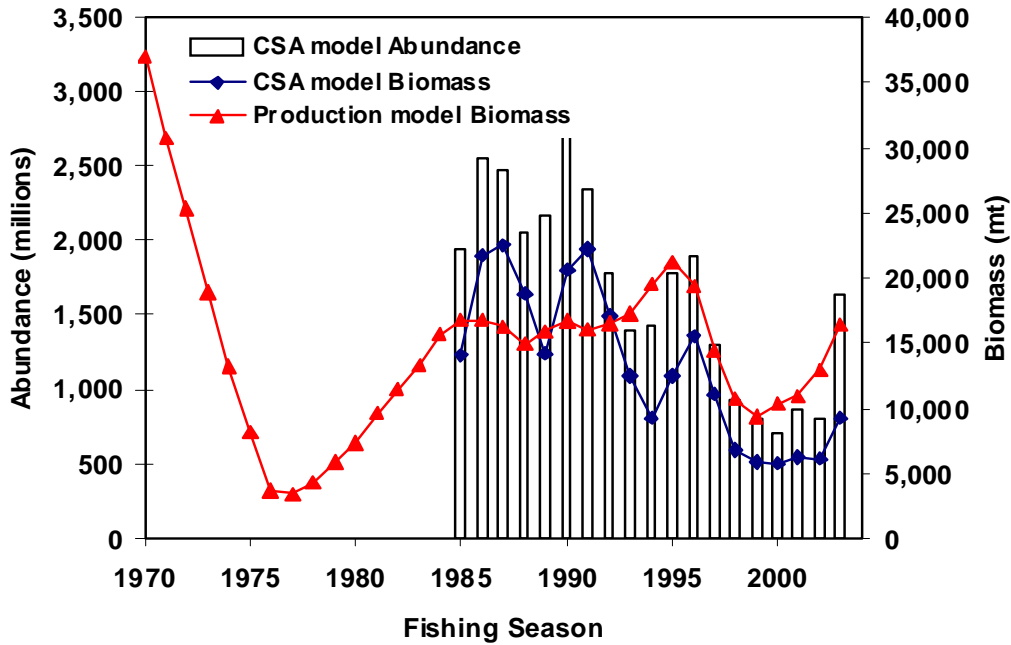**Figure C2. Trends in Abundance and Exploitable Biomass**

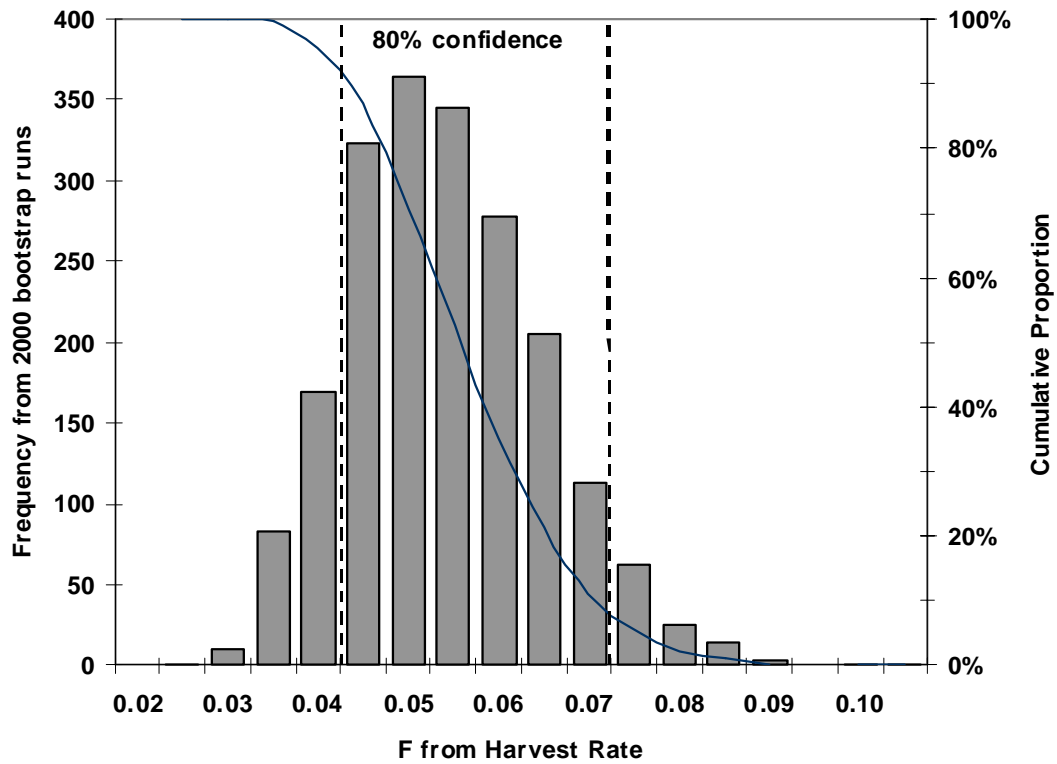# Figure C3. Precision of the 2002 Fishing Mortality Estimate

Figure C4. Yield and Egg Production per Recruit
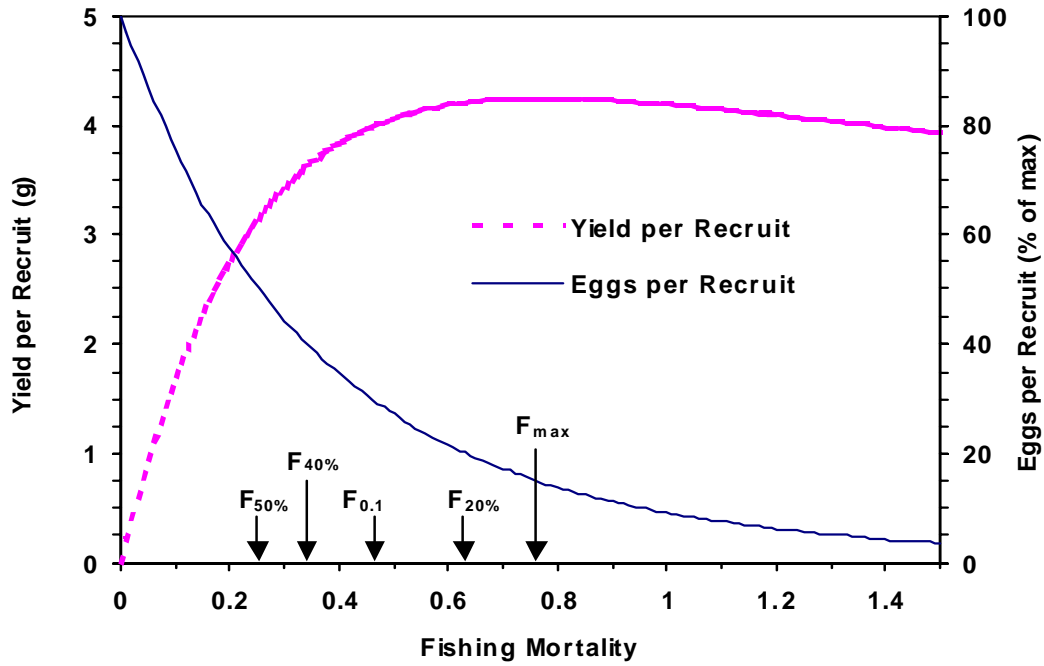
Figure C5. Relationship between summer survey index of Gulf of Maine female shrimp biomass the summer before spawning to age 1.5 abundance two years later.
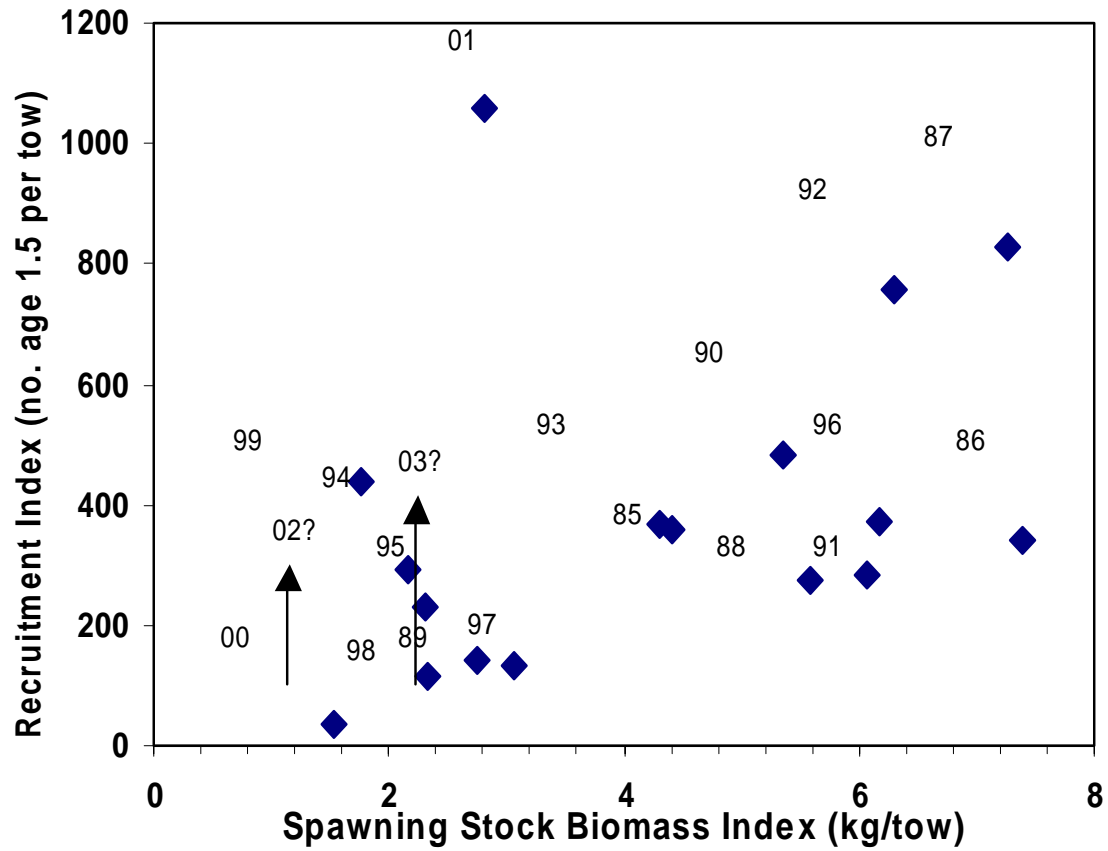
D. Atlantic Striped Bass

Introduction

The 36th SARC was asked to provide review and comment on a number of methodological aspects of the current striped bass assessment approach. The terms of reference included neither requests for stock status nor management advice. This part of the Advisory Report therefore differs from the previous sections and attempts to directly answer the Terms of Reference provided by the Atlantic States Marine Fisheries Commission.

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

Total catch in numbers including landings and discards dropped about 14%, from 5.04 million in 2000 to 4.3 million in 2001. While the 2000 total catch represented a series high, the 2001 catch is slightly above the 1996-2000 average of 3.9 million. Ages 4 to 7 represented 62% of the total catch, and ages 8+ represented 24%. The modal age is 5, consistent with that in 2000. The 1993-1997 year classes dominate, accounting for 12-18% of total catch. Although the proportion of 8 and older fish in the catch dropped to 15% in 2000 from 21% in 1999, it rose to a series high 24% in 2001.

Recreational fisheries accounted for 71% of the total 2001 catch, 46% of which was landings and 25% discards. New Jersey recreational fisheries accounted for 28% of total recreational landings, followed by MD (19%), VA (15%), MA (14%), and NY (9%). The remaining States each accounted for 4% or less of the total recreational landings. Commercial fisheries accounted for 29% of the total 2001 catch, 22% of which was landings and 7% was discards. Maryland commercial fisheries accounted for 57% of the total commercial landings, followed by VA (16%), PRFC (9%), and NY (6%). The remaining States each accounted for 4% or less of the total commercial landings.

Although total catch dropped considerably in 2001, total landings in numbers dropped less than 1% from 2.98 million fish in 2000 to 2.95 million in 2001. Landings by weight increased 8% to 25.8 million pounds, surpassing the previous high of 23.7 million pounds set in 2000.

Catch and Stock Status Summary (landings, discard, and SSB in metric tons, recruitment in millions of fish).

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Max[1]	Min[1]	Mean[1]
Commercial														
Landings	460	638	777	805	1,555	2,178	2,679	2,936	2,941	3,003	2,826	4,312	63	1,425
Discard	1,030	560	1,041	1,113	1,567	1,233	675	1,102	583	1,499	1,098	53	1,598	806
Recreational														
Catch	1,921	2,089	3,125	4,407	6,049	8,657	11,830	11,116	10,850	14,728	14,663	391	14,728	4,749
Total	3,411	3,287	4,943	6,325	9,171	12,069	15,184	15,155	14,375	19,231	18,588	773	19,231	6,369
SSB	20,976	23,365	27704	30,871	33,365	40,342	43,587	47,760	48,589	47,335	51,916	2,154	51,916	23,999
Recruitment	20.98	23.37	27.7	30.87	33.37	40.34	43.59	47.76	48.59	47.34	51.92	2.15	51.92	24
F age 4-10	0.1	0.08	0.11	0.12	0.18	0.18	0.23	0.21	0.22	0.24	0.23	0.05	0.41	0.17

[1] Based on 1982-2001 period.

2. **Review the VPA-based stock assessment and provide guidance on determining the best, most appropriate model configuration. Provide specific guidance on plus grouping, as well as an evaluation of the fishery independent surveys and the ages on which to base the last true age F.**

Age structure
Future assessments should review the selection of fully recruited ages for F estimation. Using age 5 striped bass as the first fully recruited age may not be appropriate. Proper assignment of the plus group should also be investigated. Creating a 12+ age group is an acceptable compromise, given that the 12+ group constitutes about 2% of the total harvest on average. Potential age misspecification is problematic, especially for older striped bass. The assessment should be re-run after the ageing issues are resolved. A calibration matrix that creates a conversion between scales and otoliths can be used to correct age misspecification from scale samples.

PR model
A flat-topped PR model specification is probably not appropriate. The data presented indicate that the dome-shaped PR is more suitable to Atlantic striped bass analysis. Specifically, catch on ages 4, 5 and 6, tagging information, and movement of large fish offshore, where there is little fishing activity, are evidence for a dome-shaped curve.

Tuning indices
An objective discrimination of which tuning indices to include or withhold from the model should be integrated in the next assessment. Candidate indices may be selected for inclusion by randomizing the series to see how each index performs. If parameter estimates and VPA diagnostics are significantly improved, then the index is a candidate for tuning the VPA. Indices should also be scrutinized for spatial and temporal compatibility with stock migration patterns. Statistical weights may be assigned *a priori* to candidate indices. Survey indices from the northern range of the stock may be characterizing the entire stock complex and should receive greater weighting in the VPA.

3. **Estimate fishing mortality rates for specific components of the coastal stock complex using tagging data.**

The tagging data are used to calculate maximum likelihood estimates of the multinomial parameters of survival and recovery based on an observed matrix of recaptures (using Program MARK). These methods are used to estimate fishing mortality rates for four mixed coastal stocks (Massachusetts, New York, Delaware Bay, and North Carolina). There should be some *a priori* deletion of models that do not have significant weight in the analysis. Deletion of some models may reduce the degree of uncertainty in the estimate. For example, the constant survival tagging model ought to be removed because it is biologically not reasonable, given documented changes in fishing effort.

4. Discuss the validity of averaging stock specific estimates from several separate tagging programs as a means of estimating total stock exploitation.

Tagging programs for specific coastal stocks operate during different time frames; the Massachusetts hook and line program and the New York ocean haul survey tag fish during fall, the New Jersey program tags fish during March and April, and the North Carolina winter trawl survey tags fish during January. Estimates from the Massachusetts program are generally low, and may reflect movement of tagged fish into the EEZ. Although it is desirable to get an overall estimate of fishing mortality of the coastal population, differences among tagging programs make averaging problematic.

5. Review the discard-estimation methodology and the validity of using tag returns as an adjustment to the reporting rate.

The discard estimation methodology is appropriate. However, error bars should be included around the estimators if it is ratio-based, or bootstrapping should be done if ratios are not used. Discard estimates use percentage mortality by gear; additional studies on discard mortalities by gear should be conducted to improve the quality of discard estimates.

6. Provide a comparison of tag- and VPA-derived F estimates. If possible, provide guidance on the most comparable aspects of the VPA output and the tag-derived F. Also provide guidance on which of the tagging programs (or average of programs) would be most comparable to the VPA-derived F.

VPA Fs weighted by N for ages 5-10 and average tag Fs from coastal tagging programs (only positive F values were included in the average) are compared in one of the documents presented and reviewed. Both estimates of fishing mortality show the same increasing trend over time. The VPA Fs tend to be slightly higher than the average coastal tag Fs, although the VPA estimate is not statistically different, based on 95% confidence intervals. The NC offshore winter tag program provided the closest comparison with the VPA results. Tagging estimates and VPA estimates should be incorporated into one assessment so that there is one result. Tagging estimates could be another parameter of the overall assessment.

SARC SCHEDULING SUMMARY
2003 – 2004

37 - June 2003	38 - November 2003	39 - June 2004	40 - November 2004
Surfclams	Bluefish	Black sea bass	American shad
Spiny dogfish	Ocean quahog	Butterfish	Silver hake
Illex	Red hake	Tilefish	Monkfish
Witch flounder	Gulf of Maine haddock	American plaice	Multispecies assessment model
Hagfish	Sea scallop	White hake	Tautog
		Summer flounder	Weakfish
		American lobster	

SAW/SARC Assessment Reviews by Species

	85	1986		1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1997			1998		1999		2000		2001		2002		2003		
SAW #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	SAW #
BLACK SEA BASS	X				+	+			X		X			X						X			X		X		X												BLACK SEA BASS
BLUEFISH	X		X	X	X	X					X							X	X				X															X	BLUEFISH
BUTTERFISH	X	X		X		X		X		X		X						X																					BUTTERFISH
COD, GB	X		X			X				X		X		X		X			X		+				X		X												COD, GB
COD, GOM	X		X			X				X			X		X			X			+				X		X				X								COD, GOM
CUSK	X																				+																		CUSK
FLDR, AM. PLAICE	X	X		X						X				X							+							X				X							FLDR, AM. PLAICE
FLDR, SUMMER	X		X			X	+	+	X		X			X		X		X		X		X			X						X				X				FLDR, SUMMER
FLDR, WINTER, Offshore	X		X																																				FLDR, WINTER, Offshore
FLDR, WINTER, Inshore	X		X		+	+	+								X																								FLDR, WINTER, Inshore
FLDR, WINTER, SNE																				X									X							X			FLDR, WINTER, SNE
FLDR, WINTER, GOM																				X																X			FLDR, WINTER, GOM
FLDR, WINTER, GB																												X					X						FLDR, WINTER, GB
FLDR, WITCH	X	X																X			+								X									X	FLDR, WITCH
FLDR, YELLOWTAIL, SNE	X	X					X							X				X			+				X		X								X				FLDR, YELLOWTAIL, SNE
FLDR, YELLOWTAIL, GB																X					+				X		X								X				FLDR, YELLOWTAIL, GB
FLDR, YELLOWTAIL, CC																									X										X				FLDR, YELLOWTAIL, CC
GOOSEFISH														X							+		X						X				X						GOOSEFISH
HADDOCK-GB	X	X		X										X				X		+			X		X														HADDOCK-GB
HADDOCK-GOM	X	X																		+											X							X	HADDOCK-GOM
HERRING, Atlantic					X					X		X		X		X				X							X												HERRING, Atlantic
LOBSTER, American	X		X							X		X		X		X				X	X																		LOBSTER, American
MACKEREL, Atlantic	X	X		X		X		X		X		X								X										X									MACKEREL, Atlantic
OCEAN POUT	X									X										+																			OCEAN POUT
OCEAN QUAHOG	X		X							X				X		X					+				X				X								X		OCEAN QUAHOG
POLLOCK	X		X					X	X							X				+																			POLLOCK
RED HAKE	X	X							X											+																	X		RED HAKE
REDFISH	X	X												X						+												X							REDFISH
RIV. HERRING/SHAD	X					X																																	RIV. HERRING/SHAD
SALMON, Atlantic	X																																						SALMON, Atlantic
SCALLOPS	X	X				X		X	X	X	X	X								X		X					X		X		X						X		SCALLOPS
SCUP	X			X		X		X		X										X				X		X			X				X						SCUP
SHRIMP, NORTHERN	X		X		X															+				X					X						X				SHRIMP, NORTHERN
SILVER HAKE	X	X		X					X	X						X															X								SILVER HAKE
SKATES	X																												X		X								SKATES
SPINY DOGFISH	X							X								X										X												X	SPINY DOGFISH
SQUID, ILLEX	X	X		X		X		X		X		X		X		X				X						X				X								X	SQUID, ILLEX
SQUID, LOLIGO	X	X		X		X		X		X		X		X		X				X						X				X			X						SQUID, LOLIGO
STRIPED BASS	X																										X				X				X				STRIPED BASS
SURFCLAM, Atlantic	X		X			X		X						X		X		X		X				X				X		X								X	SURFCLAM, Atlantic
TAUTOG																				X									X										TAUTOG
TILEFISH	X												X		X																								TILEFISH
WEAKFISH			+																									X		X									WEAKFISH
WHITE HAKE	X	X								X								X		+								X			X							WHITE HAKE
WOLFFISH	X																			+																			WOLFFISH

+ = No formal assessment review; research needs, working group or special topic report. X̲ - assessment review has been completed; X - assessment review is planned.

36th SAW Advisory

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The Shark Tagger -- This newsletter is an annual summary of tagging and recapture data on large pelagic sharks as derived from the NMFS's Cooperative Shark Tagging Program; it also presents information on the biology (movement, growth, reproduction, etc.) of these sharks as subsequently derived from the tagging and recapture data. There is internal scientific review, but no technical or copy editing, of this newsletter.