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27th Northeast Regional Stock Assessment Workshop (27th SAW)

Public Review Workshop

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A Report of the 27th Northeast Regional Stock Assessment Workshop

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Public Review Workshop

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region
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TABLE OF CONTENTS

OVERVIEW

Introduction

The Public Review Workshop of the 27th Northeast Regional Stock Assessment Workshop (SAW-27) was held in two sessions as part of the meetings of the New England and Mid-Atlantic Fishery Management Councils (NEFMC and MAFMC). The first session was held August 10, 1998 in Peabody, MA during the NEFMC meeting and the second session was held August 17, 1998 in Philadelphia, PA during the MAFMC meeting, Prior to these sessions, preliminary presentations were made on the five New England groundfish stocks at a meeting of the NEFMC Groundfish Committee held July 16, 1988 in Peabody, MA, and on ocean quahogs at a meeting of the MAFMC Surfclams and Ocean Quahogs Committee held August 6, 1998 in Wilmington, DE.

The purpose of the Workshop was to present the assessment results and management advice for the stocks of Georges Bank cod, Georges Bank haddock, Georges Bank yellowtail flounder, scup, ocean quahogs, Gulf of Maine cod, Atlantic herring, black sea bass, and Southern New England yellowtail flounder to managers, fisheries representatives, and the public. The three Georges Bank stocks were peer reviewed at a meeting of the US/Canada Transboundary Resources Assessment Committee (TRAC) held April 20-24, 1998 in St. Andrews, NB, Canada. The six remaining stocks were peer reviewed by the Stock Assessment Review Committee at its June 22-26, 1998 meeting held in Woods Hole, MA. Copies of the SAW-27 draft *Advisory Report on Stock Status* and draft *Consensus Summary of Assessments* had been distributed to members of each Council prior to the Workshop. Additional copies were available to the public at each session.

The SAW Chairman, Dr. Emory Anderson of the NMFS, Northeast Fisheries Science Center (NEFSC), briefly summarized the assessment results and management advice for each stock using information contained in this report and supporting information from the *27th Northeast Regional Stock Assessment Workshop (27th SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments*. Several experts assisted in the question-and-answer periods at the sessions. Mr. Ralph Mayo (NEFSC, Chairman of the SARC Northern Demersal Working Group) assisted at the NEFMC session and Dr. Mark Terceiro (NEFSC, Chairman of the SARC Southern Demersal Working Group) and Dr. James Weinberg (NEFSC, Population Dynamics Branch) assisted at the MAFMC session.

Status Summaries

Georges Bank Cod

The Georges Bank cod stock is at a low biomass level and is over-exploited relative to the Amendment 7 rebuilding target. Biomass indices derived from research surveys indicate that the stock remains near the 30-year record low. Fishing mortality declined from record high levels in 1993 (1.1) and 1994 (1.2) to 0.26 in 1997, a level about 45% higher than $F_{0.1} = 0.18$. Spawning stock biomass (SSB) declined from about 90,000 mt in the early 1980s to a record low of 25,000 mt in 1994 and was about 36,000 mt in 1997. Recruiting year classes continue to decline in size, with the four most recent year classes being the lowest on record. At the present rate of exploitation (21%) and given the probable level of recruitment, SSB is expected to increase in 1999, but decline slightly below the current value in 2000.

Georges Bank Haddock

The Georges Bank haddock stock remains in an over-exploited condition based on the current low biomass level relative to management rebuilding thresholds and pre-collapse levels. Fishing mortality has been reduced, and F_{97} (0.11 or 9% exploitation) is below the $F_{0.1}$ rebuilding target established in US rebuilding plans and is approximately equal to the $\frac{1}{2}F_{0.1}$ rebuilding target proposed by Canadian managers. The age structure of the population is continuing to expand, and the age 4+ biomass is at its highest level since 1983. SSB in 1997 was estimated to be 40,500 mt, about half of the 80,000 mt rebuilding threshold. Although the 1994-1996 year classes appear moderate relative to recruitment observed in the past decade, they are much smaller than the average levels when the stock was in a healthy condition. The

1996 year class, currently estimated at 13.8 million fish at age 1, will result in continued increases in SSB through 1999. The increase in SSB has resulted from conservation of a series of relatively weak year classes, a necessary first step in the stock rebuilding process. Significant rebuilding above projected 1999 levels will require substantially higher recruitment than observed in the past decade. The expanded SSB age composition may enhance future recruitment prospects if paired with favorable environmental conditions.

Georges Bank Yellowtail Flounder

The stock is at a low biomass level and rebuilding. SSB in 1997 (15,700 mt) was approximately half of the SSB_{msy}. Fishing mortality in 1997, well below $F_{0.1}$ and approximately one-third the level of F_{msy}. is consistent with the Amendment 7 rebuilding strategy. Suggestions of good recruitment evident from 1997 spring survey length distributions are not confirmed in the age-based abundance estimates.

Scup

The scup stock is over-exploited and at a low biomass level based on the truncated age structure of fishery catches and current record low research survey indices of SSB which both indicate that the stock has been subject to prolonged high fishing mortality. Indices of recruitment have trended downward in recent years, except for a moderate 1994 year class and what may be a strong 1997 year class. Although discard estimates are uncertain, the majority of fishing mortality in recent years is clearly attributable to discards, particularly when incoming recruitment is strong. Reduction in fishing mortality due to discards from small-mesh fisheries will have the most positive impact on the stock, particularly considering the importance of the 1997 year class.

Ocean Quahogs

The ocean quahog resource in surveyed EEZ waters from Southern New England (SNE) to Delmarva (DMV) is at a medium-high level of biomass and, according to the existing overfishing definition, is considered under-exploited at the scale of the management unit. CPUE has declined substantially in localized areas. Analysis 1997 dredge survey data, coupled with an estimate of dredge efficiency, has led to revised estimates of biomass by region which are greater than those reported at SAW-19, derived only from trends in commercial CPUE from fished areas. Ocean quahogs exist in and are being harvested from waters deeper than those surveyed in 1997, but the magnitude of that portion of the resource is currently unknown. About 30% of the surveyed stock biomass is on Georges Bank (GBK), a region which continues to be closed to harvesting due to previous contamination by PSP. Current harvests represent a small fraction (2% per year) of the surveyed biomass in exploited Mid-Atlantic regions (SNE-DMV). Overall fishing mortality in those regions was 0.021 in 1997, half the current overfishing definition ($F_{25\%} = 0.042$). The stock in the EEZ off the coast of Maine continues to be harvested and, to date, neither NMFS nor the State of Maine has surveyed this region

Gulf of Maine Cod

The Gulf of Maine cod stock is presently at a low biomass level and remains over-exploited. Fishing mortality in 1997 (0.75) has decreased from the 1996 level (0.95), but there is a 90% probability that F in 1997 was greater than 0.57, which is about 1.5 times greater than the overfishing definition ($F_{20\%} = 0.41$) and about twice the rebuilding level ($F_{max} = 0.29$). SSB declined from over 26,000 mt in 1989 to a record low of 6,600 mt in 1998, and is expected to decline further to 5,700 mt or less in 1999. At the present and probable near-term levels of recruitment, the decline in SSB is expected to continue. At the current exploitation rate ($F = 0.75$), landings are expected to decline to about 3,000 mt in 1998, and SSB is projected to decline to about 4,100 mt in 2000. Current SSB is no longer dominated by the 1987 year class, but by a series of very low-to-average year classes produced from 1988 through 1995. The moderate 1992 year class is the only above-average year class since 1987. Recruitment from the three most recent year classes is extremely poor, far below any previously observed. An immediate and substantial reduction of about 50% in fishing mortality is required to halt the continuing decline in SSB. Stock rebuilding will require even further reductions over the long term. If F is not reduced from the present level, SSB will decline to only 4,400 mt in the near future.

Atlantic Herring

The Atlantic herring coastal stock complex is large and under-utilized. Abundance in continental shelf waters between Cape Hatteras and the Gulf of Maine has increased steadily since the mid 1980s, and the Georges Bank-Nantucket Shoals stock component has fully recovered from an over-exploited condition due to heavy foreign fishing in the late 1960s and early 1970s. Total biomass in 1997 was estimated to be 3 million mt, with an SSB of 1.8 million mt. Fishing mortality on the entire stock complex in 1997 was less than $F = 0.1$. Recent year classes appear to be very large. Projections based on either the current catch (119,000 mt), 200,000 mt, or a preliminary MSY estimate (317,000 mt) and recruitment estimates between 1986 and 1993 indicated that SSB would increase over the next three years and F would remain very low. Despite the large size of the stock complex, results of an exploratory VPA indicate that the Gulf of Maine component, which provides most of the commercial harvest, is fully utilized. Based on swept-area minimum population size estimates generated from fall bottom trawl surveys during the last 5 or 10 years, 25% of the stock complex occupies the interior Gulf of Maine area (exclusive of Georges Bank) during the spawning season, with 65% in the Nantucket Shoals area and only 10% on Georges Bank.

Black Sea Bass

The available information on black sea bass suggests that the population has remained relatively stable over the past decade, although at low levels, and is over-exploited. Recent catches are well below the historical average, and the age and size structure of catches is truncated. A length-based estimate of fishing mortality in 1997 (0.73) was above all available biological reference points. Survey indices since the late 1980s, one-tenth of those observed in the late 1970s, have fluctuated without trend, and recreational catch per angler has fluctuated annually, although exhibiting a slight increase since 1981. Recruitment of good year classes, as indicated by the survey indices, has been sporadic, and there is no indication of a strong year class since 1992. The general production model ASPIC did not provide satisfactory results with the available data. Relative exploitable biomass estimates from NEFSC spring survey data indicate the population is significantly reduced since the early 1980s.

Southern New England Yellowtail Flounder

Results from virtual population analysis and bottom trawl surveys indicate that stock abundance was still very low in 1997, although there appears to be an increasing trend. Fishing mortality declined to 0.42 in 1996 and was well below the $F_{0.1}$ reference point of 0.27 in 1997 (0.07). Recruitment still remains poor, with all recent year classes well below the historic average. Research surveys indicate that all incoming year classes are relatively poor. The 1993, 1994, 1995, and possibly the 1996 cohorts are moderately larger than cohorts during 1988-1992, but these are all small when compared to the year classes during 1973-1987. Stock age structure was severely truncated during 1970-1994, but there is some indication that this trend may have been reversed and that it may now be expanding. Forecasts indicate that SSB will continue to improve slowly during 1999-2000 if fishing mortality is kept at or below the $F_{0.1}$ level.

Conclusions of the SAW Steering Committee

The SAW Steering Committee met twice during the SAW-27 cycle. A teleconference was held May 15, 1998 to 1) recap the US/Canada Transboundary Resources Assessment Committee (TRAC) meeting, 2) review the agenda, terms of reference, and meeting schedules for SAW-27, 3) consider the proposed agenda and meeting schedules for SAW-28, and 4) discuss several SAW policy issues. A meeting was held September 30, 1998 at the NEFSC in Woods Hole, MA to 1) recap the SAW-27 meetings, 2) adopt the agenda, terms of reference, and meeting schedules for SAW-28, 3) consider the tentative agendas and meeting dates for SAW-29 and the 1999 TRAC meetings, and 4) discuss an issue paper relating to needed changes in the Northeast Region stock assessment and peer-review process. A summary of these meetings is presented in the **Conclusions of the SAW Steering Committee** section of this report.

ADVISORY REPORT ON STOCK STATUS

INTRODUCTION

The *Advisory Report on Stock Status* is an important product of the Northeast Regional Stock Assessment Workshop process. It 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 whether a stock is currently over-, fully-, or under-exploited. As these categories specifically refer to the act of fishing, they are best thought of in terms of exploitation rates relative to the Councils' overfishing and maximum sustainable yield (MSY) definitions. 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 defined by the overfishing definition, it is considered to be over-exploited. The fishery resource is considered to be under-exploited if the exploitation rate is substantially below the level that is needed to produce MSY.

Another important factor for classifying the status of a resource is the current stock level, for example, spawning stock biomass (SSB). It is possible that a stock that is not currently overfished in terms of present exploitation rates is still at a low biomass level due to heavy exploitation in the past, or as 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 SSB. Conversely, fishing down a stock that is at a high level should generally increase the long-term sustainable yield. Therefore, where possible, stocks under review are classified as having high, medium, or low biomass compared to historic levels. The figure below describes this classification and indicates the appropriate management advice for each classification.

STOCK LEVEL

EXPLOITATION STATUS	*LOW*	*MEDIUM*	*HIGH*
OVER EXPLOITED	REDUCE EXPLOITATION, REBUILD STOCK	REDUCE EXPLOITATION, BROADEN AGE DISTRIBUTION	REDUCE EXPLOITATION, INCREASE YIELD PER RECRUIT
FULLY EXPLOITED	REDUCE EXPLOITATION, REBUILD STOCK LEVEL	MAINTAIN EXPLOITATION RATE AND YIELD	MAINTAIN EXPLOITATION RATE AND YIELD
UNDER EXPLOITED	MAINTAIN LOW EXPLOITATION WHILE STOCK REBUILDS	INCREASE EXPLOITATION SLOWLY	INCREASE EXPLOITATION, REDUCE STOCK LEVEL

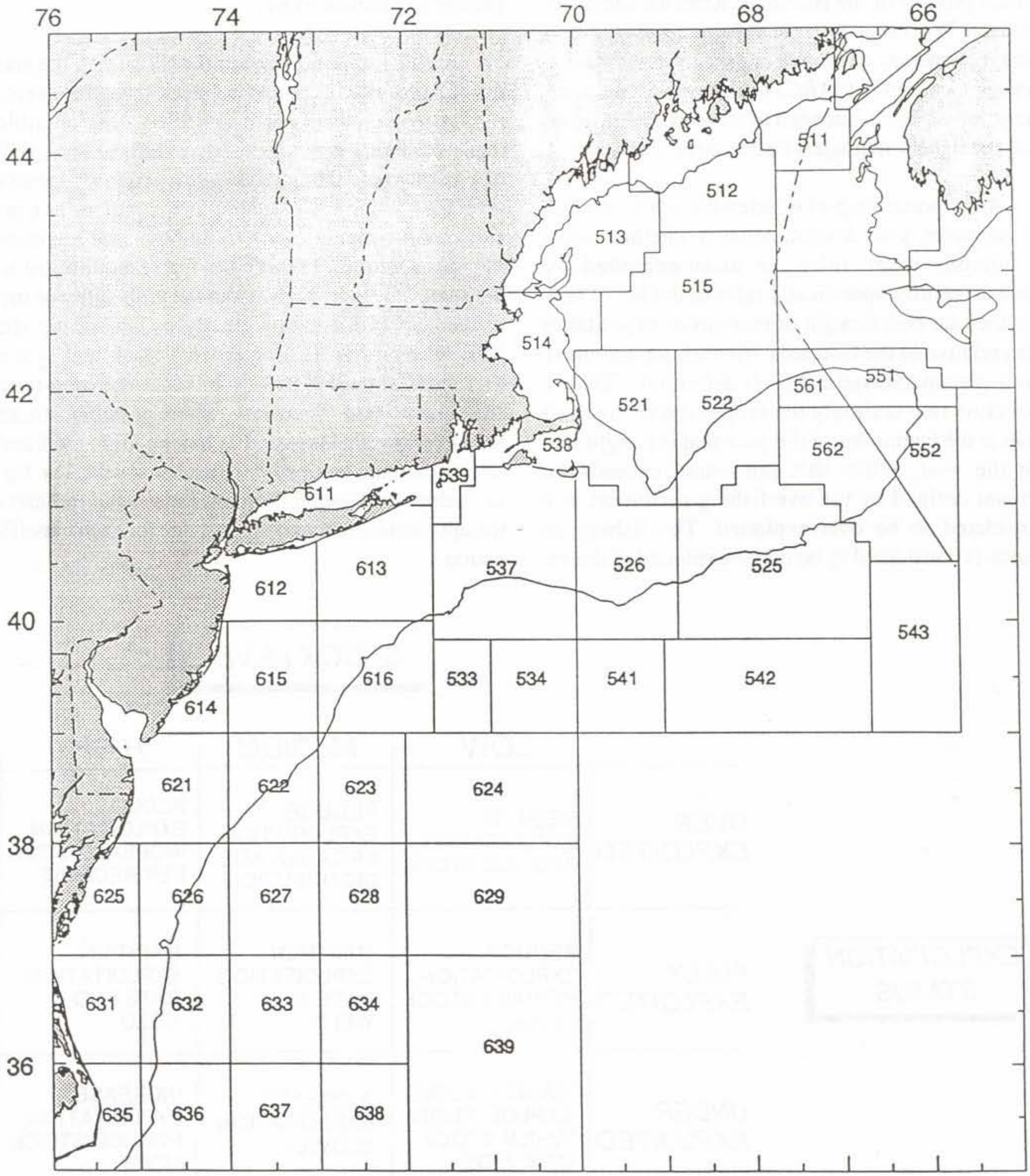

Figure 1. Statistical areas used for catch monitoring in offshore fisheries in the Northeast United States.

INTRODUCTION

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STOCK LEVEL

EXPLOITATION STATUS

	LOW	MEDIUM	HIGH
OVER EXPLOITED	REDUCE EXPLOITATION, REBUILD STOCK	REDUCE EXPLOITATION, BROADEN AGE DISTRIBUTION	REDUCE EXPLOITATION, INCREASE YIELD PER RECRUIT
FULLY EXPLOITED	REDUCE EXPLOITATION, REBUILD STOCK LEVEL	MAINTAIN EXPLOITATION RATE AND YIELD	MAINTAIN EXPLOITATION RATE AND YIELD
UNDER EXPLOITED	MAINTAIN LOW EXPLOITATION WHILE STOCK REBUILDS	INCREASE EXPLOITATION SLOWLY	INCREASE EXPLOITATION, REDUCE STOCK LEVEL

GLOSSARY OF TERMS

Biological reference points: These are specific values for the variables that describe the state of a fishery system and 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.

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 (or vector) of values ranging from 0.0 to 1.0. The pattern is referred to as "flat-topped" when the values for all the oldest ages are about 1.0, and "dome-shaped" when the values for some intermediate ages are about 1.0 and those for the oldest ages are significantly lower. This pattern often varies by type of fishing gear, area, and seasonal distribution of fishing, and the growth and migration of the fish. The pattern can be changed by modifications to fishing gear, for example, increasing mesh or hook size, or by changing the proportion of harvest by gear type.

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

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

where N_t is the number of animals in the population at time t and N_{t+1} is the number present in the next time period; **Z** is the **total instantaneous mortality rate** which can be separated into deaths due to fishing (**fishing mortality or F**) and deaths due to all other causes (**natural mortality or M**) and e is the base of the natural logarithm (2.71828). To better understand the concept of an instantaneous mortality rate, consider the following example. Suppose the instantaneous total mortality rate is 2 (i.e., Z = 2) and we want to know how many animals out of an initial population of 1 million fish will be alive at the end of one year. If the year is apportioned into 365 days (that is, the 'instant' of time is one day), then 2/365 or 0.548% of the population will die each day. On the first day of the year, 5,480 fish will die (1,000,000 x 0.00548), leaving 994,520 alive. On day 2, another 5,450 fish die (994,520 x 0.00548) leaving 989,070 alive. At the end of the year, 134,593 fish [$1,000,000 \times (1 - 0.00548)^{365}$] remain alive. If, we had instead selected a smaller 'instant' of time, say an hour, 0.0228% of the population would have died by the end of the first time interval (an hour), leaving 135,304 fish alive at the end of the year [$1,000,000 \times (1 - 0.00228)^{8760}$]. As the instant of time becomes shorter and shorter, the exact answer to the number of animals surviving is given by the survival curve mentioned above, or, in this example:

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

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

F_{MAX}: The rate of fishing mortality which 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 to 10% of the amount present in the absence of fishing.

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

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.

Maximum Spawning Potential (MSP) reference points: 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 are derived from stock-recruitment data which can be used to estimate the level of %MSP necessary to sustain a stock, or they are chosen by analogy using available information on the level required to sustain related.

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

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 which 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.

Spawning stock biomass: The total weight of all sexually mature fish in a stock.

Spawning stock biomass per recruit (SSB/R): 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 which are also assumed to be constant.

Status of exploitation: An appraisal of exploitation for each stock is given as under-exploited, fully-exploited, and over-exploited. These terms describe the effect of current fishing mortality on each stock, and are equivalent to the Councils' terms of under-fished, fully-fished, or over-fished. Status of exploitation is based on current data and the knowledge of the stocks over time.

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

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 also assumed to be constant.

Table 1. Percentage of stock (in numbers) caught annually (i.e., exploitation rate) under different fishing mortality rates and the natural (M) mortality rates for the species considered in this report.

F	Ocean quahogs M = 0.02	Cod, haddock, yellowtail flounder herring, scup, black sea bass M = 0.20
0.1	9	9
0.2	18	16
0.3	26	24
0.4	33	30
0.5	39	36
0.6	45	41
0.7	50	46
0.8	55	51
0.9	59	55
1.0	63	58
1.1	66	62
1.2	69	65
1.3	72	67
1.4	75	70
1.5	77	72
1.6	79	74
1.7	81	76
1.8	83	78
1.9	84	79
2.0	86	81

A. GEORGES BANK COD ADVISORY REPORT

State of Stock: The stock is at a low biomass level and is over-exploited relative to the Amendment 7 rebuilding target ($F_{0.1} = 0.18$). Fishing mortality declined from a record high of 1.17 (64% exploitation) in 1994 to 0.26 (21% exploitation) in 1997 (Figure A1). Spawning stock biomass has increased from the time series low in 1994, but in 1997 was only 36,000 mt (Figure A2), well below the Amendment 7 minimum SSB threshold of 70,000 mt. The sizes of recruiting year classes continue to decline, with the most recent year classes (1994, 1995, 1996, and 1997) being the lowest in the VPA time series (1978-1997) (Figure A2). Initial indications are that the 1997 year class is extremely low.

Management Advice: Fishing mortality should be reduced from the current level (F = 0.26, 21% exploitation) to substantially less than $F_{0.1} = 0.18$ (Amendment 7 rebuilding target). Poor recruitment coupled with a truncated age structure from years of overfishing has decreased the potential for stock rebuilding at the current fishing mortality rate. Reducing fishing mortality will avoid declines in SSB and enhance the probability of long-term rebuilding. Low fishing mortalities will eventually lead to an expansion of the age distribution of the population and increase the likelihood of improved future recruitment.

SFA Considerations: Although F_{97} is below the proposed F_{msy}, current (1997) total stock biomass (47,400 mt) is well below the proposed B_{msy} (108,000 mt). Projections conducted by the Overfishing Definition Review Panel under the proposed control law indicate that the stock could be rebuilt in five years at mortality rates consistent with the Amendment 7 rebuilding target. The SARC notes, however, that these projections reflect long-term average conditions and are too optimistic considering the recent run of poor recruitment.

Forecast for 1998-2000: The forecasts for 1998-2000 (Figure A4) were based on the VPA-calibrated 1998 stock sizes. Projections were performed for $F_{0.1} = 0.18$ (15% exploitation), $F_{98} = 0.26$ (21% exploitation), and F = 0.14 (12% exploitation) (recommended level from proposed control rule). Recruitment at age 1 in 1998 was set at the VPA estimate (0.4 million) and in 1999-2000 was estimated from the distribution of the 1991-1997 year classes.

Forecast Table: Basis: $F_{98} = 0.26$ (*status quo* F_{97} from calibrated VPA); SSB estimated to be 36,000 mt in 1997; average 1994-1997 partial recruitment and maturation and 1995-1997 mean weights at age (weights in '000 mt).

1998				1999		2000	
F	Landings	SSB	$F_{1999\text{-}2000}$	Landings	SSB	SSB	Consequences/Implications
0.26	9.4	39.1	0.18 ($F_{0.1}$)	7.1	39.9	38.5	SSB in 2000 decreases to about 62% of the series average; landings decline from current record low levels
			0.26 (F_{98})	9.8	39.9	35.3	SSB in 2000 decreases to about 57% of the series average; landings remain at current record low levels
			0.14	5.6	40.2	40.2	SSB in 2000 stabilizes at about 65% of the series average; landings decline from current record low levels.

Catch and Status Table (weights in '000 mt, recruitment in millions): Georges Bank Cod

Year	1990	1991	1992	1993	1994	1995	1996	1997	Max[3]	Min[3]	Mean[3]
Total commercial landings	42.5	37.6	28.6	23.1	15.2	7.9	8.9	10.4	57.2	7.9	32.5
US commercial landings	28.2	24.2	16.9	14.6	9.9	6.8	7.0	7.5	40.1	6.8	23.6
Canada commercial landings	14.3	13.5	11.7	8.5	5.3	1.1	1.9	2.9	17.8	1.1	8.9
Discards	Discards occur but reliable estimates not presently available										
US recreational landings[1]	1.0	1.9	0.6	2.9	1.5	2.1	0.8	1.5	9.1	0.6	2.6
Catch used in assessment	42.5	37.6	28.6	23.1	15.2	7.9	8.9	10.4	57.2	7.9	32.5
Spawning stock biomass[2]	68.5	53.1	40.8	32.6	25.1	27.8	34.2	36.0	92.8	25.1	61.5
Recruitment (age 1)	9.4	19.2	8.0	10.8	10.1	3.5	6.2	6.5	42.8	3.5	17.4
F (ages 4-8)	0.65	0.83	0.79	1.07	1.17	0.38	0.20	0.26	1.17	0.20	0.61
Exploitation rate	44%	52%	50%	61%	64%	29%	17%	21%	64%	17%	40%
F (ages 3-6, weighted)[4]	0.56	0.86	0.80	0.81	0.68	0.25	0.24	0.31	0.86	0.24	0.54
Exploitation rate	39%	53%	51%	51%	45%	20%	19%	21%	53%	19%	38%

[1]Not used in assessment. [2]At beginning of the spawning season (i.e., March 1). [3]Over period 1978-1997. [4]For comparing US 5Z and Canadian 5Zjm assessments.

Stock Identification and Distribution: The Georges Bank cod stock is distributed primarily from the Northeast Peak of Georges Bank to Nantucket Shoals, with minor occurrence in the Southern New England and Mid-Atlantic regions. The distribution on the Northeast Peak spans the US-Canada boundary.

Catches: Commercial landings increased in the late 1970s and early 1980s, peaking at a record high 57,000 mt in 1982. During 1983-1986, landings declined, but subsequently increased through 1990 (Figure A1). Total commercial landings have since declined to a record low of 7,900 mt in 1995, and increased to 10,400 mt in 1997. Recreational catches have ranged from 500 mt to 9,100 mt and accounted for 1-19% of the total catch.

Data and Assessment: An analytical assessment (VPA) of commercial landings-at-age data was conducted. Information on recruitment and abundance was taken from standardized NEFSC spring and autumn and Canadian spring survey catch-per-tow-at-age data. Discards and recreational catches were not included in the VPA. The uncertainty associated with the estimates of fishing mortality and spawning stock biomass in 1997 were evaluated (Figures A5 and A6).

Biological Reference Points: Updated yield- and SSB-per-recruit analyses with an assumed M of 0.20 indicate that $F_{0.1} = 0.18$ (15% exploitation), $F_{max} = 0.34$ (26% exploitation), and $F_{20\%} = 0.41$ (31% exploitation) (Figure A3). Changes in $F_{20\%}$ are partly due to a revision to the maturation schedule employed in the present assessment. Amendment 7 stipulates that below a spawning stock biomass of 70,000 mt, the fishing mortality target for stock rebuilding is $F_{0.1}$ (0.18). Once the SSB has rebuilt above this overfishing threshold, the fishing mortality can be no greater than the overfishing definition of $F_{20\%}$ (0.41). The SARC notes that the current overfishing definition is inconsistent with the requirements of the SFA. The Overfishing Definition Review Panel has estimated that, at an overfishing limit threshold (B_{msy}) of 108,000 mt, yield (MSY) would be 35,000 mt at F = 0.32 (F_{msy}, biomass-weighted age 1+).

Fishing Mortality: Fishing mortality doubled between 1979 and 1985 from 0.35 (27% exploitation) to 0.74 (48% exploitation), declined to 0.48 (35% exploitation) in 1986-1987, but increased in 1988 to 0.79 (50% exploitation) (Figure A1). F increased again in 1991 to 0.83 (52% exploitation) and peaked at a record high of 1.17 (64% exploitation) in 1994, and has since declined to 0.26 (21% exploitation) in 1997. There is a 100% probability that F in 1997 exceeded $F_{0.1}$.

Recruitment: Strong year classes were produced in 1980, 1983, and 1985 (Figure A2). The 1990 year class was slightly above average, but the 1994, 1995, and 1996 year classes are among the lowest on record. The 1997 year class is estimated to be extremely poor, lower than the previous estimated low 1994 year class.

Spawning Stock Biomass: The long-term average SSB is 62,000 mt. SSB declined about 50% between 1980 and 1985/1986 (92,800 mt to 56,000 mt), increased to 74,000 mt in 1988, but declined to 41,000 mt in 1992 before falling to a record low of 25,000 mt in 1994 (Figure A2). SSB increased to 36,000 mt in 1997 and is projected to increase in 1998. There is a 100% probability that SSB in 1997 was less than 70,000 mt.

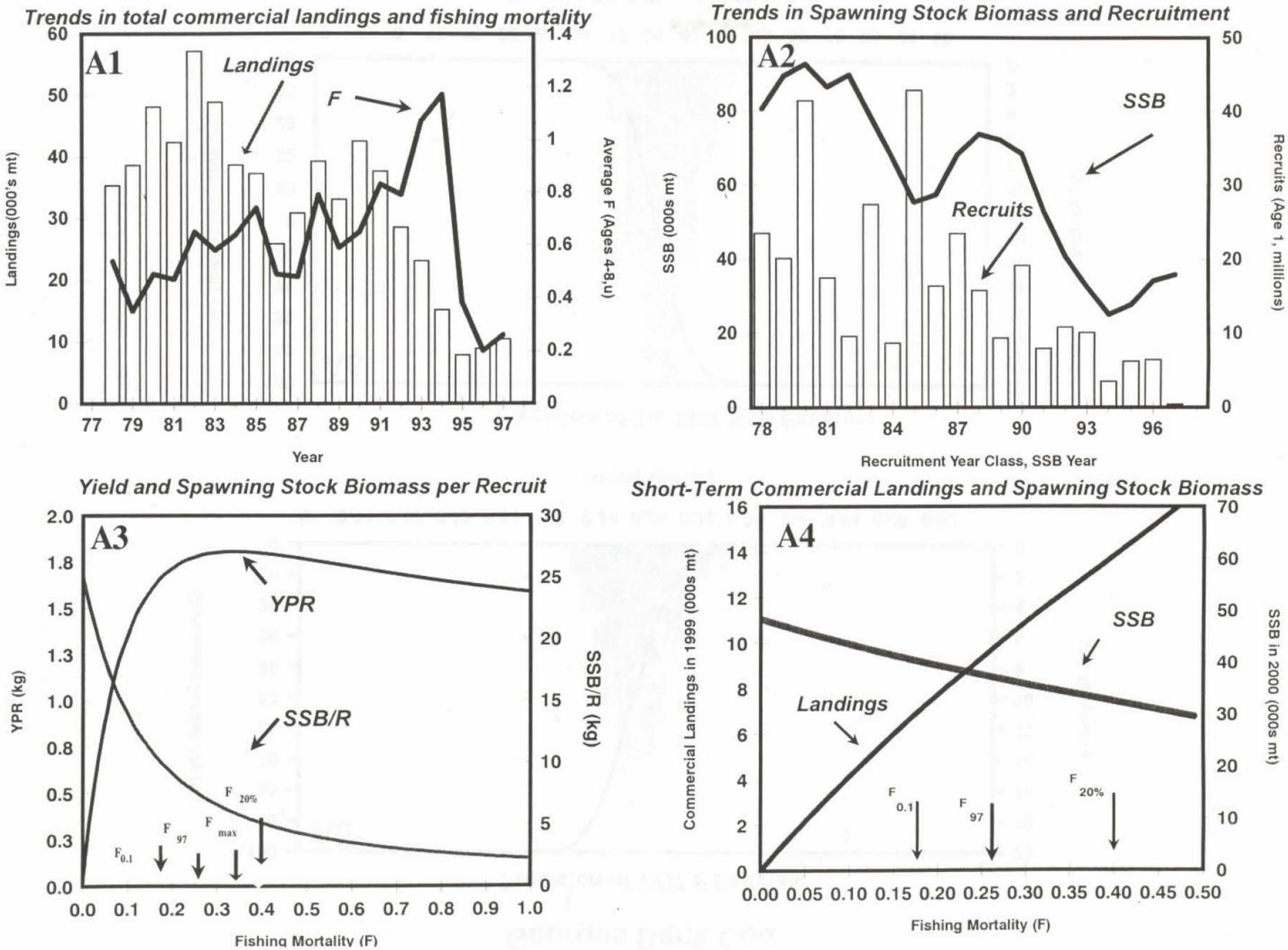
Special Comments: Lack of discard data in the assessment may result in an underestimate of F on the youngest ages, and lack of recreational catches in the assessment may affect all ages, although the extent is unknown.

Comparison of US 5Z and Canadian 5Zjm assessments indicate similar trends in estimates of biomass(age 3+), recruitment, and fishing mortality.

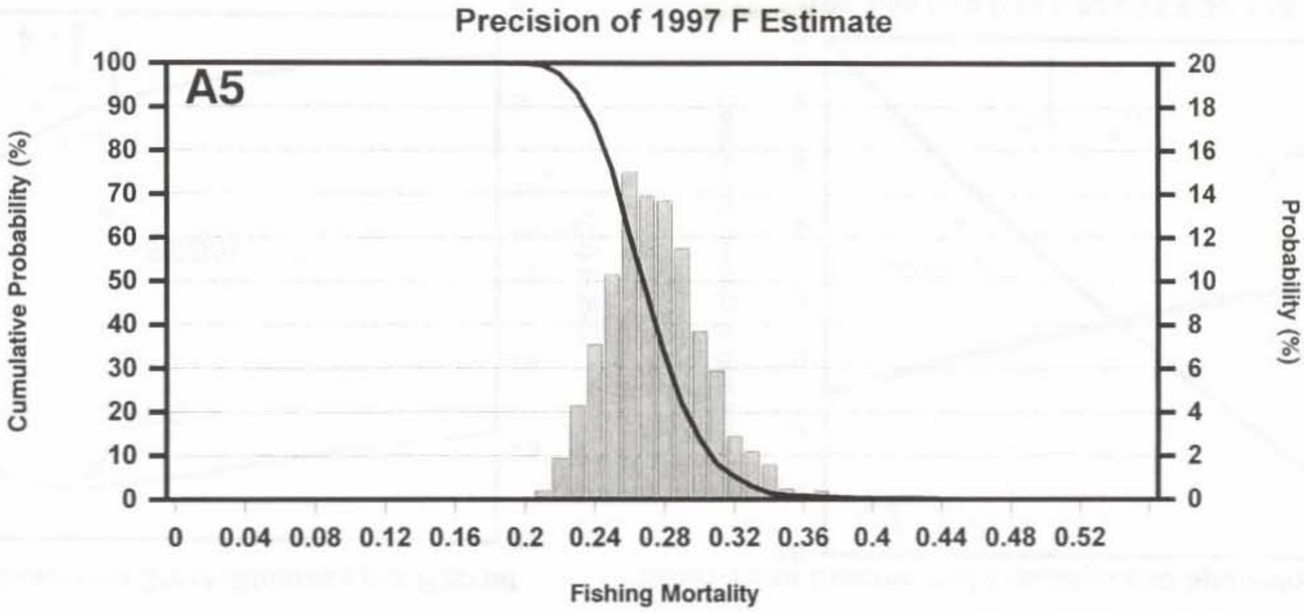
The 1998 Canadian TAC is 1,900 mt for eastern Georges Bank (5Zjm) which, when combined with the projected US catch, will result in a fishing mortality rate approximately the same as in 1997.

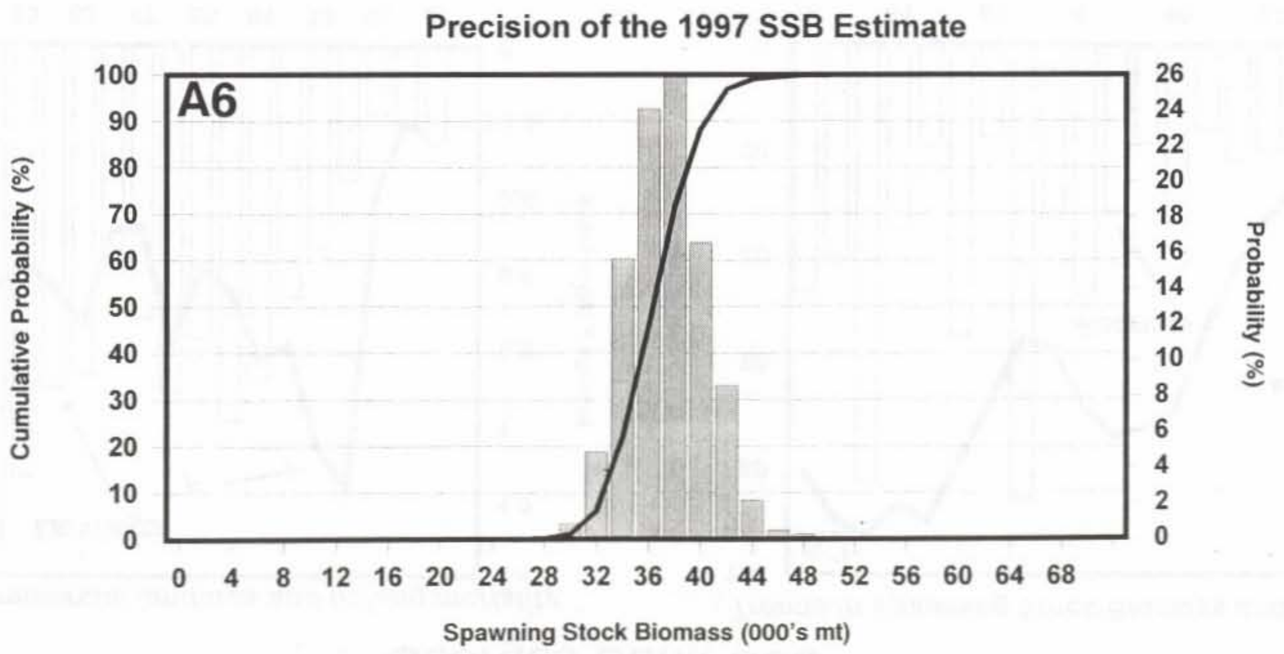
Source of Information: Report of the 27th Northeast Regional Stock Assessment Workshop (27th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 98-xx; L. O'Brien, Assessment of the Georges Bank cod stock for 1998, NEFSC Ref. Doc. 98-xx).

Georges Bank Cod



Georges Bank Cod





B. GEORGES BANK HADDOCK ADVISORY REPORT

State of stock: The stock is at a low biomass level and is fully exploited. Fishing mortality is below the rebuilding fishing mortality target defined by Amendment 7 ($F_{0.1} = 0.26$), and moderate rebuilding of spawning stock biomass has occurred. The age structure of the population is continuing to expand and the age 4+ biomass is at its highest level since 1983. Spawning stock biomass has increased from record low levels primarily due to growth of fish from recent year classes, not because these year classes were strong. Spawning stock biomass in 1997 was estimated to be 40,500 mt, approximately half of the rebuilding threshold (80,000 mt). Although the 1994-1996 year classes appear to be moderate relative to recruitment observed over the past decade, this recruitment level is far below average levels when the stock was in a healthy condition (Figure B2). The moderate-sized 1996 year class will result in continued increases in spawning stock biomass through 1999, provided that fishing mortality remains low. Increases in spawning stock biomass after 1999 are unlikely at the current fishing mortality rate, unless recruitment improves to levels exceeding those observed during the past decade.

Management Advice: Fishing mortality should be maintained at or reduced below $F_{97} = 0.11$ (9% exploitation rate) to continue stock rebuilding and improve the spawning potential. Allowing fishing mortality to increase to the Amendment 7 target of $F_{0.1}$ (0.26) will result in a decrease in SSB in 2000. To improve the probability of good recruitment, it is imperative that SSB be allowed to increase ($SSB_{97} = 40{,}500$ mt).

SFA Considerations: Current spawning stock biomass ($SSB_{97} = 40{,}500$ mt) is well below the proposed proxy for B_{msy} (SSB of 105,000 mt), and F_{97} is below F_{msy} (0.26). The potential for stock rebuilding to B_{msy} in 10 years or less has not been re-evaluated, but simulations provided at SAW-24 indicate about a 50% probability of achieving the B_{msy} proxy in this time frame at $F = 0.10$.

Forecast for 1998-2000: Forecasts for 1998-2000 (Figure B4) were based on the VPA-calibrated 1998 stock sizes. Projections were performed assuming fishing mortality rates in 1999 and 2000 of *status quo* $F_{97} = 0.11$ and $F_{0.1} = 0.26$. At $F_{97} = 0.11$, 1999 landings are projected to be 4,600 mt and the SSB in 2000 will decline slightly to 56,900 mt. At $F_{0.1} = 0.26$, 1999 landings are projected to be 10,100 mt and the SSB in 2000 will decline to 49,200 mt.

Forecast Table: Basis: $F_{98} = 0.11$ (*status quo* F_{97} from calibrated VPA); SSB estimated to be 40,500 mt in 1997; average 1995-1997 partial recruitment, mean weights at age, and maturation; age 1 recruitment in 1998 and 1999 estimated from the distribution of observed age 1 stock sizes during 1979-1996 (weights in '000 mt).

1998				1999		2000	
F	Landings	SSB	$F_{1999\text{-}2000}$	Landings	SSB	SSB	Consequences/Implications
0.11	4.1	52.4	0.11 (F_{97})	4.6	57.4	56.9	SSB reaches a plateau in 1999 and declines slightly (1%) in 2000, US/Canada landings increases slightly (12%).
			0.26 ($F_{0.1}$)	10.1	55.6	49.2	SSB reaches a plateau in 1999 and declines by 12% in 2000, US/Canada landings increase by 146%.

Catch and Status Table (weights in '000 mt, recruitment in millions): Georges Bank Haddock

Year	1990	1991	1992	1993	1994	1995	1996	1997	Max[1]	Min[1]	Mean[1]
US commercial landings	2.0	1.4	2.0	0.7	0.2	0.2	0.3	0.9	52.9	0.2	12.2
Otter trawl	1.9	1.3	2.0	0.7	0.2	0.1	0.2	0.8	52.0	0.1	11.0
Longline	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.1	<0.1	0.2
Other gear	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	<0.1	<0.1
Canada commercial landings	3.3	5.4	4.1	3.7	2.4	2.1	3.7	2.7	18.3	0.5	5.1
Otter trawl	2.4	4.0	2.6	2.5	1.6	1.6	2.7	2.0	17.9	0.4	4.4
Longline	0.9	1.3	1.4	1.1	0.7	0.4	0.9	0.7	1.4	<0.1	0.5
Other gear	0.1	0.1	0.1	0.1	0.1	<0.1	<0.1	<0.1	0.3	<0.1	<0.1
Other commercial landings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	82.6	0.0	[2]10.7
Total commercial landings	5.3	6.8	6.1	4.4	2.6	2.3	4.0	3.6	150.4	2.3	21.0
Discards											
US commercial discards	N/A	N/A	N/A	N/A	0.5	0.1	0.3	0.6	N/A	N/A	N/A
Catch used in assessment	5.3	6.8	6.1	4.4	3.1	2.4	4.3	4.3	150.4	2.4	21.8
Spawning stock biomass[3]	20.8	19.0	14.3	11.9	16.0	27.6	33.5	40.5	180.5	10.9	48.8
Recruitment (age 1)	2.8	2.6	10.0	17.7	13.4	10.1	8.9	13.8	471.9	0.4	[4]8.2
F (ages 4-7, unweighted)	0.32	0.39	0.42	0.40	0.32	0.12	0.15	0.11	0.61	0.11	0.35
Exploitation rate	25%	29%	31%	30%	25%	10%	13%	9%	42%	9%	27%

[1]Over period 1963-1996. [2]Over period 1962-1976. [3]At beginning of the spawning season. [4]Geometric mean.

Stock Identification and Distribution: Georges Bank haddock are distributed primarily from the Northeast Peak to Nantucket Shoals, with minor occurrence in the Southern New England and Mid-Atlantic regions. Highest concentrations are currently found along the Northern Edge and Northeast Peak of Georges Bank, although in earlier periods significant concentrations were also located near the Great South Channel. From the mid-1980s through the early 1990s, haddock resources were concentrated in the Northeast Peak area, primarily in Canadian waters. Distribution patterns from recent research vessel surveys suggest increased abundance of haddock resources in the Great South Channel area of Georges Bank.

Catches: Total commercial landings increased sharply in 1965 and 1966 as a result of increased exploitation by distant water fleets commencing in the early 1960s. Catches declined thereafter to less than 6,000 mt between 1972 and 1976, but increased in the late 1970s to a maximum of 27,000 mt in 1980. Total catches have since declined to an estimated 2,400 mt in 1995, and increased to 4,300 mt in 1997 (Figure B1). Discards have been periodically estimated and added to the catch when levels were significant. Estimates of regulatory discarding occurring during 1994-1997 are included in the current assessment. Only the US and Canada have participated in this fishery since 1976. Landings by US vessels are almost exclusively by otter trawl, while Canadian landings are taken by otter trawl and longline gear. Recreational landings from this stock have been negligible.

Data and Assessment: Analytical assessment (VPA) of 1963-1997 commercial landings-at-age data tuned with the ADAPT method using Canadian DFO spring and standardized NEFSC spring and autumn survey numbers-at-age data. The precision and uncertainty associated with the estimates of fishing mortality and spawning stock biomass in 1997 were quantitatively evaluated.

Biological Reference Points: The yield-per-recruit and spawning-stock-biomass-per-recruit relationships were not updated from the 1997 assessment. Yield- and SSB-per-recruit analyses performed with an assumed M of 0.20 indicate that $F_{0.1} = 0.26$ (21% exploitation) and $F_{30\%} = 0.45$ (33% exploitation) (Figure B3). Amendment 7 stipulates that below a spawning stock biomass of 80,000 mt, the fishing mortality target for stock rebuilding is $F_{0.1}$ (0.26). Once the SSB has rebuilt above this overfishing threshold, the fishing mortality can be no greater than the overfishing definition of $F_{30\%}$ (0.45). The SARC notes that the current overfishing definition is inconsistent with the requirements of the SFA. The Overfishing Definition Review Panel has estimated proxies for the overfishing limit threshold (B_{msy}) of 105,000 mt, and $F_{msy} = F_{0.1} = 0.26$.

Fishing Mortality: Fishing mortality remained between 0.3 and 0.4 (24-30% exploitation) during most of the 1980s, but increased to about 0.42 (31% exploitation) in 1992 before declining to 0.11 (9% exploitation) in 1997 (Figure B1). Accounting for the uncertainty associated with the 1997 fishing mortality estimates, there is an 80% probability that fishing mortality in 1997 lies between 0.10 (8% exploitation) and 0.12 (10% exploitation) (Figure B6).

Recruitment: Recruitment since 1979 has been far below historical average levels estimated when healthy stock conditions were observed from 1931 to 1960. The 1992 (17.7 million), 1993 (13.4 million), and 1996 (13.8 million) year classes are larger than other year classes produced over the past decade (Figure B2), but are less than 1/3 the average recruitment expected from a rebuilt stock. The 1997 year class (5.4 million) is currently estimated to be the weakest year class since 1990.

Spawning Stock Biomass: SSB declined by 83% between 1978 (69,000 mt) and 1993 (11,900 mt). SSB began to increase in 1994 with improved recruitment and lower fishing mortality, and reached 40,500 mt by 1997 (Figure B2). Accounting for the uncertainty associated with the 1997 SSB estimates, there is an 80% probability that the 1997 SSB was between 34,200 mt and 48,100 mt (Figure B5). Current SSB levels can be contrasted with SSB levels estimated for the 1935-1960 time period when stable recruitment resulted in sustainable landings of 40,000-60,000 mt. SSB levels during the historical period have been estimated to average 120,000 mt, approximately 3-fold higher than current levels and 50% higher than the US management threshold of 80,000 mt.

Special Comments: Low levels of sampling of US landings and discards contribute to the uncertainty in estimates of the size and age composition of the US catch. US sampling of landings improved significantly after September 1, 1997 when liberalization of the US haddock trip limit resulted in increased availability of large haddock trips in US ports. Current vessel trip reports (logbooks) and at-sea observations by the sea sampling program are inadequate to reliably estimate the quantity of haddock discards or to characterize their size and age composition.

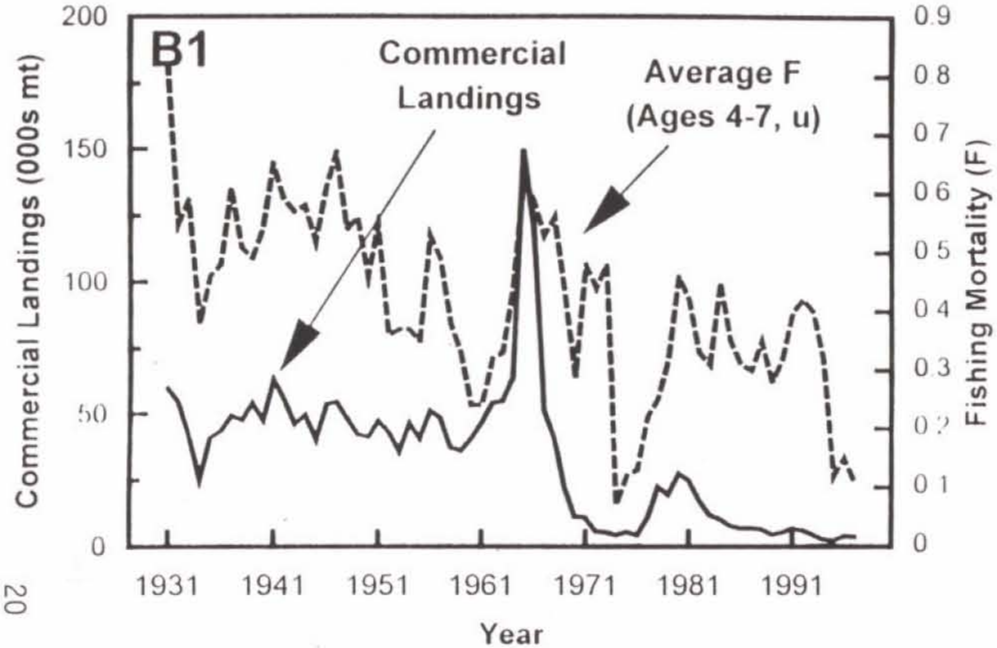
The existence of Closed Area II and conservation of limited days at sea have largely displaced the US fleet to the western part of Georges Bank. Comprehensive stock rebuilding will require the accumulation of haddock biomass and the realization of haddock recruitment in the western part of the stock area.

Canada has set a 1998 TAC of 3,900 mt for eastern Georges Bank (5Zjm) included within the area described by this assessment. This amount, together with the projected US landings for 1998, would result in fishing mortality increasing from 1997.

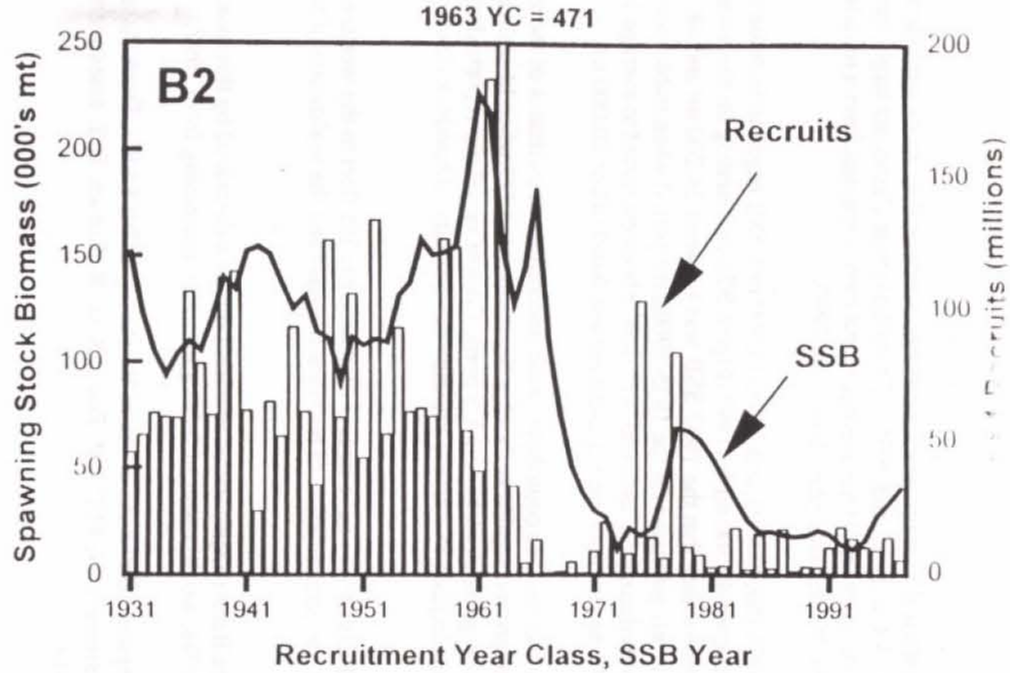
Source of Information: Report of the 27th Northeast Regional Stock Assessment Workshop (27th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 98-xx; R. Brown, U.S. assessment of the Georges Bank haddock stock, 1998, NEFSC Ref. Doc. 98-xx.

Georges Bank Haddock

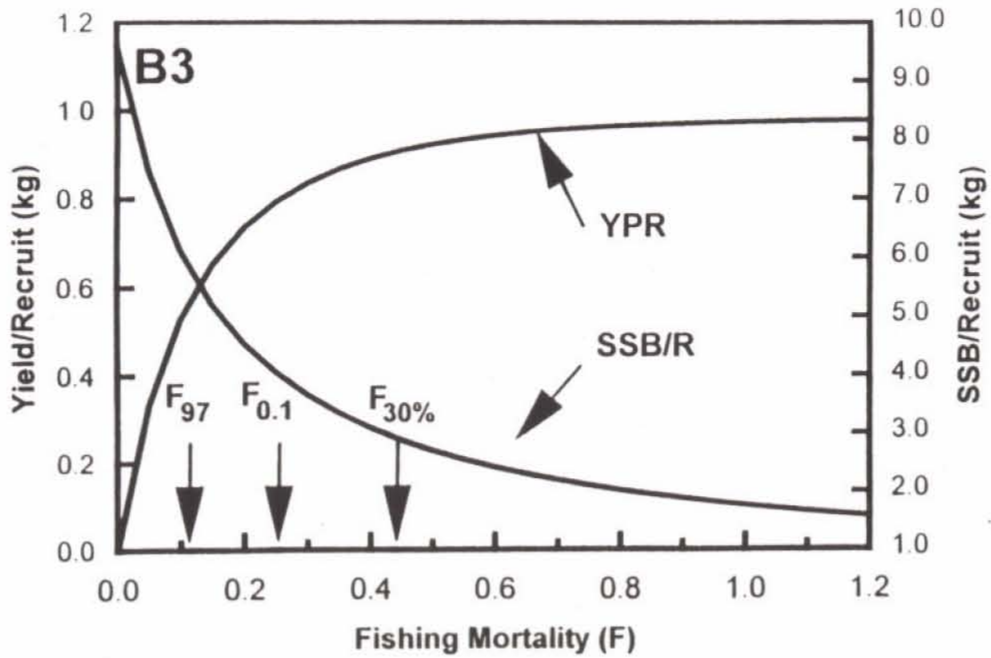
Trends in Commercial Landings and Fishing Mortality



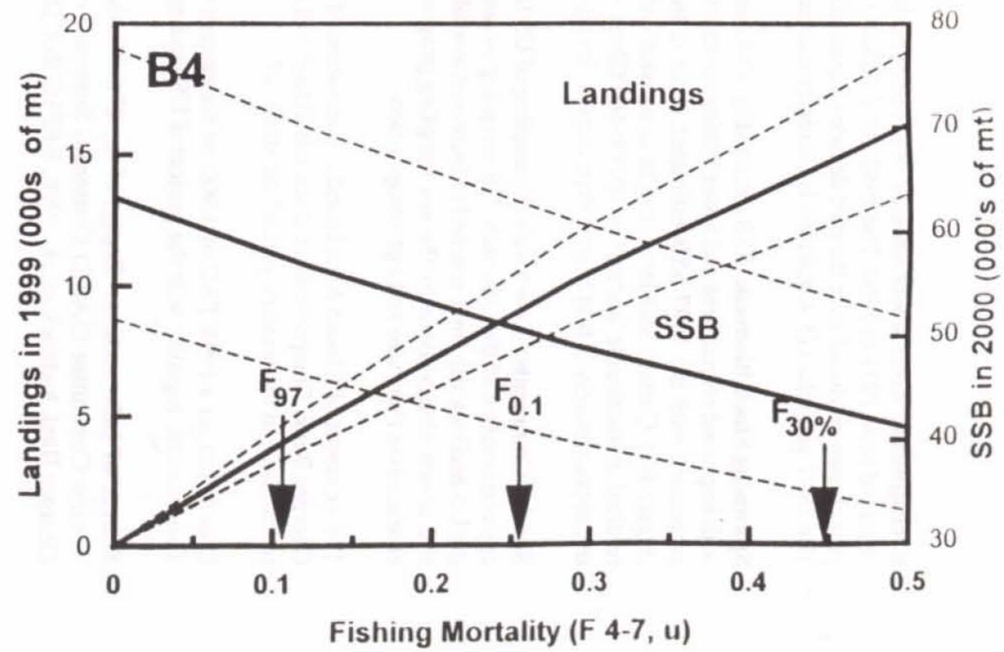
Trends in Spawning Stock Biomass and Recruitment

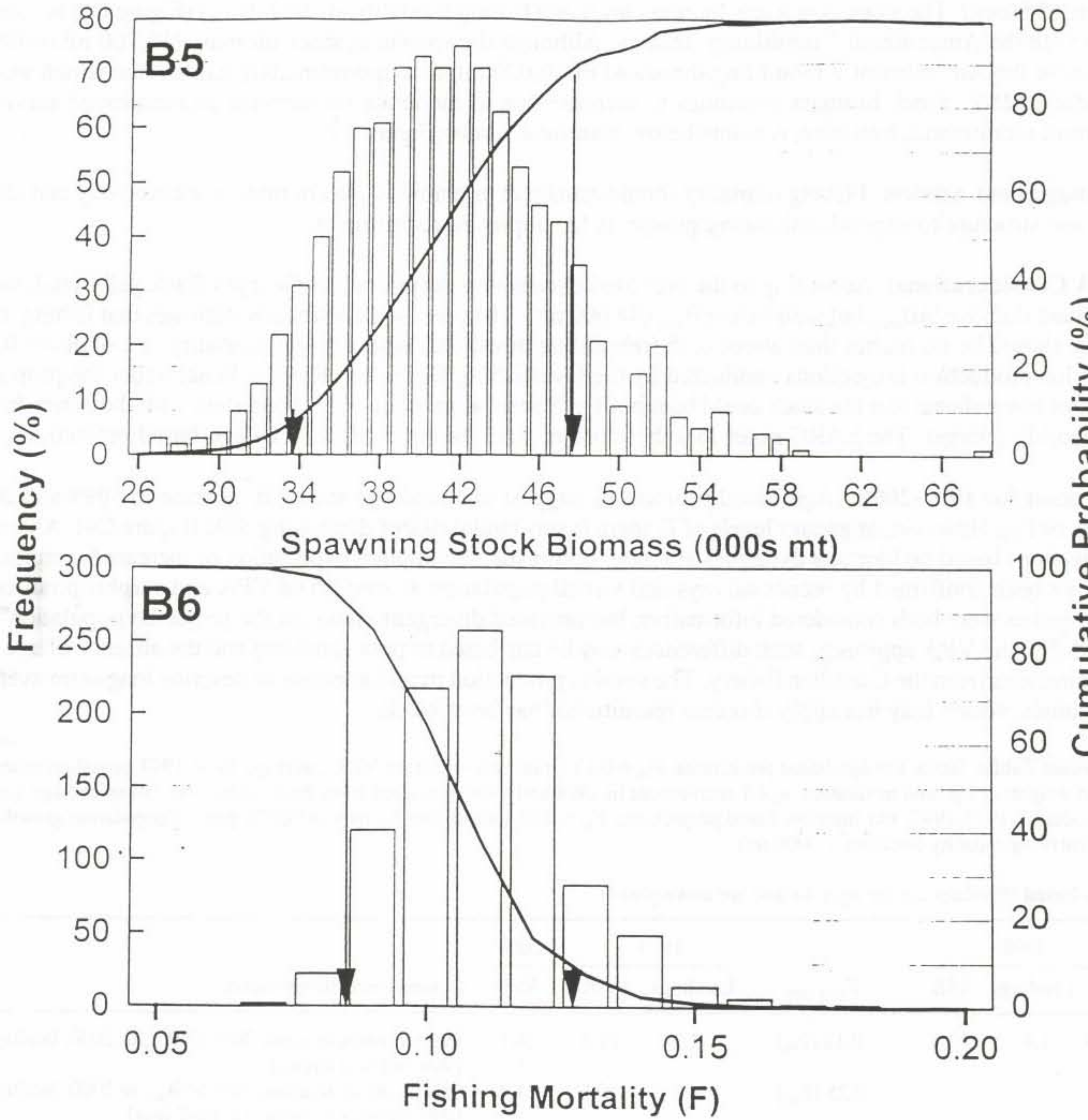


Yield and Spawning Stock Biomass per Recruit



Short-Term Landings and Spawning Stock Biomass





Figures B5 and B6. Precision of the estimates of spawning stock biomass (Figure B5) at the beginning of the spawning season (April 1) and instantaneous rate of fishing mortality (Figure B6) on the fully-recruited ages (ages 4+) in 1997 for Georges Bank haddock. The vertical bars display both the range of the estimator and the probability of individual values within the range. The solid line gives the probability of individual values within the range. The solid line gives the probability that F is greater than or SSB is less than the corresponding value on the X-axis. The solid arrows indicate the approximate 90% and 10% confidence levels for F and SSB. The precision estimates were derived from 200 bootstrap replications of the final ADAPT VPA formulation.

C. GEORGES BANK YELLOWTAIL FLOUNDER ADVISORY REPORT

State of Stock: The stock is at a low biomass level and fishing mortality in 1997 (0.13) (Figure C1) is consistent with the Amendment 7 rebuilding strategy. Although the spawning stock biomass (15,700 mt in 1997) is above the Amendment 7 rebuilding threshold of 10,000 mt, it is approximately half of that which would produce MSY. Stock biomass continues to increase due to moderate recruitment and improved survival. Current recruitment, however, remains below historical levels (Figure C2).

Management Advice: Fishing mortality should remain at or below $F_{0.1}$ to continue stock recovery and allow the age structure to expand, enhancing prospects for improved recruitment.

SFA Considerations: According to the proposed overfishing definition for Georges Bank yellowtail, stock biomass is above $\frac{1}{4}B_{msy}$, but well below B_{msy} (44,000 mt). The proposed control law indicates that fishing mortality should be no higher than about 0.25 (rebuilding threshold) with a target mortality rate of about 0.18. Surplus production projections conducted by the Overfishing Definition Review Panel under the proposed control law indicate that the stock could be rebuilt in 5 years at mortality rates consistent with the Amendment 7 rebuilding target. The SARC notes that these projections are not confirmed by age-based projections.

Forecast for 1998-2000: Age-based projections suggest that landings and SSB increase in 1999 and 2000 at F_{97} or $F_{0.1}$. However, at greater levels of F, there is substantial risk of decreasing SSB (Figure C4). Although projections based on biomass dynamics are more optimistic, the implicit expectation of increased recruitment has not been confirmed by recent surveys and virtual population analysis. The VPA and surplus production approaches were both considered informative, but provided divergent views on the projected population and yield. For the VPA approach, such differences may be attributed to poor sampling and the absence of age determinations from the Canadian fishery. The surplus production model attempts to describe long-term average dynamics, which may not apply if recent recruitment has been weak.

Forecast Table: Basis: For age-based projections, $F_{98} = 0.13$ (*status quo* F_{97} from VPA); average 1994-1997 partial recruitment, mean weights at age, and maturation; age 1 recruitment in 1998 and 1999 estimated from the distribution of observed age 1 stock sizes during 1973-1997. For biomass-based projections, $F_{98} = 0.08$ (*status quo* F_{97} from ASPIC); general population growth rate and carrying capacity (weights in '000 mt).

Age-based (F values are for ages 4+ and are unweighted)

1998				1999		2000	
F	Landings	SSB	$F_{1999-2000}$	Landings	SSB	SSB	Consequences/Implications
0.13	1.8	17.8	0.13 (F_{98})	2.2	21.5	24.1	SSB increases to about 70% SSB_{msy} in 2000; landings in 1999 increase slightly.
			0.25 ($F_{0.1}$)	4.0	20.6	21.4	SSB increases to about 60% SSB_{msy} in 2000; landings in 1999 increase to twice the 1997 level.

Biomass-based (F values are for ages 1+ and are weighted by biomass)

1998				1999		2000	
F	Landings	B	$F_{1999-2000}$	Landings	B	B	Consequences/Implications
0.08	2.6	26.2	0.08 (F_{98})	3.4	36.3	46.4	Biomass (B) surpasses B_{msy} in 2000; landings in 1999 increase to almost twice the 1997 level.
			0.17 ($F_{0.1}$)	7.3	36.3	42.5	Biomass increases to about 97% B_{msy} in 2000; landings in 1999 increase to four times the 1997 level.

Catch and Status Table (weights in '000 mt, recruitment in millions): Georges Bank Yellowtail Flounder

Year	1990	1991	1992	1993	1994	1995	1996	1997	Max	Min	Mean[4]
US											
Landings	2.8	1.8	2.9	2.1	1.6	0.3	0.8	1.0	15.9	0.3	7.7
Discards	0.8	0.2	1.9	1.1	0.1	<0.1	<0.1	0.1	6.4	<0.1	1.6
Canada											
Landings	<0.1	<0.1	<0.1	0.7	2.1	0.5	0.5	0.8	2.1	0.0	0.1
Discards[1]	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1	0.0	<0.1
Total catch	3.6	2.0	4.7	3.9	3.9	0.8	1.3	1.8	16.6	0.8	9.8
Biomass	5.9	6.7	7.4	7.4	7.8	10.3	16.1	24.1	60.3	4.1	[2]31.0
SSB	4.7	4.3	4.8	4.6	3.4	5.4	10.7	15.7	21.1	2.7	[3]7.6
Recruitment (age 1)	11.8	22.3	17.2	16.5	27.0	20.9	14.8	21.1	68.5	5.8	[3]23.5
F (age 4+,u)	1.00	1.35	1.18	1.08	2.05	0.49	0.19	0.13	2.14	0.13	[3]1.10
Exploitation rate	58%	69%	64%	61%	81%	35%	16%	11%	83%	11%	[3]62%
F (age 1+,wb)	0.60	0.30	0.63	0.53	0.50	0.08	0.08	0.08	1.17	0.08	[2]0.52
Exploitation rate	41%	24%	43%	37%	36%	7%	7%	7%	64%	7%	[2]37%

[1]Canadian discards previous to 1997 are unknown, but considered to be small. [2]From surplus production modeling, 1968-1997. [3]From VPA, 1973-1997. [4]Over period 1963-1997 except as otherwise indicated.

Stock Distribution and Identification: Yellowtail flounder range from Labrador to Chesapeake Bay and are considered relatively sedentary. A major concentration of yellowtail occurs on Georges Bank to the east of the Great South Channel, as indicated from tagging studies from the late 1950s and early 1960s.

Catches: US landings were generally greater than 10,000 mt from 1963 to 1976, but have not exceeded 3,000 mt since 1986 (Figure C1). US discards were 6,400 mt in 1963 coincident with strong recruitment, fluctuated from 3 to 2,000 mt during 1977-1993 because of variable recruitment, but have been low since 1993. Canadian landings peaked in 1994 at 2,100 mt; under quota control, landings were less than 500 mt in 1995 and 1996 and 810 mt in 1997.

Data and Assessment: US landings in 1973-1993 were estimated from dealer records and interview information. US landings in 1994-1997 were prorated from dealer records according to vessel logbook data. US discards at age in 1963-1993 were estimated from vessel interviews, survey length distributions, and sea sampling information. Discards in 1994-1997 were estimated from discard-to-kept ratios reported in vessel logbooks.

Canadian landings of unspecified flounder from Georges Bank were substantial in 1993 and 1994. The ratio of specified yellowtail to other species was used to prorate landings of unspecified flatfish. With improvements in dockside monitoring, landings of unspecified flounder decreased from 49 mt in 1996 to 32 mt in 1997.

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

Given uncertainties in the age composition in recent years, a non-equilibrium surplus production model was also used to assess the stock. Input data included commercial landings and discards at age and three of the surveys used in the VPA. Unlike the VPA, this approach is based on biomass and catch, but information on age structure is not required.

Biological Reference Points: Biological reference points were revised: $F_{0.1}$ = 0.25 (20% exploitation; Figure C3). Amendment 7 stipulates that below a spawning stock biomass of 10,000 mt, the fishing mortality target for stock rebuilding is $F_{0.1}$ (0.25). Once the SSB has rebuilt above this overfishing threshold, the fishing mortality can be no greater than the overfishing definition of $F_{20\%}$ (0.69). The SARC notes that the rebuilding threshold and current overfishing definition are inconsistent with the requirements of the SFA. It was estimated that at an overfishing limit threshold (B_{msy}) of 44,000 mt, yield (MSY) would be 13,700 mt at F_{msy} = 0.31 (biomass-weighted) (equivalent to fully-recruited F = 0.39).

Fishing Mortality: The VPA and the surplus production model produced similar trends in exploitation rates. Fishing mortality was very high ($F > 1.0$, 58% exploitation) during the 1983-1994 period, but declined in 1995-1997 to the lowest levels observed in the series (Figure C1). There is an 80% probability that F in 1997 was between 0.11 and 0.17 (9-14% exploitation; Figure C6).

Recruitment: Age 1 recruitment estimates are available from VPA. Four dominant year classes of approximately 50 million fish at age 1 were produced during 1973-1980 (Figure C2). All other cohorts in the time series were less than 30 million at age 1. The 1990-1996 cohorts were near the VPA time series average (1973-1997), but the fall survey suggests that recruitment was much greater in the 1960s.

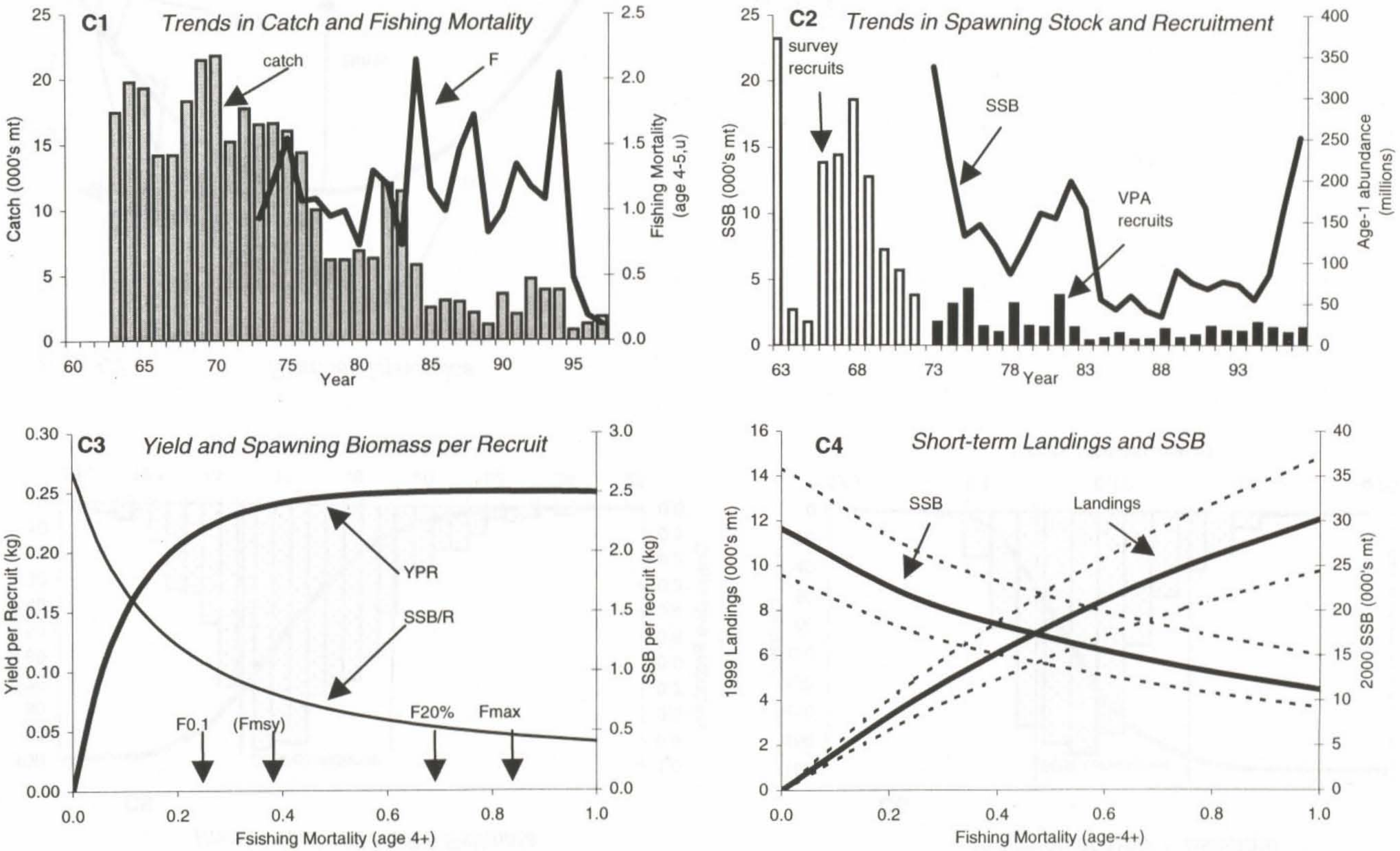
Spawning Stock Biomass: SSB exceeded 21,000 mt in 1973, but declined to less than 4,000 mt during 1984-1988 (Figure C2). SSB fluctuated below 6,000 mt from 1989 to 1995 and increased to 15,700 mt in 1997. However, historical survey catches of mature yellowtail suggest that SSB in the 1960s was approximately 50,000 mt. There is an 80% probability that SSB in 1997 was between 13,500 mt and 19,200 mt (Figure C5). Estimates of biomass from VPA follow similar trends to estimates of total biomass from the surplus production model. Both models indicate that biomass declined sharply after 1982 to low values in the mid-1980s. Biomass followed an increasing trend since 1988. However, current biomass remains far below historic levels which may have been greater than 70,000 mt early in the history of the fishery.

Special Comments: Reliability of age-based estimates was substantially compromised by poor sampling of the US fishery in the second half of 1997 and the absence of age determinations from the Canadian fishery. The estimates of MSY, B_{msy}, and F_{msy} were revised by updating the surplus production model (ASPIC) with new data from 1997, by splitting the US spring survey data into two series to account for changes in survey catchability caused by door modifications, and by lagging the Canadian survey data to include the spring 1998 estimate of stock biomass.

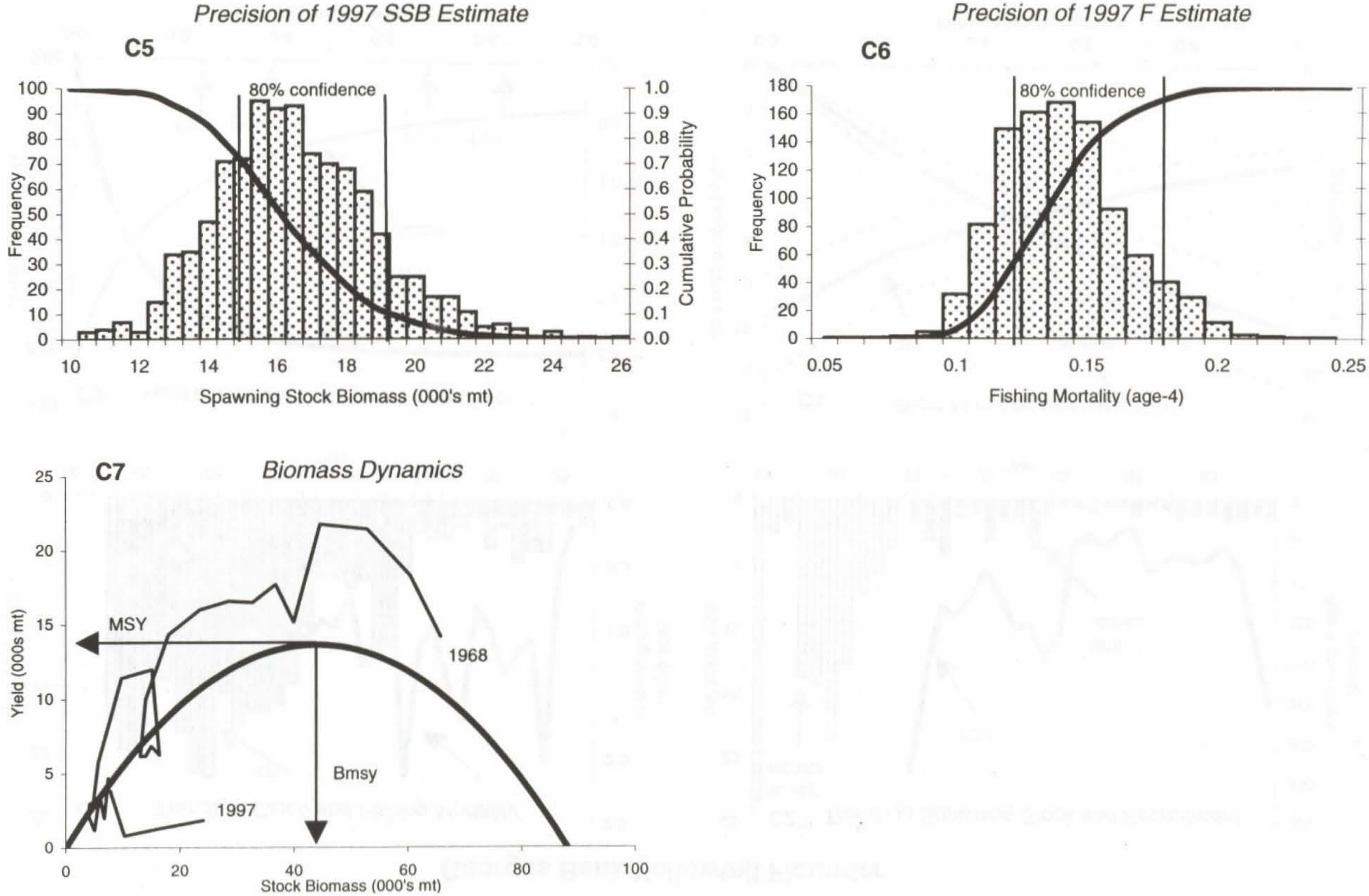
The Canadian TAC for 1998 is 1,200 mt, which, when combined with the projected US catch, should correspond to an F less than $F_{0.1}$.

Source of Information: Report of the 27th Northeast Regional Stock Assessment Workshop (27th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 98-xx; J.D. Neilson and S.X. Cadrin. 1998 assessment of Georges Bank (5Zjmnh) yellowtail flounder. DFO Res. Doc. 98/xx.

Georges Bank Yellowtail Flounder



Georges Bank Yellowtail Flounder



D. SCUP ADVISORY REPORT

State of Stock: The stock is over-exploited and at a low biomass level. Current indices of spawning stock biomass are at record lows (1996-1998 average = 0.06 kg/tow), and less than one-tenth of the maximum NEFSC indices of spawning stock biomass observed during 1977-1979 (average of 2.77 kg/tow; Figure D2). Indices of recruitment have trended downward in recent years, except for a moderate 1994 year class and what may be a strong 1997 year class (Figure D3). The stock has a highly truncated age structure, which is a likely reflection of prolonged high fishing mortality. Although discard estimates are uncertain, the majority of fishing mortality in recent years is clearly attributable to discards, particularly when incoming recruitment is strong.

Management Advice: Fishing mortality should be reduced substantially and immediately. Reduction in fishing mortality from discards will have the most impact on the stock, particularly considering the importance of the 1997 year class. This could be most effectively accomplished by reducing discards from small-mesh fisheries. The SARC recommends that the 1999 TAC be less than that in 1998 to at least remain on the current fishing mortality reduction schedule.

SFA Considerations: Estimates of B_{msy} using landings and the survey time series may be too low, given the very high commercial catches derived prior to the initiation of the NEFSC surveys (e.g., 1950s and early 1960s; Figure D1). However, a minimum biomass index for stock rebuilding can be defined as the maximum value of a 3-year moving average of the NEFSC spring survey catch per tow of spawning stock biomass (1977-1979 average = 2.77 kg/tow). Similarly, F_{msy} cannot be estimated, and $F_{0.1}$ (0.15) is suggested as a proxy for F_{msy}, although that estimate is currently subject to considerable uncertainty about the effect of discarding on exploitation patterns. The SARC believes greater caution is necessary in setting a fishing mortality threshold to accommodate the greater uncertainty in the assessment of scup, compared to other species where F_{max} has been acceptable (i.e., summer flounder). If fishing mortality rates are obtained which are at or below the current management schedule for reductions in F, there is minimal probability that the stock would rebuild to the minimum biomass index within 10 years, conditional on incoming recruitment.

Forecast for 1999: In the absence of any quantitative age-based estimates of current stock size (e.g., from virtual population analysis), a forecast of future stock and catch was not possible. However, the 1999 TAC should be less than that in 1998 to at least remain on the current fishing mortality reduction schedule.

Landings and Status Table (weights in '000 mt, recruitment in thousands): Scup

Year	1990	1991	1992	1993	1994	1995	1996	1997	Max[3]	Min[3]	Mean[3]
Commercial landings	4.3	6.9	6.0	4.5	4.2	2.9	2.7	2.2	7.8	2.2	5.0
Commercial discards[2]	3.9	3.5	5.7	1.4	0.8	2.1	1.5	1.8	5.7	0.8	2.5
Recreational landings	1.9	3.7	2.0	1.5	1.2	0.6	1.0	0.5	5.2	0.5	2.1
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	10.1	14.1	13.7	7.4	6.2	5.6	5.2	4.5	14.3	4.5	9.7

[1]Over period 1984-1997. [2]Assuming 100% mortality. [3]Assuming 15% mortality.

Stock Identification and Identification: Scup are distributed primarily between Cape Cod and Cape Hatteras. Although tagging studies have indicated the possibility of two stocks, one in Southern New England waters and the other extending south from New Jersey, the absence of definitive studies and the presence of distributional data from NEFSC bottom trawl surveys support the concept of a single unit stock extending from Cape Hatteras to New England.

Catches: From an annual average of less than 10,000 mt during 1930-1947, commercial landings increased to an average of over 19,000 mt in 1953-1964, peaked at over 22,000 mt in 1960, but then fell to only about 4,000 mt per year in the early 1970s. Commercial landings increased moderately during 1974-1986, varying between 7,000 and 10,000 mt per year, but have declined in recent years to historical low levels of 2,200 - 2,900 mt in 1995-1997. Since 1979, recreational landings have ranged between 600 and 5,300 mt per year, with 1,000 mt taken in 1996, over twice the low of 479 mt landed in 1997. Commercial discards, estimated from sea sampling data, averaged 2,600 mt per year during 1989-1997. Mortality from recreational discards averaged 44 mt annually during 1984-1997. Total catch during 1984-1997 ranged from a high of 14,000 mt in 1986 to a low of 4,500 in 1997 (Figure D1).

Data and Assessment: Scup was last assessed at SAW-25 in 1997. The current assessment is based on commercial and recreational catch-at-age data (landings and discards) for 1984-1997, and research survey indices of abundance. Commercial discards during 1984-1988 and the second half of 1992 were extrapolated from 1989-1991 and 1993 data; portions of the 1995-1996 estimates are based on long-term average rates. An exploratory VPA was tuned using a non-linear least squares technique to calibrate VPA estimates of numbers at age with the following research vessel trawl survey abundance indices: NEFSC winter, spring, and autumn, Massachusetts spring and autumn; Rhode Island autumn; Connecticut autumn, New York spring-autumn pooled, New Jersey spring-autumn pooled, and Virginia Institute of Marine Science. The SAW-25 SARC believed that the exploratory VPA integrated existing data to produce estimated trends in fishing mortality rates and biomass that were generally indicative of actual trends, but, due to gross inadequacies in the input data, rejected the exploratory VPA as a basis for formal projections. The SAW-27 SARC has made the same judgement about the adequacy of the scup VPA and projections. An exploratory ASPIC analysis using NEFSC spring and autumn biomass indices and catches during 1968-1997 was performed as an alternative to the VPA and to provide SFA reference points. Since this analysis suffers from the same input data inadequacies as the VPA, the exploratory ASPIC analysis was also rejected as a basis for current status, projections, or reference points.

Biological Reference Points: A yield-per-recruit analysis revised for this assessment with an assumed M of 0.20 indicates that F_{max} = 0.26 (21% exploitation rate). The SARC noted that reference points from the current yield-per-recruit analysis are subject to uncertainty due to effects of discarding on the fishery exploitation pattern for scup.

Fishing Mortality: The SARC concluded that reliable quantitative estimates of fishing mortality for scup are currently not available. The truncated age structure of fishery catches and historical low biomass indices from surveys indicate that the stock has been subject to prolonged high fishing mortality rates.

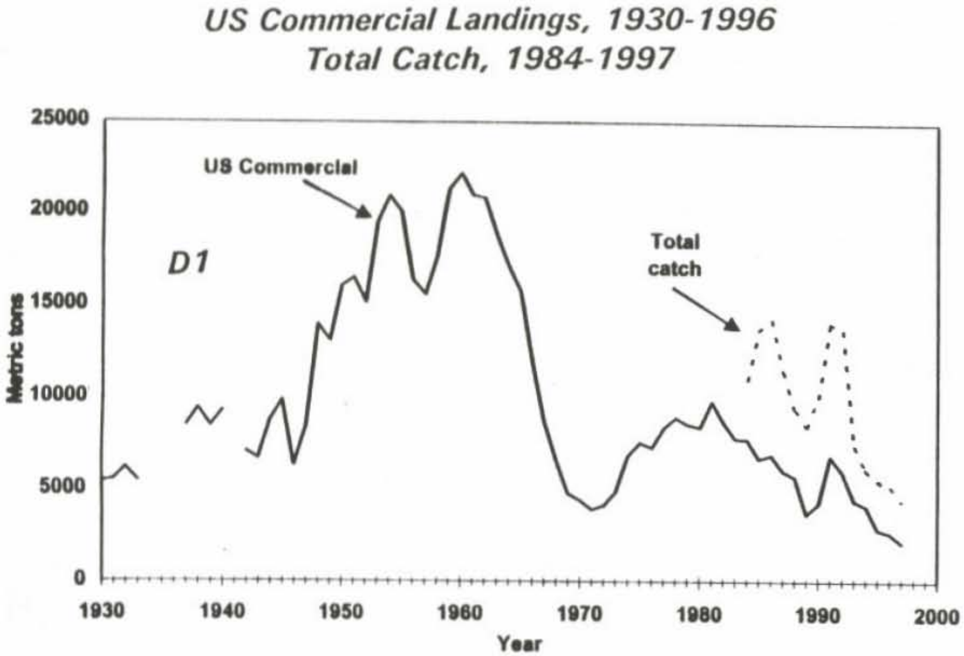
Recruitment: The 1996 index of age 0 abundance from the NEFSC autumn survey was the lowest of the 1984-1997 (age-based, inshore and offshore strata) series. The 1996 index of age 1 abundance from the NEFSC spring survey was the second lowest in the 1984-1997 (age-based, inshore and offshore strata) series (Figure D3). The RIDFW 1997 survey at age 0 and NEFSC 1998 winter and spring survey indices at age 1 indicate that the 1997 year class may be the largest since the 1994 year class.

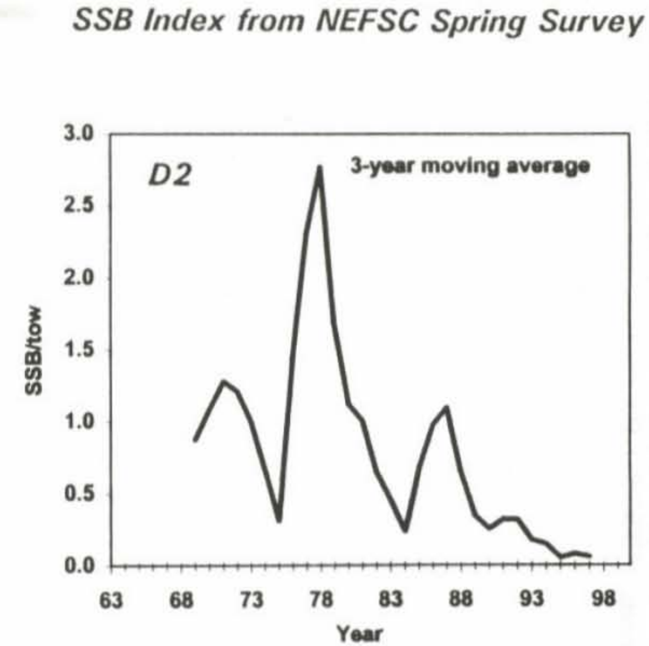
Spawning Stock Biomass: Indices of stock biomass and abundance for 1997 were among the lowest in the NEFSC, MA DMF, CT DEP, and NJ BMF research survey time series (Figures D2 and D4).

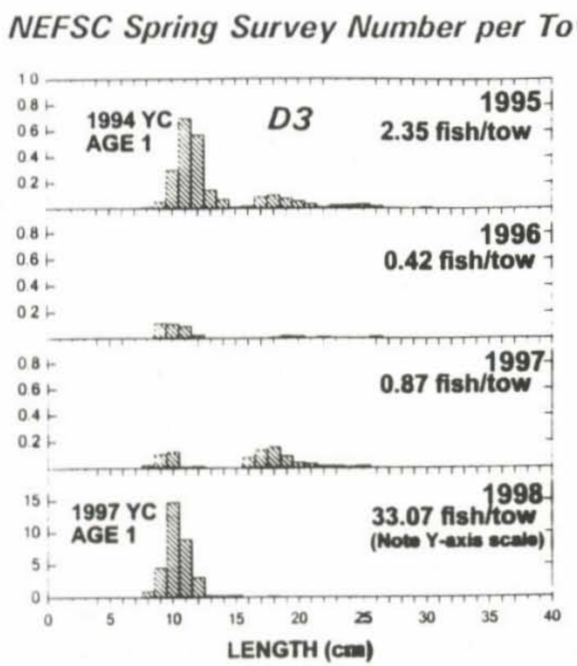
Special Comments: Due to limitations in the sea sampling data used to estimate and characterize the commercial discards, age compositions of the total catch and the estimates of fishing mortality and stock size derived from them are uncertain. The fishery appears to be targeted on immature fish of ages 0, 1, and 2. The possibility of a good incoming 1997 year class (age 1 in 1998, age 2 in 1999) increases the potential for significant discards in 1999 at age 2 even with current regulations.

Source of Information: Report of the 27th Northeast Regional Stock Assessment Workshop (27th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 98-xx.

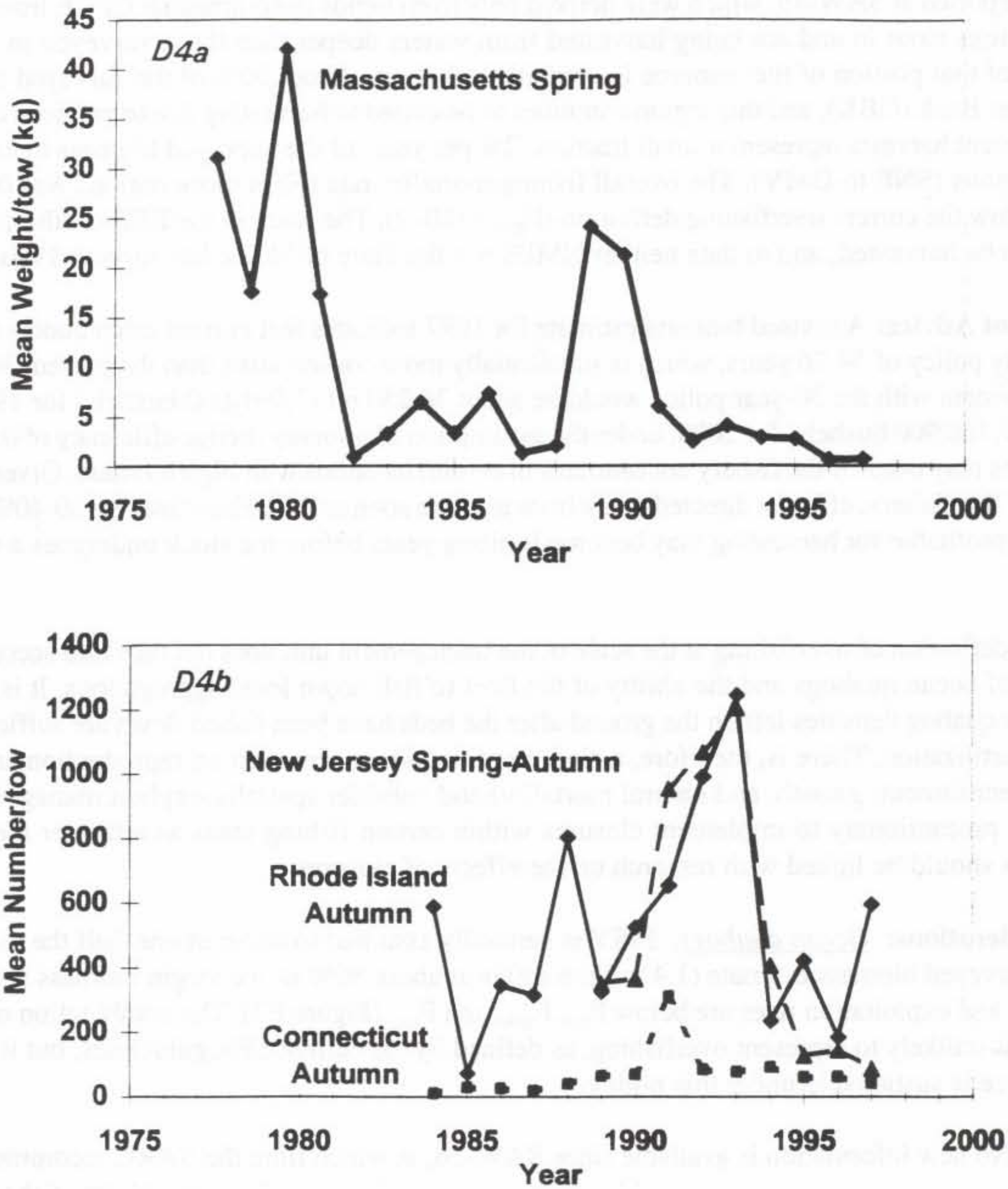
Scup


US Commercial Landings, 1930-1996
Total Catch, 1984-1997
D1
US Commercial
Total
catch
Metric tons
25000
20000
15000
10000
5000
0
1930
1940
1950
1960
1970
1980
1990
2000
Year


SSB Index from NEFSC Spring Survey
D2
3-year moving average
SSB/tow
3.0
2.5
2.0
1.5
1.0
0.5
0.0
63
68
73
78
83
88
93
98
Year


NEFSC Spring Survey Number per Tow
D3
1994 YC
AGE 1
1995
2.35 fish/tow
1996
0.42 fish/tow
1997
0.87 fish/tow
1997 YC
AGE 1
1998
33.07 fish/tow
(Note Y-axis scale)
LENGTH (cm)

Survey Biomass and Abundance Indices



E. OCEAN QUAHOG ADVISORY REPORT

State of Stock: The ocean quahog resource in surveyed EEZ waters from Southern New England (SNE) to Delmarva (DMV) is at a medium-high level of biomass and, according to the existing overfishing definition, would be considered under-exploited at the scale of the management unit. However, CPUE has declined substantially in localized areas (Figures E1-E4). Analysis of data from the 1997 survey, coupled with an estimate of dredge efficiency, led to revised estimates of ocean quahog biomass by region. These estimates are greater than those reported at SAW-19, which were derived only from trends in commercial CPUE from fished areas. Ocean quahogs exist in and are being harvested from waters deeper than those surveyed in 1997, but the magnitude of that portion of the resource is currently unknown. About 30% of the surveyed stock biomass is on Georges Bank (GBK), and this region continues to be closed to harvesting due to previous contamination by PSP. Current harvests represent a small fraction (2% per year) of the surveyed biomass in exploited Mid-Atlantic regions (SNE to DMV). The overall fishing mortality rate (F) in those regions was 0.021 in 1997, which is below the current overfishing definition ($F_{25\%} = 0.042$). The stock in the EEZ off the coast of Maine continues to be harvested, and to date neither NMFS nor the State of Maine has surveyed this region.

Management Advice: A revised biomass estimate for 1997 indicates that current catch quotas are consistent with a supply policy of 54-76 years, which is substantially more conservative than the present 30-year policy. Quotas consistent with the 30-year policy would be about 36,250 mt (7,991,600 bushels) for 1999 and about 35,240 mt (7,768,900 bushels) for 2000, under the assumption of a survey dredge efficiency of 0.43. However, local declines may occur if the fishery concentrates in certain locations with high biomass. Given the past performance of this fishery, effort is directed away from areas as soon as CPUE declines by 30-40%, so the number of areas profitable for harvesting may become limiting years before the stock undergoes a major decline in biomass.

The current definition of overfishing at the scale of the management unit does not take into account the sedentary nature of ocean quahogs and the ability of the fleet to fish down local aggregations. It is currently unknown if the quahog densities left on the ground after the beds have been fished down are sufficient to ensure successful fertilization. There is, therefore, a clear need to gain information on reproduction and population dynamics (recruitment, growth, and natural mortality) and consider spatially-explicit management policies. It would be precautionary to implement closures within certain fishing areas as a further measure of protection. This should be linked with research on the effects of closures.

SFA Considerations: *Ocean quahogs*. MSY is generally assumed to occur at one-half the virgin biomass. The 1997 surveyed biomass estimate (1.4 million mt) is at about 80% of the virgin biomass (1.8 million mt) (Figure E9), and exploitation rates are below $F_{0.1}$, $F_{20\%}$, and F_{max} (Figure E7). The combination of current biomass and F is unlikely to represent overfishing, as defined by the current SFA guidelines, but it is not known if the resource is sustainable under this policy.

Surfclams. No new information is available since SAW-26, at which time the SARC recommended that the catch associated with net production would maintain the population in the area(s) being fished.

Forecasts: *Supply-Year Model*. This model computes the annual catch that could be taken for *n* years, after which population size would be zero. This calculation is updated on an annual basis, so population size does not actually equal zero after *n* years. Therefore, it is more accurate to call this a "planning horizon" model in which harvest rates are continuously adjusted such that the population will always last for the duration of the planning horizon. The model makes assumptions about levels of natural mortality (M), recruitment, and growth (see table).

Results are given for four supply-year policies ranging from $n = 30$ to 76 years. The 30-year planning horizon represents the historical MAFMC policy for quota setting. The 54-, 63-, and 76-year policies represent 1999 catches of 5, 4.5, and 4 million bushels, respectively, which are in the range of recent annual harvests. According to the model, the starting biomass in the year 2000 would be at least 92% of the 1997 biomass estimate for all of these policies. For the 30-year policy, exploitation rates in 1999 and 2000 range from 3.9 to 4.0% in the exploited area, and equal 2.7% for the total surveyed stock. The longer supply-year policies are more conservative. All exploitation rates in the table are at or below the F-based reference points for this species (Figure E7).

Forecast Table from Supply-Year Model (starting value for 1997 exploitable biomass: 958,974 mt meats)

Supply-year policy	Year	Exploitable biomass (mt)	% of 1997 value	Total biomass (mt)	Catch (mt)	Annual exploitation rate (%)	
						Exploited areas	All areas
30	1999	919,612	95.9	1,329,596	36,249	3.9	2.7
	2000	883,116	92.1	1,292,606	35,239	4.0	2.7
54	1999	919,612	95.9	1,329,596	[1] 22,679	2.5	1.7
	2000	896,519	93.5	1,306,009	22,381	2.5	1.7
63	1999	919,612	95.9	1,329,596	[2] 20,411	2.2	1.5
	2000	898,759	93.7	1,308,249	20,193	2.2	1.5
76	1999	919,612	95.9	1,329,596	[3] 18,144	2.0	1.4
	2000	900,998	94.0	1,310,488	17,995	2.0	1.4

Model results are based on the following inputs: the exploited region is SNE-DMV; stock biomass includes all sizes, assuming a dredge efficiency of 0.43 and unrevised length/weight equations; GBK is unexploited and is 30% of initial stock biomass; annual recruitment by pre-recruits is 10,798 mt/yr in the exploited region and 4,628 mt/yr in the unexploited region, M = 0.02; instantaneous growth (g) rate of full recruits is 0.0076 per year; the 1998 catch is assumed to be 18,140 mt, the EEZ quota. [1]5 million bushels. [2]4.5 million bushels. [3]4 million bushels.

<u>*Production Model*</u>. A model of total biomass production and harvesting in the various assessment areas was developed based on annual biomass production from survey-based estimates. Annual production (biomass gain from individual growth) minus losses (natural mortality, landings, and unobserved fishing mortalities) was estimated for each area based on survey size compositions, revised length-weight parameters, growth equations (in shell length), swept-area population estimates from surveys, and natural mortality rates. The model was run using "original" and "augmented" size frequency distributions. The latter contain additional individuals in the small size classes to account for selectivity by the survey dredge.

Owing to the slow growth rate of this species and the dominance of large individuals in the survey samples, annual production is low even when revised length/weight equations are used. Given current harvest levels, the model results indicate losses of 1-3% per year in fished areas and a gain of 1-2% on unfished Georges Bank. For the entire stock, the annual change would be approximately -1% per year.

It must be cautioned that the production model results are highly uncertain owing to several factors. There is a likely negative bias in the productivity estimates because of the absence of small quahogs in the survey dredge catches and a preponderance of very old quahogs in the population whose net production is less than that of the small quahogs. Furthermore, the likely errors associated with the very low growth, recruitment, and natural mortality rates employed in the model (e.g., 1-2%), the 1-3% calculated production losses or gains, and the production/total biomass ratios of only 0.2-0.5% are near the limits of existing data to estimate and, consequently, render the results tenuous. Considerably more research will be required to improve the precision of these estimates before the production model results should be viewed as anything but preliminary.

Forecast Table from Production Model, short-term 1-year projection, (weights in mt): Ocean quahogs (all sizes)

Region	Size frequency	Annual production of biomass	Direct + indirect[1] annual landings	Current[2] biomass	Projected biomass	% change in biomass
GBK	Original	7,560	0	521,149	528,709	1.45
	[3]Augmented	10,268			531,417	1.97
SNE	Original	142	9,406	323,728	314,464	-2.86
	Augmented	1,588			315,910	-2.41
LI	Original	-1,635	5,387	487,570	480,548	-1.44
	Augmented	-1,276			480,907	-1.37
NJ	Original	-2,413	4,456	272,434	265,565	-2.52
	Augmented	-2,252			265,726	-2.46
DMV	Original	-442	1,111	59,812	58,259	-2.60
	Augmented	-366			58,335	-2.47
SVA	Original	0	0	60	60	-
	Augmented	0			60	-
Total[4] stock	Original	3,212	20,360	1,664,753	1,647,605	-1.03
	Augmented	7,963			1,652,356	-0.74

[1]Indirect landings are assumed to be 5% of the reported landings from 1997. [2]Biomass estimates include all sizes, are based on 1-mm size intervals and revised length/weight equations from 1997, and assume dredge efficiency = 0.43. [3]"Augmented" to account for low selectivity of small individuals. [4]Includes GBK.

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

Year	1990	1991	1992	1993	1994	1995	1996	1997	Max	Min	Mean
Quota: EEZ TAC	24.0	24.0	24.0	24.5	24.5	22.2	20.2	19.6	-	-	-
Landings[1]:											
EEZ	21.1	22.2	22.8	22.1	21.0	21.2	19.5	19.7	[2]23.6	[2]1.9	[2]17.7
SNE	0.9	0.9	1.1	1.0	1.0	5.4	8.3	9.0	[3]9.0	[3]0.6	[3]2.2
LI	0.7	1.7	11.9	8.7	12.0	9.5	5.9	5.1	[4]12.0	[4]0.1	[4]4.9
NJ	15.6	14.6	6.9	10.2	7.0	5.4	4.9	4.2	[5]15.6	[5]4.2	[5]8.7
DMV	3.4	4.8	2.4	2.0	1.0	0.7	0.7	1.1	[5]11.7	[5]0.7	[5]4.6
Tot S[6]	21.0	22.0	22.4	21.8	20.9	21.0	19.8	19.4	[5]22.4	[5]7.7	[5]17.9
ME[7]	-	0.2	0.1	-	0.1	0.2	0.2	0.1	0.1	0.2	0.2
Other	0.5	0	0.4	0.2	0	0	0	1.3			
Catch used in assessment:											
SNE	0.9	0.9	1.1	1.0	1.0	5.4	8.3	9.0			
LI	0.7	1.7	11.9	8.7	12.0	9.5	5.9	5.1			
NJ	15.6	14.6	6.9	10.2	7.0	5.4	4.9	4.2			
DMV	3.4	4.8	2.4	2.0	1.0	0.7	0.7	1.1			

[1]Landings are from all vessels classes except for Maine where small vessels are used. [2]Based on years 1976-1997. [3]Based on years 1983-1997. [4]Based on years 1986-1997. [5]Based on years 1978-1997. [6]"Tot S"= total southern area and includes GBK, SNE, LI, NJ, DMV, and SVA/NC. [7]Based on years 1991-1997.

Stock Distribution and Identification: Ocean quahogs are distributed on both sides of the Atlantic from the Bay of Cadiz of Southwest Spain intermittently across the North Atlantic and down the North American coast to Cape Hatteras. Commercial concentrations occur throughout the continental shelf area between Georges Bank and Cape Hatteras, at least to depths of 80 m (Figures E1 and E5). They also occur in deeper water, but quantitative surveys of abundance have not yet been conducted. Some concentrations also exist in the Gulf of Maine. No explicit studies of stock definition have been undertaken. However, given the extended larval life span of quahogs, animals on the southern shelf are likely components of a single population. Life history differences between Gulf of Maine and southern quahogs exist; environmental factors may play a large role in producing these differences.

Catches: Annual EEZ quotas have been set since 1978. EEZ landings generally account for about 95-100% of annual totals. Total EEZ landings of ocean quahogs increased from 0 in 1975 to 15.7 thousand mt (shucked meats) in 1979, and peaked at 23.8 thousand mt in 1985 (Figures E1 and E2). The spatial pattern of landings has changed markedly over the last two decades (Figures E1-E3) in response to a variety of factors including reductions in catch rate and relocations of processing plants. The fishery was concentrated off Delmarva and Southern New Jersey during the 1970s and until the mid-1980s. During the late 1980s and early 1990s, the fishery expanded northward first off Northern New Jersey, and then to the Long Island area. The fishery continued moving north and east and expanded to Southern New England in 1995. In 1997, 47% of the catches were from this area. Total landings in the Maine region are about 100 mt.

Data and Assessment: Ocean quahogs were last assessed in 1994 (SAW-19) using a modified Leslie-DeLury method, regressing cumulative catch in numbers on annual CPUE. The present assessment was based primarily on a refined swept-area biomass survey estimate measured in 1997, based on traditional length/weight equations. Kriging and bootstrapping procedures were used to estimate biomass. Dredge efficiency was estimated experimentally for commercial clam dredges, and that point estimate was applied to the survey data to estimate total biomass. Regional Fs (and exploitation rates) were computed and compared to reference point Fs and spatial and temporal trends in CPUE to determine the state of the stock and provide management advice. The CPUE data from 10-minute squares was used to characterize the typical fishing pattern over time. Survey data are not available for areas north of Georges Bank. Annual production of biomass was based on revised (1997) length/weight equations.

Biological Reference Points: Given new information on the length/weight relationship for ocean quahogs from 1997, the analysis of yield-per-recruit and spawning biomass-per-recruit reference points for LI were recomputed. The revised estimates are F_{max} = 0.065, $F_{0.1}$ = 0.022, and $F_{25\%}$ = 0.042. Estimates were similar to those reported previously. Note that these estimates were produced with a nominal M of 0.02, recruitment to the fishery at age 17, maturity between ages 5 and 11, and a plus group for individuals >99 years old. F levels resulting in zero net production, F_{P0}, are difficult to assess for ocean quahogs owing to uncertainty in the annual estimates of recruitment, natural mortality, and average instantaneous growth. The magnitude of each process is small, ranging between 1% and 2%, and is near the limitations of existing data to estimate.

Fishing Mortality: F for 1997 was estimated to be 0.021 for the exploited region (Southern New England through Delmarva) (Figure E7). Based on the 95% confidence interval (CI) associated with stock biomass in that region, the CI for F_{97} is 0.014 - 0.036. Point estimates of F_{97} by region are 0 (GBK), 0.035 (SNE), 0.013 (LI), 0.018 (NJ), 0.019 (DMV), and 0 (SVA/NC). F_{97} for the entire surveyed stock, including unexploited GBK, is 0.014.

Recruitment: "Recruits" are those individuals that will become fully recruited to the fishery given one year of growth. Based on commercial landings data, 80-mm shell length was chosen as the size of a fully-recruited ocean quahog. Owing to the extremely slow growth rate of this species at this length (0.54 mm/yr), the weighted average recruitment over all regions is low, estimated at 1.126% of the stock biomass (Figure E8). When small individuals have been found in recent NMFS surveys, the tows were taken primarily on Georges Bank and, to a lesser degree, off Southern New England and Long Island. Georges Bank may be a source of larvae to Southern New England. Likewise, offshore populations that have not been surveyed may contribute larvae to shallower areas.

Stock Biomass: Based on the 1997 survey (Figures E5 and E6), the minimum swept-area biomass (and 95% bootstrap confidence intervals) was 177.5 kmt (114.3 -238.3) on GBK, 112.7 kmt (45.0 - 207.3) in Southern New England, 171.8 kmt (107.0 - 232.2) off Long Island, 103.4 kmt (73.9 - 130.6) off New Jersey , and 24.5 kmt (15.0 - 36.2) off Delmarva. Additional biomass is likely to exist in deeper water, beyond the depth range of the NMFS survey gear in 1997. These estimates, based on traditional length/weight equations, can be converted to total surveyed biomass by dividing by dredge efficiency, which is approximately 0.43. Current stock is approximately 80% of the pristine biomass level.

Special Comments: Biomasses estimated in the current assessment are significantly larger than those previously reported. The current estimates are based on swept-area biomass calibrated for dredge efficiency and tow-path length. The information required for these calibrations was based on a joint NMFS-industry research program conducted in 1997. Earlier estimates were from analysis of CPUE from fished areas only.

Detection of changes in stock biomass from the historical survey data is difficult, owing to likely changes in dredge efficiency between surveys, difficulties standardizing the catch data for distance sampled per tow, and high levels of within-year sampling variance. In addition, changes in predicted biomass that would occur at current exploitation rates are small relative to the variation in population estimates. Owing to the slow growth of ocean quahogs and selectivity of the survey dredge, a cause-effect relationship between stock reductions and subsequent recruitment will take approximately 20 years to occur, and will be difficult to measure.

Initial application of geostatistical methods to NMFS survey data yielded nearly equivalent estimates to those using a bias-corrected bootstrap estimator of the stratified random survey design. Geostatistical methods improved precision and may be useful for finer-scale analysis of abundance and exploitation patterns.

Estimates of recruitment to the fishery were inferred from analysis of size composition in surveys over time, estimates of growth from the LI region, and an assumed knife-edge selection by the commercial fishing gear.

Profitability considerations in the industry appear to induce movement to new fishing areas when CPUE is reduced to less than 80 bushels per hr. Using basic information on towing speed and gear efficiency, these harvest rates imply residual densities of about 1.2 individuals per m^2.

Increases in price or improvements in harvest technology could result in increased harvest rates in areas now fished at low levels.

Sources of Information: NEFSC. 1995. Report of the 19th Northeast Regional Stock Assessment Workshop (19th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 95-08; Weinberg *et al.* 1994. Working Paper to 19th SARC, Assessment of ocean quahog resources off the Northeast United States, 1994; Kraus, M.G., B.F. Beal, S.R. Chapman, and L. McMartin. 1992. A comparison of growth rates in *Arctica islandica* (Linnaeus, 1767) between field and laboratory populations. J. Shellfish. Res. 11(2): 289-294; Murawski, S.A., J.W. Ropes, and F.M. Serchuk. 1982. Growth of the ocean quahog, *Arctica islandica*, in the Middle Atlantic Bight. Fish. Bull. 80(1): 21-34; Weinberg, J.R. 1993. Ocean quahog populations from the Middle Atlantic to the Gulf of Maine in 1992. NEFSC Ref. Doc. 93-02. 18 pp; NEFSC. 1996a. Report of the 22nd Northeast Regional Stock Assessment Workshop (22nd SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 96-13; NEFSC. 1996b. Report of the 22nd Northeast Regional Stock Assessment Workshop (22nd SAW), Public Review Workshop, NEFSC Ref. Doc. 96-16; NEFSC. 1998. Report of the 26th Northeast Regional Stock Assessment Workshop (26th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 98-03; Report of the 27th Northeast Regional Stock Assessment Workshop (27th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 98-03.

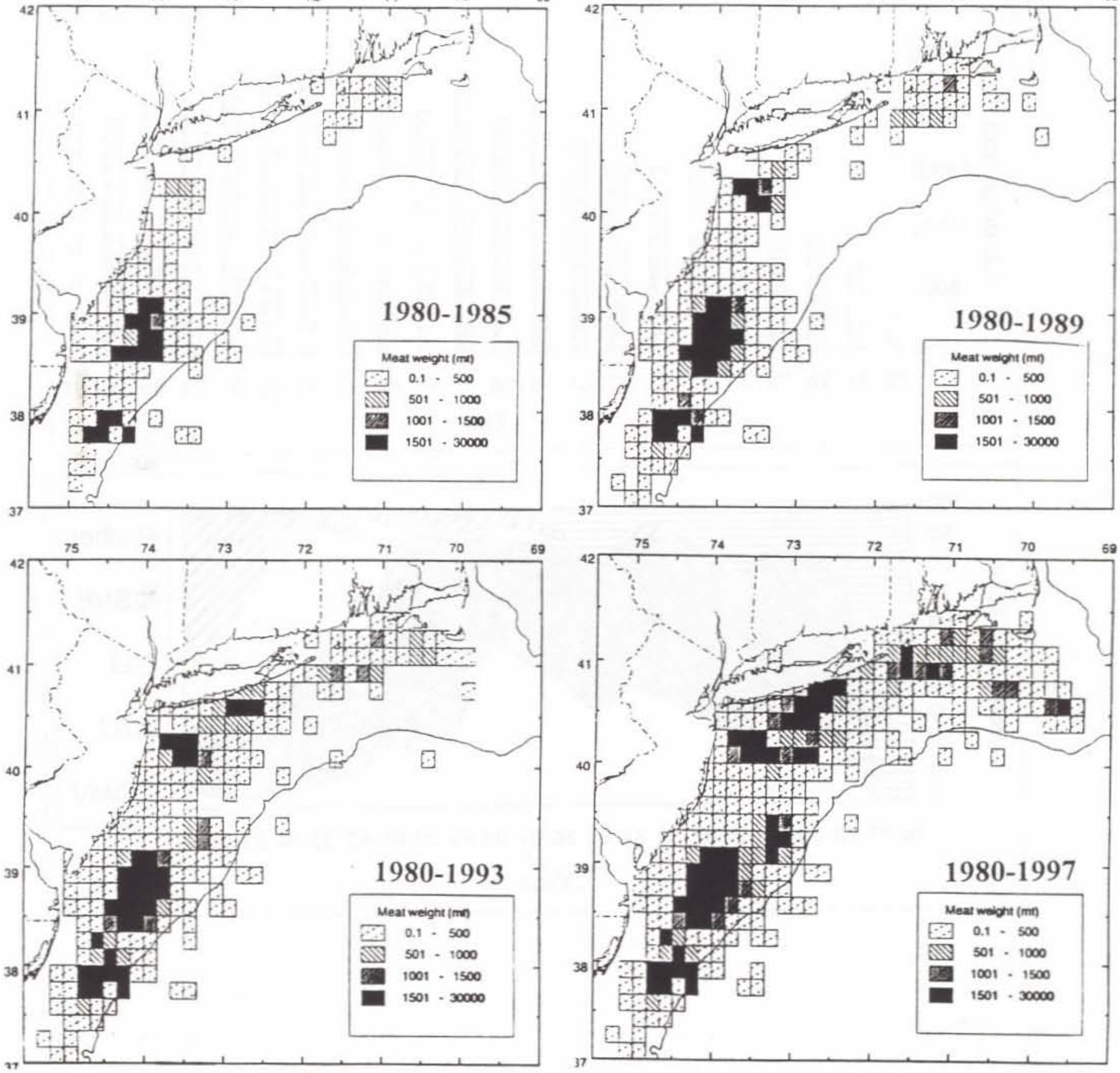


Figure E1. Maps of cumulative landings (mt of meats) of ocean quahogs by 10-minute square for 1980-1985, 1980-1989, 1980-1993, and 1980-1997.

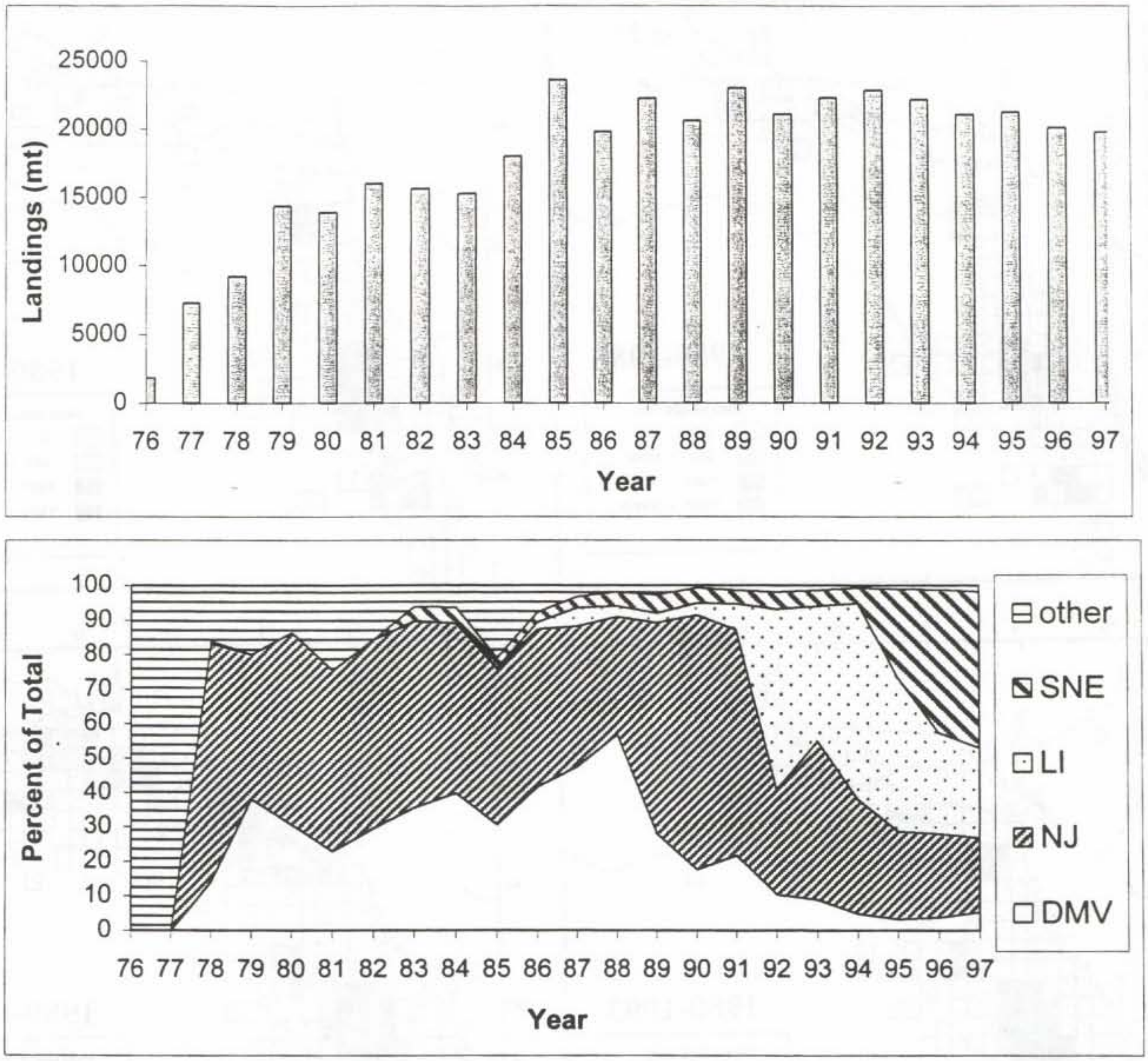


Figure E2. (a) Total landings of ocean quahogs from EEZ waters, 1976-1997 ('000 mt of meats) and (b) percent composition by region for Delmarva (DMV), New Jersey (NJ), Long Island (LI), and Southern New England (SNE).

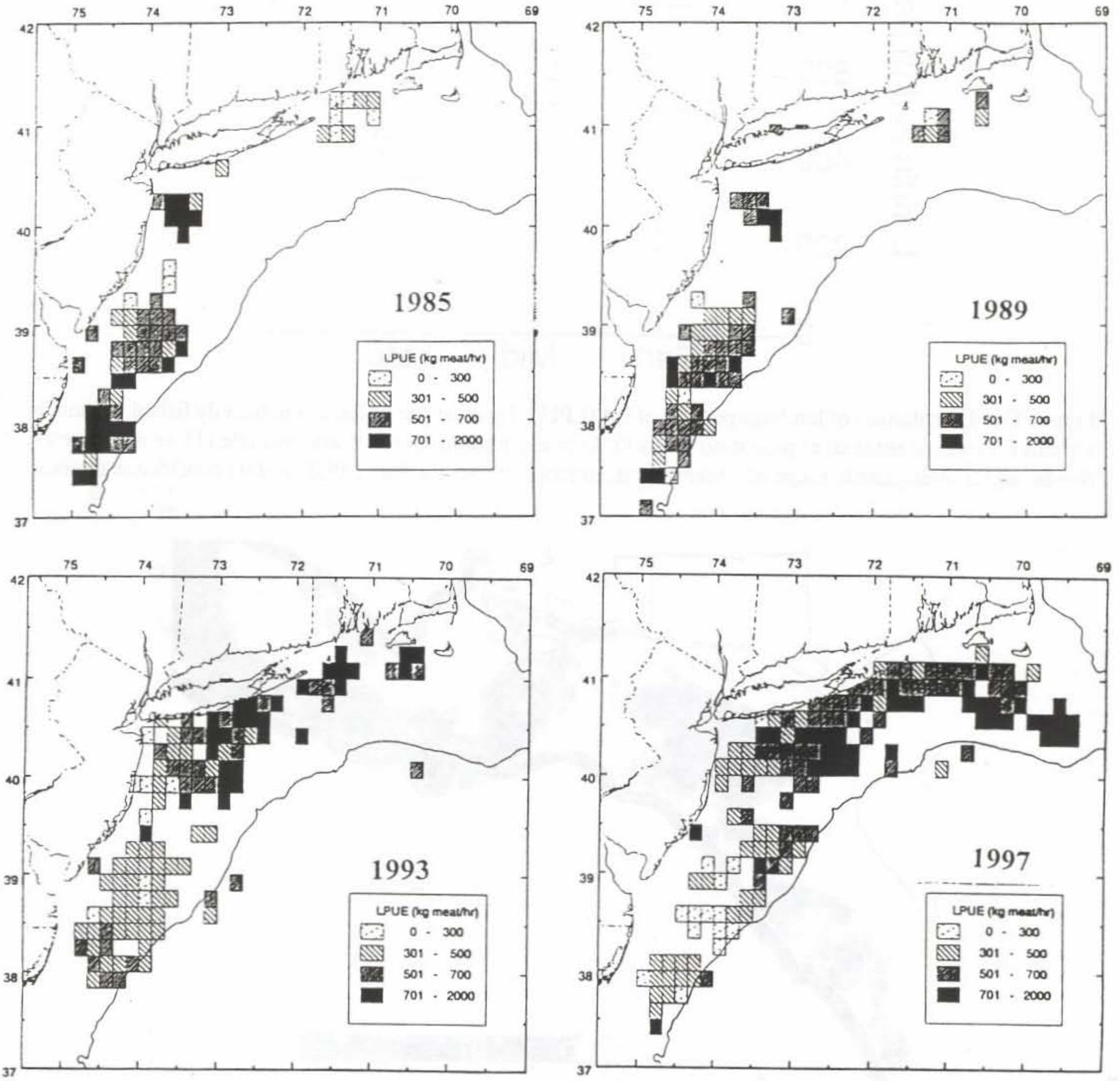


Figure E3. Maps of landings per unit effort (LPUE, kg meat per hr fished) of ocean quahogs by 10-minute square for 1985, 1989, 1993, and 1997.

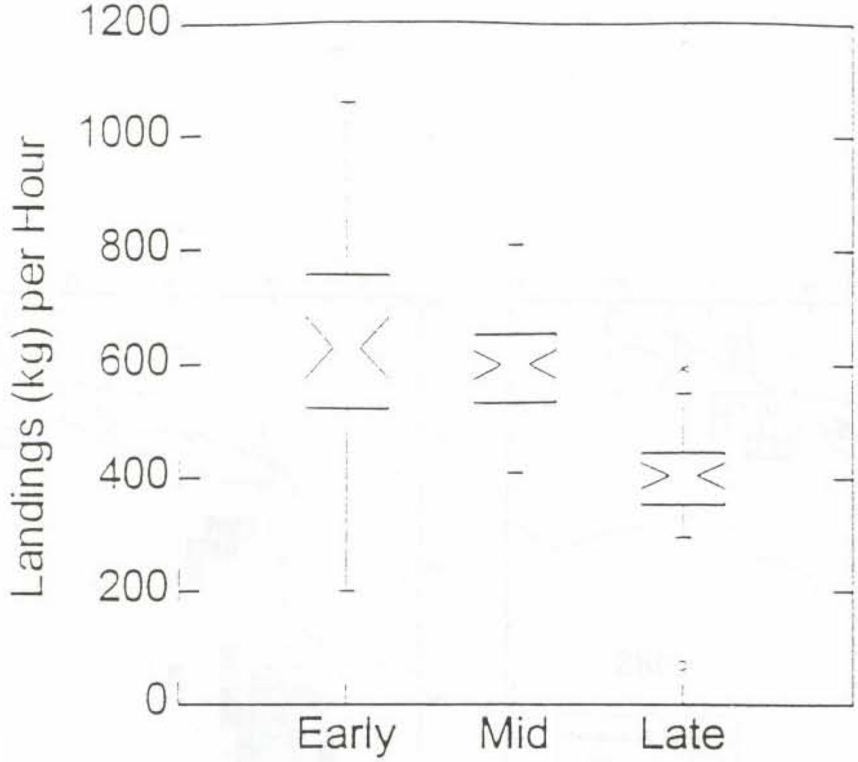


Figure E4. Distribution of landings per unit effort (LPUE, kg meat per hr fished) in heavily fished 10-minute squares for three stanzas of exploitation: early (1-4) years, middle (5-10) years, and late (11 or more) years. Boxes depict interquartile range of observations, notches denote median LPUE and its confidence interval.

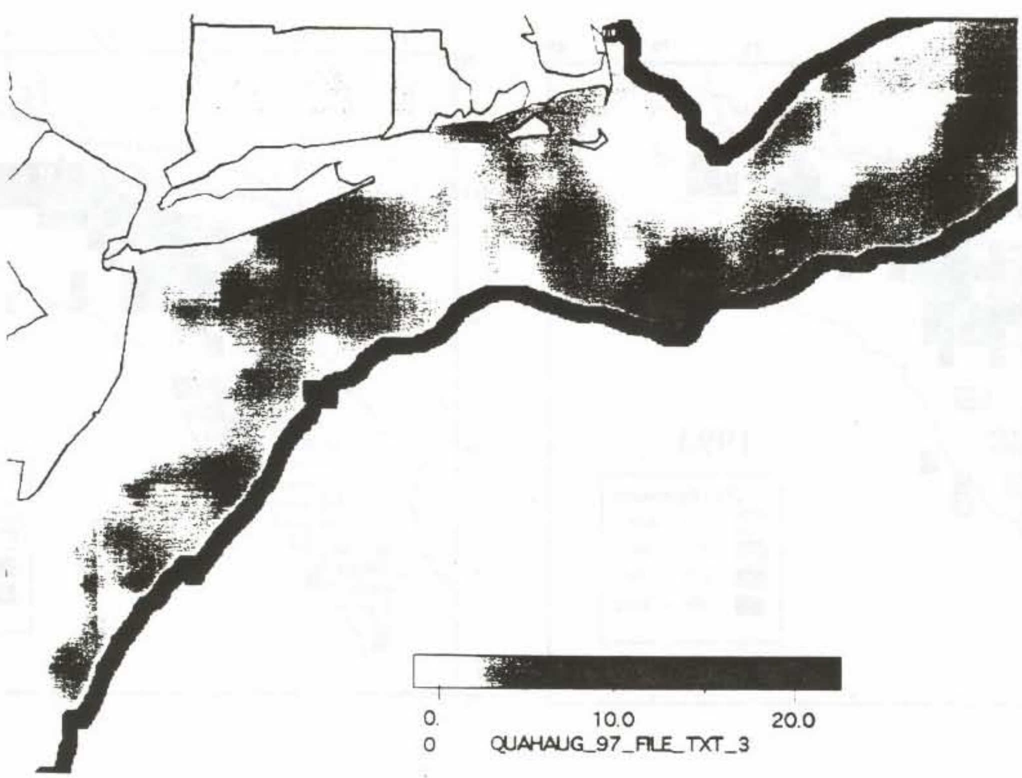


Figure E5. Map of ocean quahog catch per tow (kg meats) for 1997 based on geostatistical model (kriging). Level of resolution of a 5 x 5 km square.

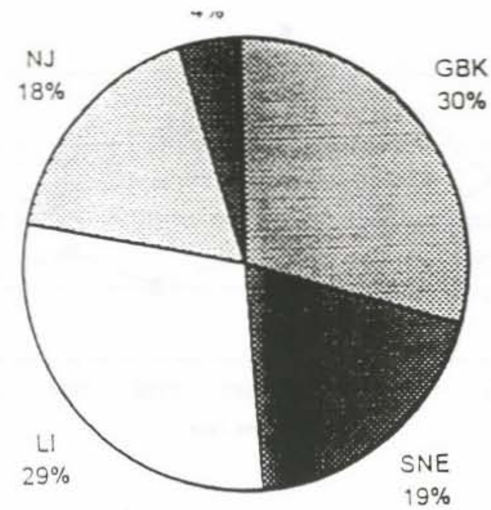


Figure E6. Percent of stock biomass by region based on the 1997 NMFS survey. Tows were standardized to 0.15 nm tow distance based on sensor data and assuming a 4 in critical blade depth.

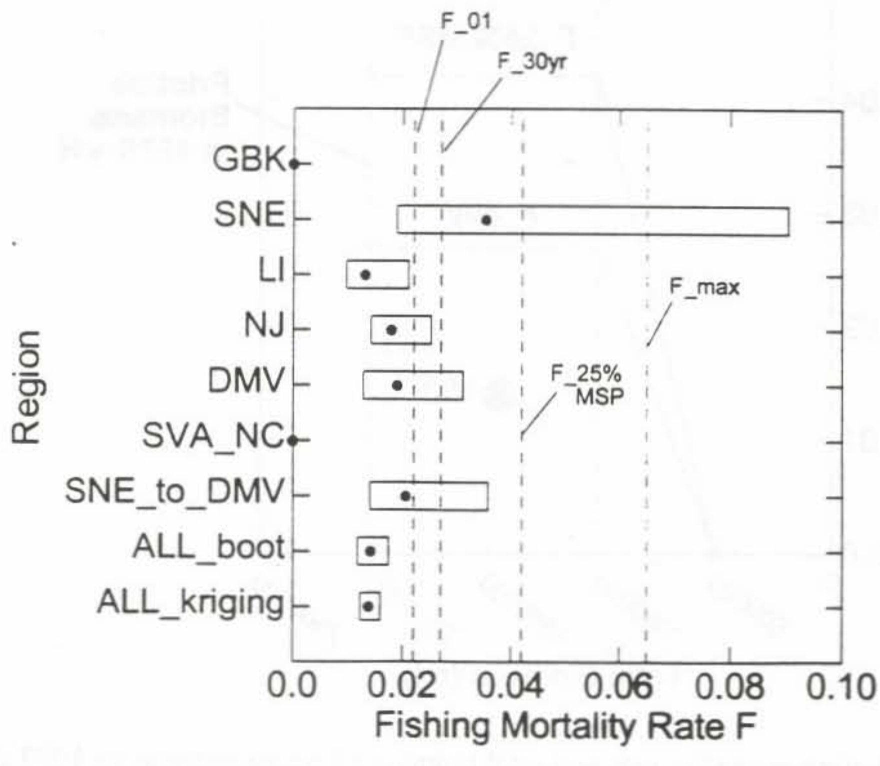


Figure E7. Comparison of estimated fishing mortality rates by region for ocean quahogs with alternative biological reference points. Dots represent the mean estimates, bars represent the lower and upper percentiles of 95% confidence intervals on F derived from bootstrap estimates of population biomass. For F estimates derived from kriging, the bars represent ±2 SD. Dashed lines represent alternative biological reference points.

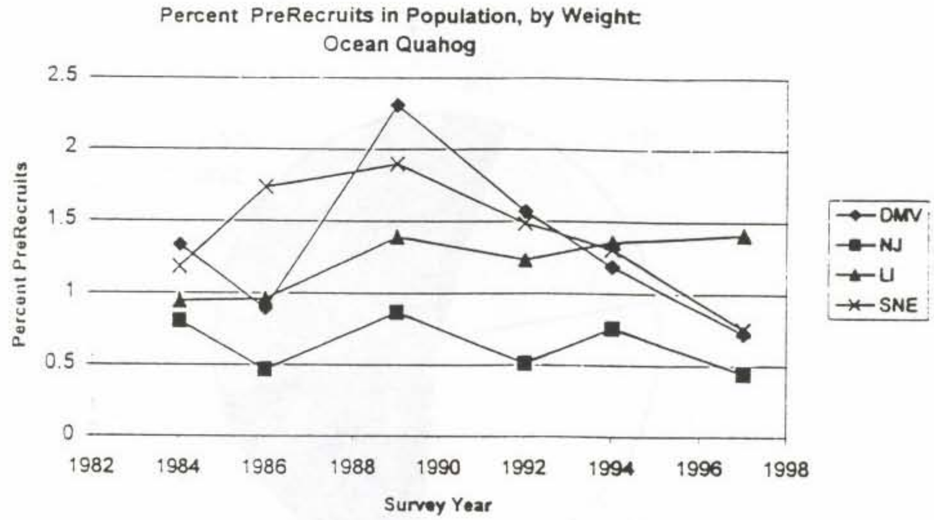


Figure E8. Estimated recruitment rates (percent of total population biomass) of ocean quahogs by region for 1984, 1986, 1987, 1992, 1994, and 1997 survey years. Recruits are defined as the number of individuals below 80 mm that are expected to exceed 80 mm within 1 year (i.e., total number of individuals that grow into exploitable range with 1 year).

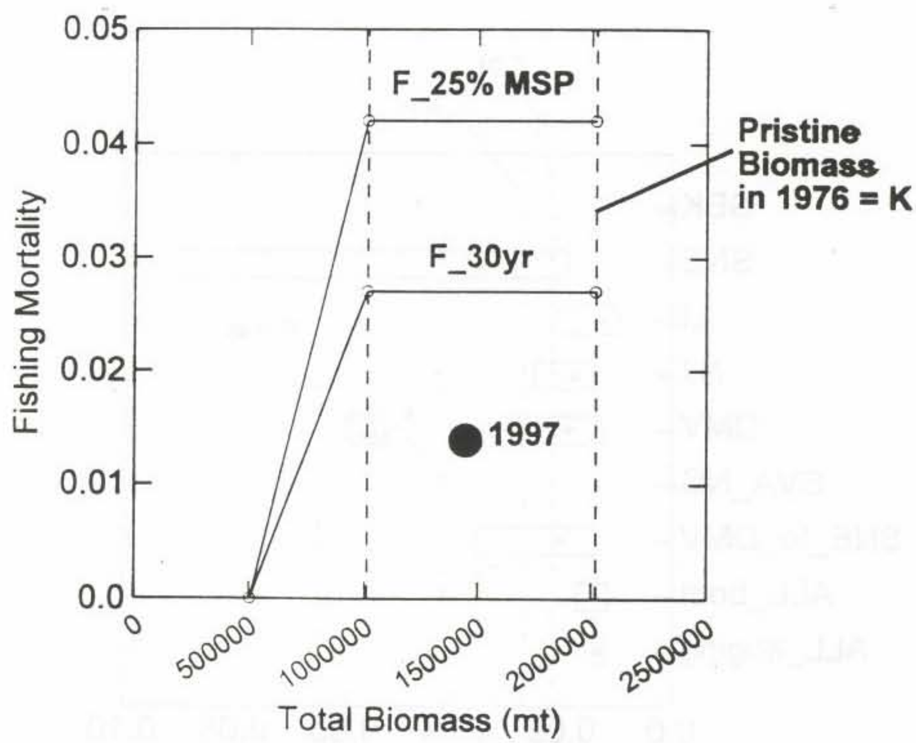


Figure E9. Estimated fishing mortality rate and total biomass of ocean quahogs in 1997 (filled circle) in relation to fishing mortality biomass thresholds and targets. Pristine biomass (K) in 1976 (right dashed line) is estimated via back-calculation method using 1997 population estimate and cumulative harvests. B_{msy} (left dashed line) is estimated as ½K. Horizontal lines represent two alternative fishing mortality thresholds. Sloped lines represent implied fishing mortality rates for population biomass levels between ¼K and ½K.

F. GULF OF MAINE COD ADVISORY REPORT

State of Stock: This stock continues to be over-exploited, and biomass has declined to an extremely low level. The three successive year classes (1994-1996) which recruited to the fishery between 1996 and 1998 are by far the lowest ever observed. In addition, the survival of pre-recruits (as indexed by R/SSB survival ratios) has been declining over the last four years and is now at an all-time low. Fishing mortality has been very high (in excess of F = 0.88 or 54% exploitation) between 1983 and 1996), while spawning stock biomass has declined to a new record low in 1997. There is a 90% probability that the 1997 F was greater than 0.57 (40% exploitation), or about 1.5 times greater than the overfishing definition ($F_{20\%}$ = 0.41 or 31% exploitation) and about twice the rebuilding level (F_{max} = 0.29 or 23% exploitation).

Management Advice: The SARC recommends an immediate reduction in fishing mortality to near zero. Measures should be implemented immediately to cease all directed fishing and minimize bycatch on this stock. Measures implemented in 1998 were only intended to achieve F_{max}. Reductions to F_{max} will be insufficient to promote rebuilding from record low spawning stock biomass. The combined effects of low spawning stock biomass, high fishing mortality, record low recruitment, and record low survival of pre-recruit fish indicate that the stock is collapsing.

SFA Considerations: The current (1997) total stock biomass of 11,300 mt is less than one-third of the proposed B_{msy} of 33,000 mt and is projected to decrease further in 1998 (7,900 mt) to less than the proposed minimum biomass threshold of ¼B_{msy} (8,300 mt). Total stock biomass is projected to increase to about 8,900 mt in 1999, but this increase is predicated on the assumed recruitment for 1998 and 1999, which is higher than that observed in the last several years. The current overfishing definition in Amendment 7 is inconsistent with the requirements of the SFA. According to the proposed control rule for this stock based on SFA requirements, fishing mortality should be reduced to near zero.

Forecast for 1998-2000: The forecasts were performed assuming that fishing mortality in 1998 was the same as in 1997 (i.e., F = 0.75 or 48% exploitation). This fishing mortality rate implies that commercial landings in 1998 will be about 3,800 mt and the SSB in 1999 will decline to less than 6,000 mt (Figure F4).

Forecast Table: Basis: F_{98} = 0.75 (*status quo* F_{97} from tuned VPA); SSB estimated to be 8,600 mt in 1997; age 2 recruitment in 1999 and 2000 (1997 and 1998 year classes) estimated from the distribution of observed age 2 stock sizes during 1995-1997 (median = 1.34 million) (weights in '000 t).

1998				1999		2000	
F	Landings	SSB	$F_{1999\text{-}2000}$	Landings	SSB	SSB	Consequences/Implications
0.75	3.8	6.6	0.00	0.0	6.0	8.0	SSB in 2000 increases slightly above 1998 level; landings prohibited in 1999
			0.16 ($F_{0.1}$)	0.8	5.8	7.1	SSB in 2000 increases slightly above 1998 level; landings decline to record low in 1999
			0.29 (F_{max})	1.4	5.7	6.4	SSB in 2000 increases but remains below 1998 level; landings decline to record low in 1999
			0.41 ($F_{20\%}$)	1.9	5.6	5.8	SSB in 2000 remains at record low 1999 level; landings decline to record low in 1999
			0.75 (F_{98})	3.0	5.4	4.4	SSB in 2000 declines precipitously to new record low

Catch and Status Table (weights in '000 t, recruitment in millions): Gulf of Maine Cod

Year	1990	1991	1992	1993	1994	1995	1996	1997	Max[1]	Min[1]	Mean[1]
USA commercial landings	15.2	17.8	10.9	8.3	7.9	6.8	7.2	5.4	17.8	5.4	10.3
Otter trawl	10.4	13.0	7.3	4.9	4.2	3.5	4.0	2.8	13.0	2.8	6.6
Sink gillnet	4.4	4.2	3.1	3.1	3.3	3.1	2.8	2.2	4.4	2.2	3.3
Handline/line trawl	0.2	0.3	0.5	0.3	0.3	0.3	0.3	0.4	0.5	<0.1	0.2
Other gear	0.2	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	<0.1	0.1
Canada commercial landings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other commercial landings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total commercial landings	15.2	17.8	10.9	8.3	7.9	6.8	7.2	5.4	17.8	5.4	10.3
Discards[2]	3.6	1.1	0.6	0.3	0.2	0.4	0.2	0.2	[3]3.6	[3]0.2	[3]1.0
US recreational landings[2]	2.8	2.9	0.6	1.2	0.9	0.8	0.9	0.3	2.9	0.3	1.4
Catch used in assessment	15.2	17.8	10.9	8.3	7.9	6.8	7.2	5.4	17.8	5.4	10.3
Spawning stock biomass[4]	22.3	19.9	13.0	10.1	12.2	14.3	12.6	8.6	26.1	8.6	15.8
Recruitment (age 2)	2.8	2.8	4.8	4.4	6.8	2.8	1.3	0.9	17.7	0.9	[5]4.4
F (ages 4-5,u)	0.88	1.00	1.08	0.89	2.03	1.07	0.95	0.75	2.03	0.59	1.02
Exploitation rate	54%	58%	61%	54%	81%	61%	56%	48%	81%	41%	59%

[1]Over period 1982-1997. [2]Not used in assessment. [3]Over period 1989-1997. [4]At beginning of the spawning season. [5]Geometric mean.

Stock Distribution and Identification: Gulf of Maine cod are distributed from Massachusetts Bay north along the coast of Maine to the Bay of Fundy and eastward across the Gulf of Maine. Cod are found in most depths in the Gulf of Maine throughout the year, but appear to form coastal concentrations in summer months. Gulf of Maine cod are distinguished from those on Georges Bank by a slower rate of growth and later age at full sexual maturation.

Catches: Commercial landings increased in the mid 1970s and early 1980s, reaching 14,000 mt in 1983. Landings declined during 1974-1986, increased to record highs in 1990 and 1991, but have since declined sharply (Figure F1). Total commercial landings in 1997 were 5,421 mt and are expected to decline to less than 4,000 mt in 1998. Discards in the commercial fishery have ranged from an estimated 200 mt to over 3,600 mt per year since 1989. Landings of cod from the recreational component have averaged 1,500 mt per year since 1982.

Data and Assessment: Analytical assessment (VPA) of commercial landings-at-age data tuned with the ADAPT method using standardized NEFSC and Massachusetts DMF spring and autumn survey catch-per-tow-at-age data. Standardized US commercial LPUE indices were employed only through 1993 due to a change in the effort data collection methods in 1994-1996. The precision and uncertainty associated with the estimates of fishing mortality and spawning stock biomass in 1996 were quantitatively evaluated.

Biological Reference Points: Yield- and SSB-per-recruit analyses performed with an assumed M of 0.20 indicate that $F_{0.1} = 0.16$ (13% exploitation), $F_{max} = 0.29$ (23% exploitation), and $F_{20\%} = 0.41$ (31% exploitation) (Figure F3). The Amendment 7 overfishing definition ($F_{20\%}$) is slightly higher than previous estimates because of an accelerated maturation schedule employed in the SSB/R analysis. The SARC notes that the current overfishing definition is inconsistent with the requirements of the SFA. The Overfishing Definition Review Panel has proposed that B_{msy} = 33,000 mt, MSY = 10,400 mt, and $F_{msy} = 0.31$ (biomass-weighted age 1+).

Fishing Mortality: Fishing mortality remained very high (in excess of F = 0.88 or 54% exploitation) between 1983 and 1996 (Figure F1), declined slightly in 1997 to 0.75 (48% exploitation), but continues to be far in excess of F_{max}, the current rebuilding objective. Accounting for the uncertainty associated with the 1997 F estimates, there is an 80% probability that the 1997 F lies between 0.57 (40% exploitation) and 1.00 (58% exploitation) (Figure F5).

Recruitment: The 1987 year class was the strongest during the assessment period, although survey data suggests that even stronger year classes occurred in the 1970s. Year classes subsequent to 1987, except for 1992, are generally well below average. The most recent year classes (1994, 1995, and 1996) are by far the poorest in the VPA time series, averaging less than 1 million age 2 fish (Figure F2). Since 1992, each year class has been approximately one-half the size of its immediate predecessor. Survival ratios (R/SSB) have also been declining at about the same rate over the last four years and are now at an all time low.

Spawning Stock Biomass: SSB declined by nearly 40% between 1982 (22,400 mt) and 1987 (14,100 mt), and increased to a relatively high level of 26,100 mt in 1989 due to recruitment of the strong 1987 year class to the spawning stock. SSB declined to 10,100 mt in 1993, increased slightly through 1995, but has since fallen to a record-low 8,600 mt in 1997 (Figure F2). Accounting for the uncertainty associated with the 1997 SSB estimates, there is an 80% probability that the 1997 SSB lies between 7,700 mt and 10,900 mt (Figure F6). Survey data (Figure F7) suggest that SSB has declined by 80% since the early 1960s.

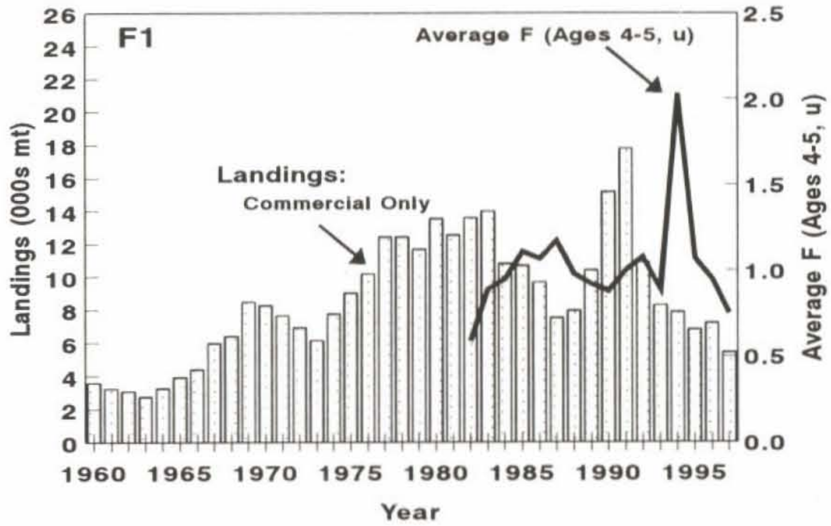
Special Comments: The SARC is particularly concerned about the recent trend in recruitment as each of the last four successive year classes has been about one-half the strength of its immediate predecessor. The recent decline in SSB can be expected to continue as these year classes comprise the majority of the remaining spawning stock.

A revision to the maturity schedule employed in the 1998 assessment reflects an earlier maturation of age 3 fish since 1994. This has resulted in slightly higher SSBs in recent years compared to the 1997 assessment, although stock size estimates have not changed appreciably.

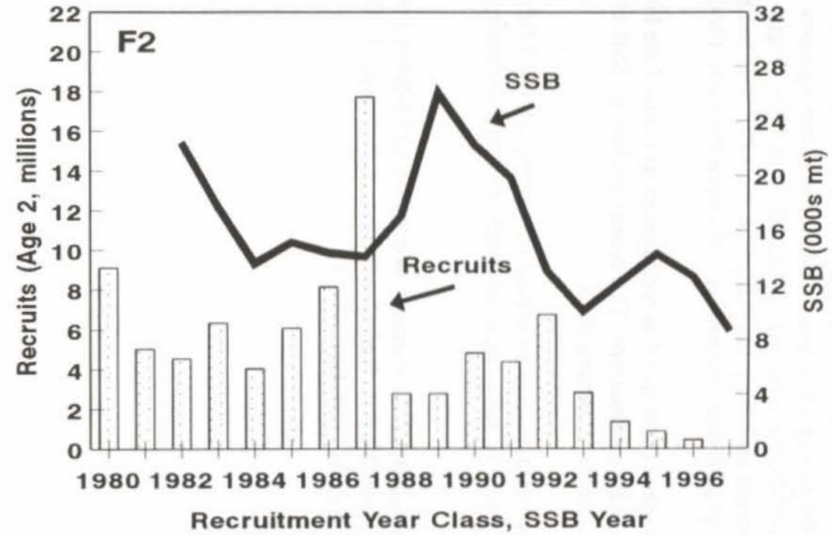
Source of Information: Report of the 27th Northeast Regional Stock Assessment Workshop (27th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 98-xx; R.K. Mayo, L. O'Brien, and S.W. Wigley, Assessment of the Gulf of Maine cod stock for 1998, NEFSC Ref. Doc. 98-xx.

Gulf of Maine Cod

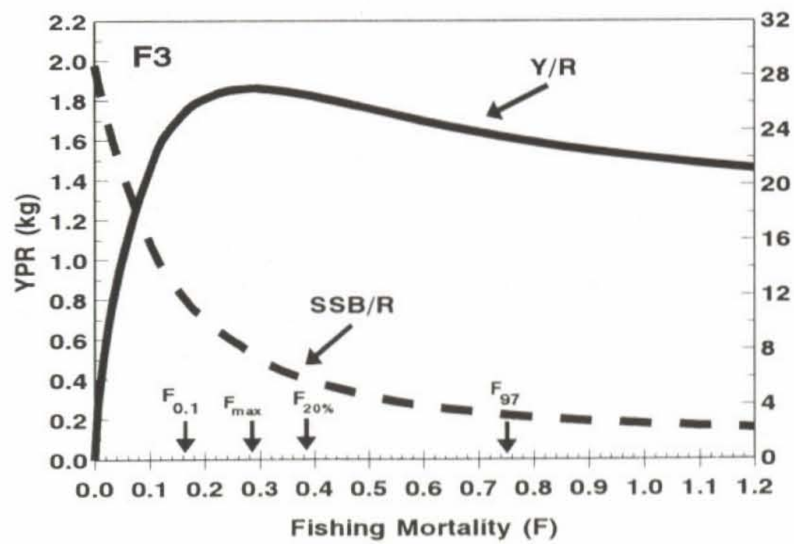
Trends in Landings and Fishing Mortality



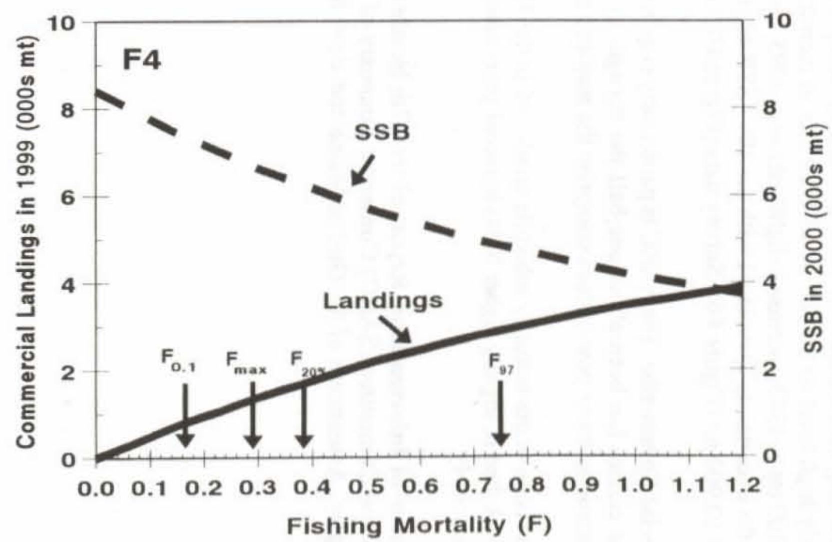
Trends in Spawning Stock Biomass and Recruitment



Yield and Spawning Stock Biomass per Recruit

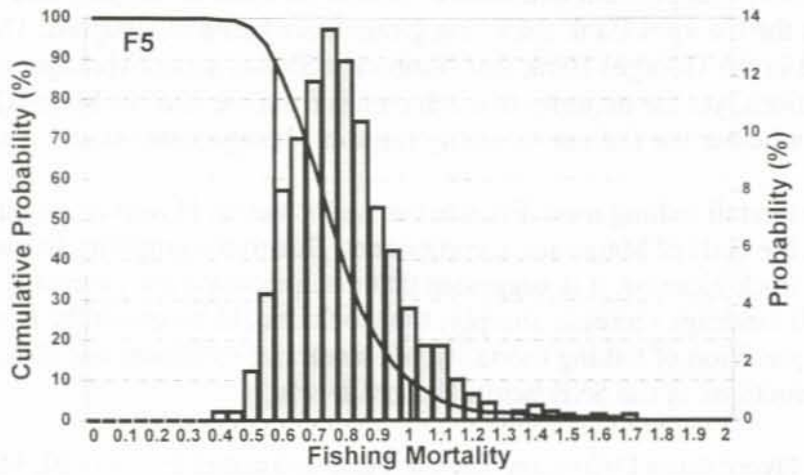


Short-Term Commercial Landings and Spawning Stock Bioma

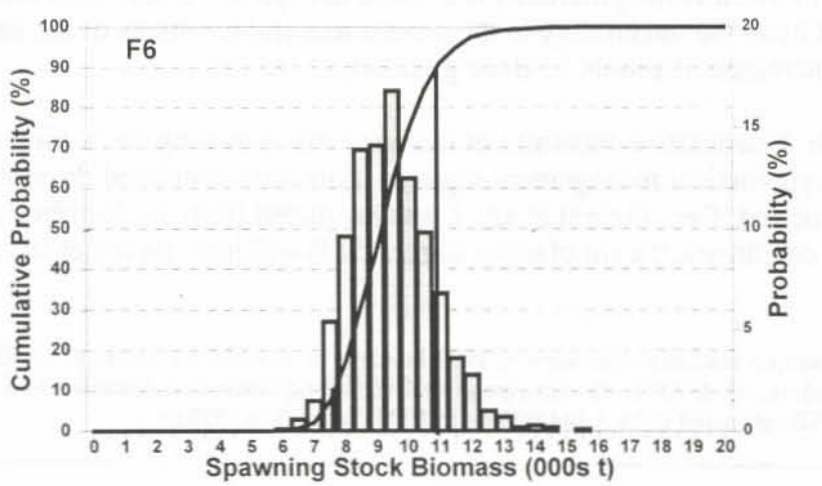


Gulf of Maine Cod

Precision of 1997 F Estimate



Precision of 1997 SSB Estimate



G. ATLANTIC HERRING ADVISORY REPORT

State of Stock: The stock complex is at a high biomass level and is under-exploited. Fishing mortality (F) in 1997 decreased to a record low (Figure G1), while spawning stock biomass (SSB) in 1997 increased to a record high (Figure G2). Fishery-independent abundance indices continue to suggest that the stock complex is increasing in size and that the Georges Bank spawning grounds are being reoccupied. The majority of biomass appears to be centered in the Georges Bank and Nantucket Shoals areas (Management Areas 2 and 3) based on swept-area calculations, yet the majority of catch comes from the Gulf of Maine (Management Area 1). It is currently unknown whether the fishing mortality rates in Management Area 1 are sustainable.

Management Advice: The overall fishing mortality rate can be increased. However, any increases in herring catch should not come from the Gulf of Maine stock component. Due to uncertainties in the estimates of fishing mortality and spawning stock biomass, it is suggested that catch increase incrementally so that the impact on SSB can be evaluated. If landings increase sharply, the stock should be carefully monitored. Increased catches should improve the precision of fishing mortality and stock size estimates and thus allow adjustments in management to avoid reductions in the SSB below desired levels.

SFA Considerations: The Overfishing Definition Review Panel estimated $F_{msy} = 0.30$, MSY = 317,000 mt, and $B_{msy} = 1.07$ million mt based on a surplus production model. However, the SARC had reservations about the application of this model to a stock complex, given the likely differences in productivity of the individual components. The SARC proposes $F_{0.1} = 0.20$ as an alternative proxy for F_{msy}. Alternative estimates of MSY and B_{msy} were calculated using average recruitment and yield per recruit. Depending on the years considered in this analysis, the MSY based on geometric mean recruitment ranged from 108,000 to 290,000 mt. There is no firm basis to select within this range, but it would not be prudent to consider MSY to be above 200,000 mt or B_{msy} to be above 1.5 million mt until the sizes of recent year classes are better estimated. Although F_{97} for the entire stock complex is likely below the proposed F_{msy} ($F_{0.1} = 0.20$), harvesting has been concentrated in the Gulf of Maine and, consequently, the reference level may already be exceeded for this stock component, as indicated by an untuned VPA for the Gulf of Maine stock component. Current (1997) total stock biomass (3.0 million mt) for the stock complex is above the B_{msy} reference point. However, this is due to very high recruitment since the early 1990s. If fishing mortality is allowed to expand too fast, this could have a detrimental impact on the complex. Given the uncertainty in the assessment and the status of the various stock components, if exploitation is increased, it should be done gradually.

Forecast for 1998-2000: Quantitative forecasts of landings and spawning stock biomass are provided for 1998-2000 under three hypothetical management regimes. Forecasts simulated three scenarios of constant landings levels over the period. Recruitment at age 1 was estimated from the distribution of the 1986-1993 year classes. Under these conditions, the simulations suggest SSB will increase under any of the constant landings scenario.

Forecast Table: Basis: *Status quo* landings equivalent to 1997 landings of 119,000 mt: landings of 200,000 mt correspond to SARC estimate of MSY; landings of 317,000 mt correspond to Overfishing Definition Review Panel estimate of MSY from calibrated ASPIC analysis; SSB estimated to be 2,444,000 mt in 1998 (weights in '000 mt).

1998			1999			2000			
F	Landings	SSB	F	Landings	SSB	F	Landings	SSB	Consequences/Implications
0.031	119	2,444	0.029	119	3,170	0.028	119	3,715	SSB increases about 52% from 1998 to 2000
			0.049	200	3,121	0.048	200	3,589	SSB increases about 47% from 1998 to 2000
			0.078	317	3,051	0.080	317	3,405	SSB increases about 39% from 1998 to 2000

Catch and Status Table (weights in '000 mt, recruitment in billions): Atlantic Herring

Year	1990	1991	1992	1993	1994	1995	1996	1997	Max[1]	Min	Mean
US commercial landings	57.0	55.3	61.2	57.1	54.3	85.5	108.6	97.8	436.4	25.0	122.8
Canada commercial landings	38.8	24.6	32.0	31.6	22.2	18.2	15.9	20.6	44.1	8.7	25.6
Discards	1.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.2
Catch used in assessment	97.2	80.8	93.2	88.7	76.6	103.8	124.5	118.4	469.6	36.5	147.4
Spawning stock biomass	143	161	196	363	638	787	939	1,838	1,838	19	293
Recruitment (age 1)	3.9	8.8	6.4	3.6	4.5	29.2	8.9	24.8	29.2	0.4	[2]2.7
F (ages 3-7)	0.36	0.23	0.21	0.18	0.15	0.15	0.08	0.05	1.12	0.05	0.49
Exploitation rate	30%	21%	19%	16%	14%	14%	8%	4%	67%	4%	36%

[1]Max, min, and mean for assessment time series, 1967-1997. [2]Geometric mean.

Stock Identification and Distribution: Herring which spawn off Southwest Nova Scotia, on Georges Bank and Nantucket Shoals, and in coastal waters of the Gulf of Maine have historically been recognized as separate stocks. Historical assessments were specific to either the Georges Bank/Nantucket Shoals stock or the Gulf of Maine stock. However, the early Gulf of Maine stock assessments were tuned with the spring bottom trawl survey data even though it was recognized at the time that herring from both stocks mixed in unknown proportions south of Cape Cod in the winter and spring. It was precisely for this reason that this approach was abandoned in 1991 in favor of a single assessment for the Atlantic coast stock complex.

Catches: Commercial landings were at their highest levels during the 1960s and 1970s during the period the offshore fishery for herring on Georges Bank was still in existence (exceeding 400,000 mt in 1968). After the Georges Bank spawning stock collapsed, the landings for the stock complex leveled off between 50,000 and 100,000 mt per year throughout the 1980s, but increased to about 120,000 mt in 1996 and 1997 (Figure G1).

Data and Assessment: An analytical assessment (VPA-ADAPT methodology) of commercial landings-at-age and discard data was conducted. Catch data from US commercial fisheries, New Brunswick (Canada) fixed-gear fisheries, distant water fleets, IWP, and discards from US mackerel JV fisheries were used to develop the catch-at-age matrix. Mean weights at age were determined from US coastal fisheries only. Information on abundance and size of the spawning stock was taken from NEFSC spring and winter surveys of catch per tow disaggregated by age.

Biological Reference Points: Preliminary biological reference points for herring were calculated based on a non-equilibrium surplus production model (ASPIC). MSY for the coastal stock complex was estimated to be 317,000 mt, with an associated B_{msy} of 1.07 million mt, and $F_{msy} = 0.30$. Biological reference points for herring based on an exploitation pattern estimated by separable VPA indicate that $F_{0.1} = 0.20$ (18% exploitation), $F_{max} = 0.40$ (33% exploitation), and $F_{20\%} = 0.34$ (29% exploitation) (Figure G3).

Fishing Mortality: Fishing mortality exceeded 0.75 for a number of years immediately following the stock collapse of the 1970s. However, F has been less than 0.1 for the past two years (Figure G1). Current fishing mortality is well below all biological reference points.

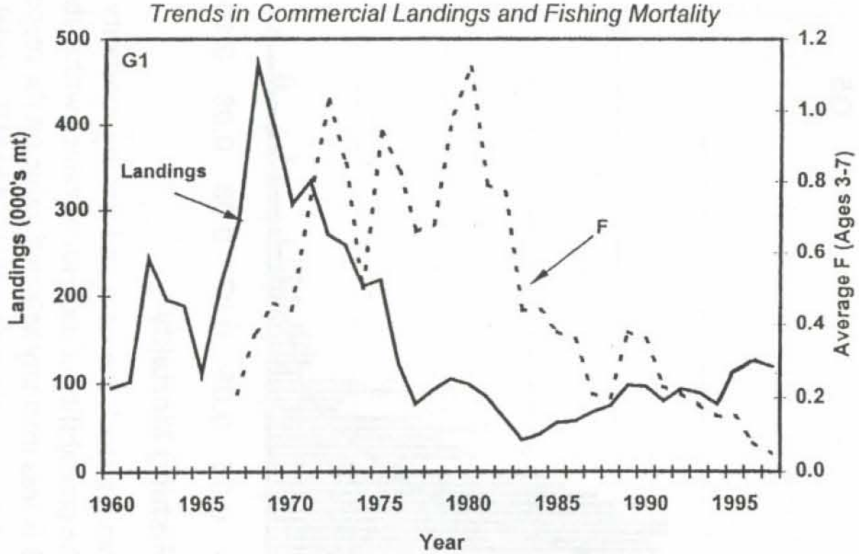
Recruitment: Indications are that the trend of increasing recruitment that began in the 1980s has continued with recent year classes (Figure G2). However, caution should be applied to interpretation of recent recruitment since these values are estimated with low precision.

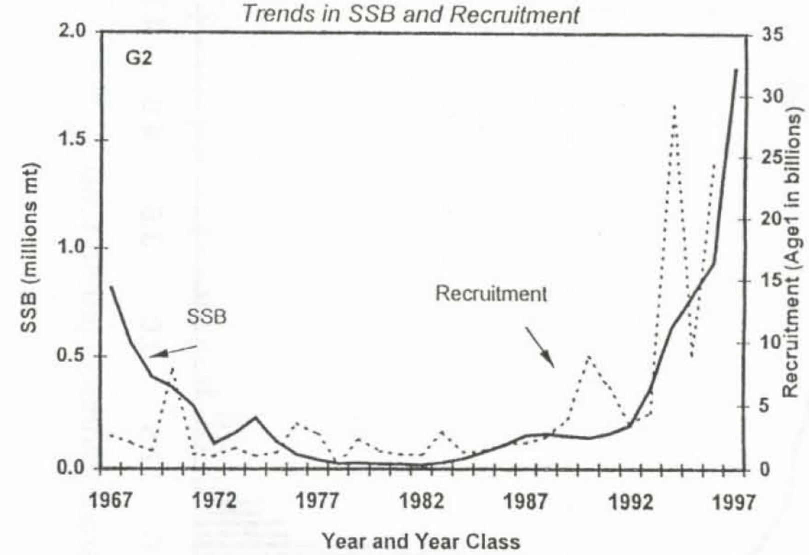
Spawning Stock Biomass: Spawning stock biomass has increased in recent years to a record high level of 1.84 million mt in 1997 (Figure G2). Prior to the collapse of the Georges Bank spawning stock, SSB of the complex was as high as 812,000 mt and may have been at higher levels prior to the beginning of the assessment time series. If the 1994 and 1996 year classes are as strong as initially predicted, SSB should increase in future years.

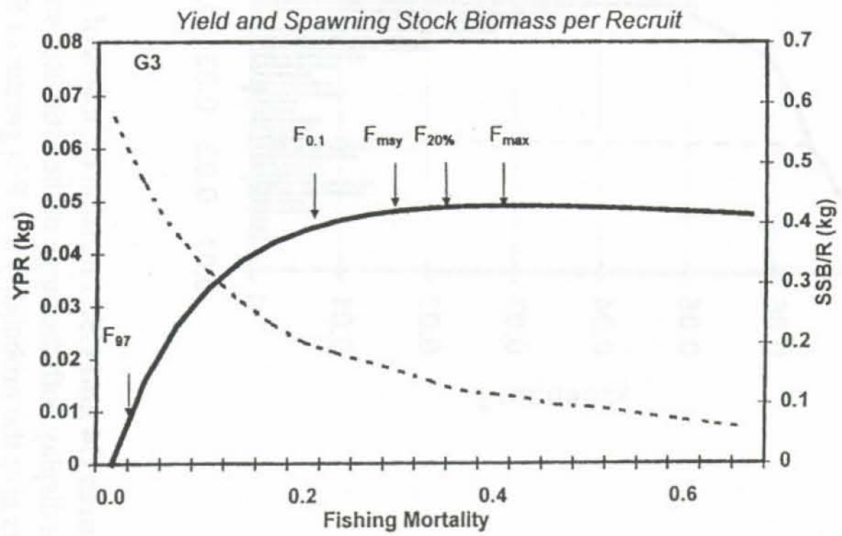
Special Comments: If the level of fishing mortality on the stock complex remains low, analytical assessment and the provision of advice should continue to be done biennially. The assessment and management advice for the coastal stock complex and its component stocks could be improved with the development of a survey specifically for pelagic resources, resolution of stock identification issues, better tracking of weight data used in the assessment, examination of historical data from a variety of sources including former Eastern Bloc resource agencies, and development of assessments for the individual stock components. The current assessment has produced low estimates of precision of F and SSB, in part, due to the low fishing mortality on the stock complex. A 5-year retrospective analysis indicated that SSB has tended to be considerably over-estimated and F considerably under-estimated. Because catch from the stock complex will be taken in Canadian waters, a joint assessment by representatives of the two countries is highly recommended.

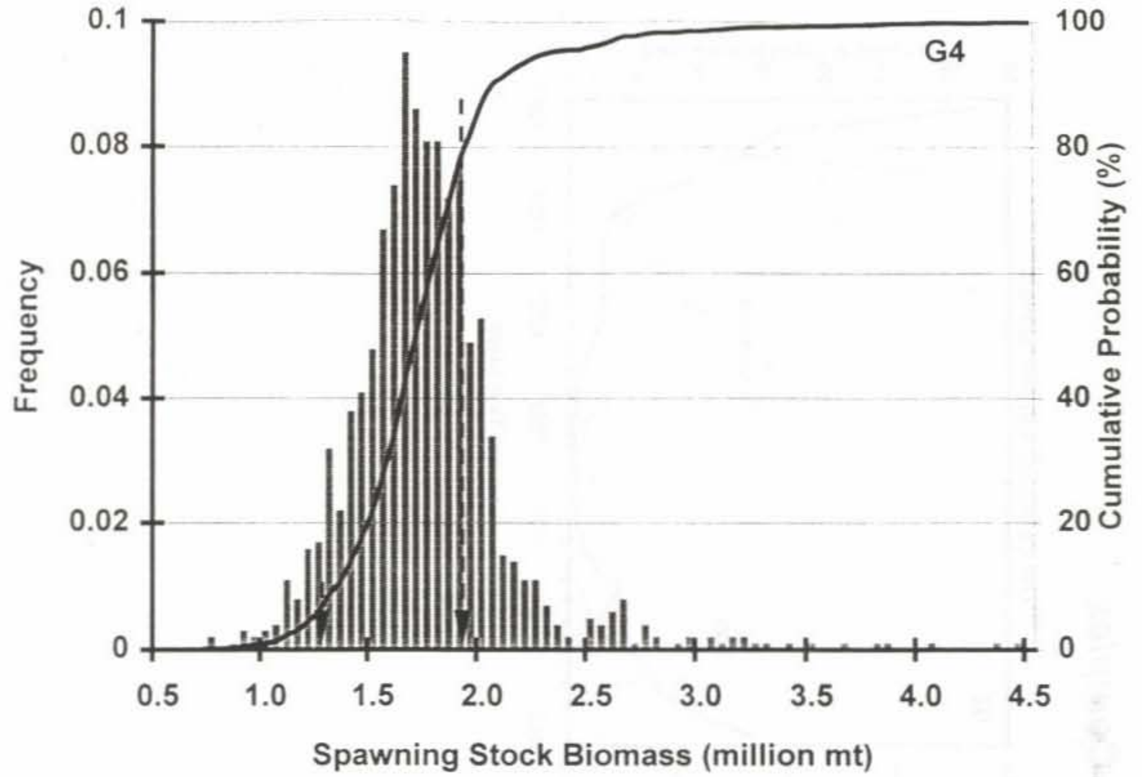
Source of Information: Report of the 27th Northeast Regional Stock Assessment Workshop (27th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 98-xx.

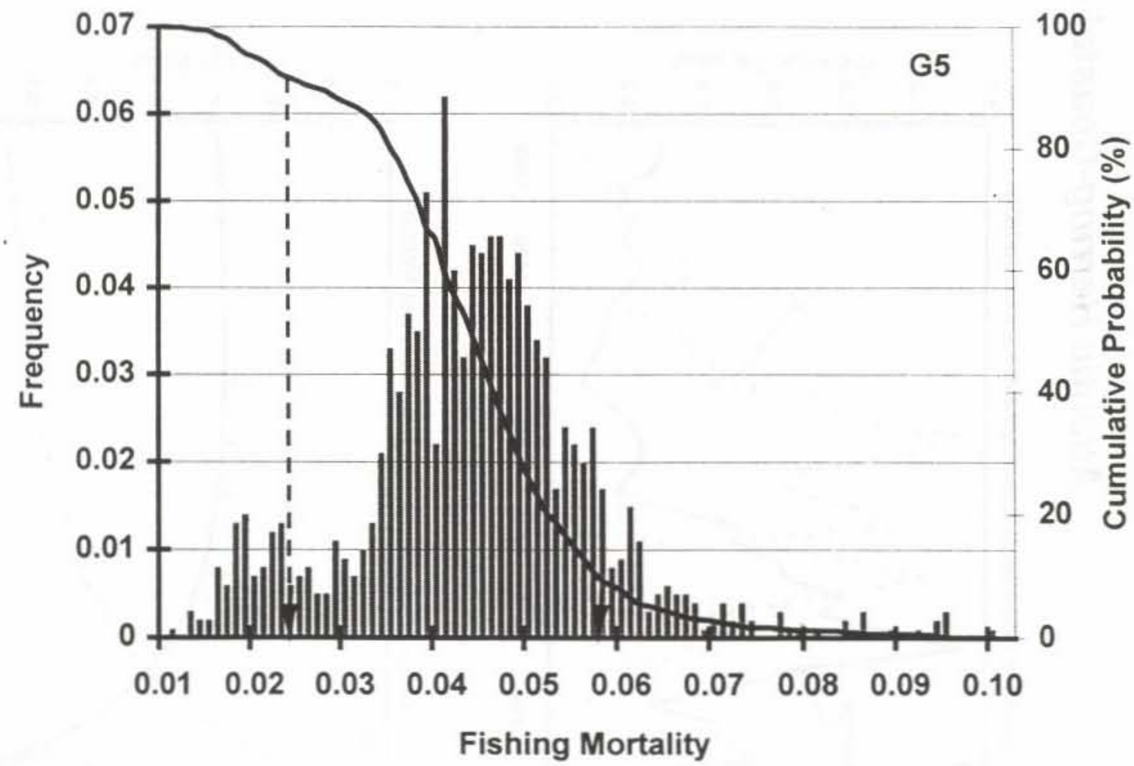
Atlantic Herring-Coastal Stock Complex











Figures G4 and G5. Precision estimates of spawning stock biomass and fishing mortality in 1997. Vertical bars display both the range of the estimator and the probability of individual values within the range. The solid lines give the probability that F is greater or SSB is less than any selected value on the respective X-axis. The precision estimates were derived from 1,000 bootstrap replications of the ADAPT model.

H. BLACK SEA BASS ADVISORY REPORT

State of Stock: The stock is over-exploited and at a low biomass level. Recent catches are well below the historical average (Figure H1), age and size structure is truncated, and survey biomass indices since the late 1980s (Figure H2) have been one-tenth (1995-1997 average = 0.09 kg/tow) of those observed in the late 1970s (1977-1979 average = 0.90 kg/tow). Average annual fishing mortality, estimated from length-based analyses, ranged from 0.56 to 0.79 during 1984-1997 and was 0.73 (48% exploitation) in 1997 (Figure H1). Recruitment in 1997, as indicated by survey indices, was well below the 1972-1996 average.

Management Advice: High fishing mortality rates have kept this stock at a low biomass level. Fishing mortality should be reduced, according to the existing schedule, to improve yield per recruit, age/size structure, and recruitment.

SFA Considerations: Estimates of B_{msy} using landings and the survey time series may be too low, given the very high commercial catches derived prior to the initiation of the survey (e.g., 1950s). However, a minimum biomass index for stock rebuilding can be defined as the maximum value of a 3-year moving average of the NEFSC spring survey catch per tow of exploitable stock biomass (1977-1979 average = 0.90 kg/tow). Similarly, F_{msy} cannot be estimated, and $F_{0.1}$ (0.18) is suggested as a proxy for F_{msy}. The SARC believes greater caution is necessary in setting a fishing mortality threshold to accommodate the greater uncertainty in the assessment of black sea bass, compared to other species where F_{max} has been acceptable (i.e., summer flounder). Based on historic trends in survey data, the stock has the capability of rebuilding to the minimum stock biomass index within 10 years. Black sea bass is a protogynous species that changes sex from female to male at a length of approximately 30 cm in response to yet-to-be-identified population or environmental conditions. In addition, black sea bass is closely associated with structured habitats at the adult stage. The protogynous nature of the species and specific habitat requirements suggest that the SFA guidelines may not be sufficient to protect the productive capacity of black sea bass and that additional measures, taking specific account of the black sea bass life history characteristics, may be required.

Forecast for 1999: In the absence of any quantitative age-based estimates of current stock size (e.g., from virtual population analysis), a forecast of future stock and catch was not possible. However, the existing fishing mortality rate reduction schedule, if effective, should result in increased survival of recruits leading to increases in stock biomass, if recruitment does not decrease.

Catch and Status Table (weights in '000 mt): Black Sea Bass

Year	1990	1991	1992	1993	1994	1995	1996	1997	Max[3]	Min[3]	Mean[3]
Commercial landings	1.6	1.3	1.4	1.4	0.9	0.9	1.5	1.1	2.0	0.9	1.3
Commercial discards[1]	0.1	0.1	0.1	0.1	0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.1
Recreational landings	1.3	1.9	1.2	2.0	1.5	2.6	2.7	1.4	5.6	0.7	1.8
Recreational discards[2]	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	<0 .1	0.1
Catch used in assessment[4]	3.1	3.4	2.9	3.6	2.4	3.7	4.3	2.5	7.8	2.4	3.5
Fishing mortality[5]	0.64	0.69	0.71	0.73	0.64	0.66	0.66	0.73	[6]0.79	[6]0.56	[6]0.68
Exploitation rate	43%	46%	47%	48%	43%	44%	44%	48%	50%	39%	45%

[1]Assuming 100% mortality (trawl) and 50% mortality (pots). [2]Assuming 25% mortality. [3]Over period 1984-1997[4] Landings only in 1997. [5] Average from two length-based methods. [6]Over period 1984-1997.

Stock Distribution and Identification: Stock identification studies have indicated two stocks, one south of Cape Hatteras and one north of Cape Hatteras. The northern stock is distributed primarily between Cape Cod and Cape Hatteras. The management unit of the MAFMC and ASMFC is the northern stock, which was the subject of this assessment.

Catches: Commercial landings increased from around 2,600 mt prior to 1948 to a peak of 9,900 mt in 1952, but then fell to only about 1,000 mt per year in the early 1970s. Commercial landings increased moderately during 1975-1979, varying between 1,700 and 2,400 mt per year, and have remained relatively constant in recent years (900-2,000 mt), and were 1,100 mt in 1997 (Figure H1). Recreational landings have ranged between 560 and 5,600 mt per year, with 1,430 mt taken in 1997. Commercial discards averaged 110 mt per year during 1989-1994; the 1995 and 1996 estimates declined sharply to 2 and 13 mt, respectively. The best 1997 estimate was 73 mt. Recreational discards during 1984-1996 ranged from 34 to 205 mt annually (average 118 mt). Recreational discards during 1997 were the among the highest in the time series at 172 mt. Total catch during 1984-1997 ranged from a high of nearly 8,000 mt in 1986 to a low of 2,400 mt in 1994. Total catch in 1997 was 2,800 mt.

Data and Assessment: The SARC concluded that the available data were inadequate to provide the basis for conducting an assessment using either age-based or surplus production models. The status of the resource was evaluated from NEFSC spring and autumn survey indices. Fishing mortality was estimated using two different length-based methods applied to length distributions of commercial and recreational landings.

Biological Reference Points: Yield per recruit was not changed from the SAW-25 estimate of $F_{0.1}$ = 0.18 (15% exploitation) and F_{max} = 0.32 (25% exploitation) (Figure H3). MSY and B_{msy} were not estimated.

Fishing Mortality: Annual fishing mortality (F) during 1984-1997, estimated from length-based models, varied between 0.41 and 0.56 using one model and between 0.70 and 1.03 using another model. Annual averages from these two methods varied between 0.56 and 0.79; the 1997 average was 0.73 (Figure H1).

Recruitment: Survey data indicate that recruitment in 1997 was below the average for the last decade (Figure H2).

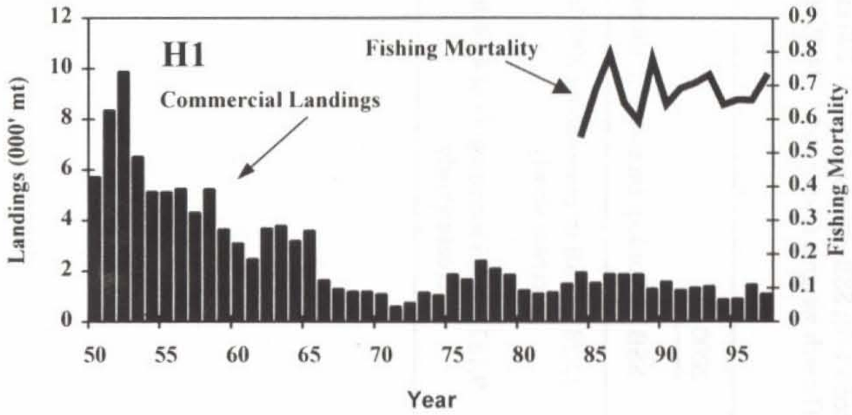
Spawning Stock Biomass: SSB was not estimated in the current assessment. However, mean number per tow of black sea bass $\geq$ age 2 in the 1997 NEFSC spring survey increased to the highest value since 1986.

Special Comments: Discard losses in the commercial and recreational fisheries are uncertain due to insufficient sampling data from some components of the fishery. Sampling should be substantially increased in the commercial and recreational fisheries to improve estimates of length and age composition of catches. In addition, there is some uncertainty in the survey population estimates due to a refuge effect in the structured habitat preferred by black sea bass, which may result in biased estimates of abundance and size composition from standard sampling gear.

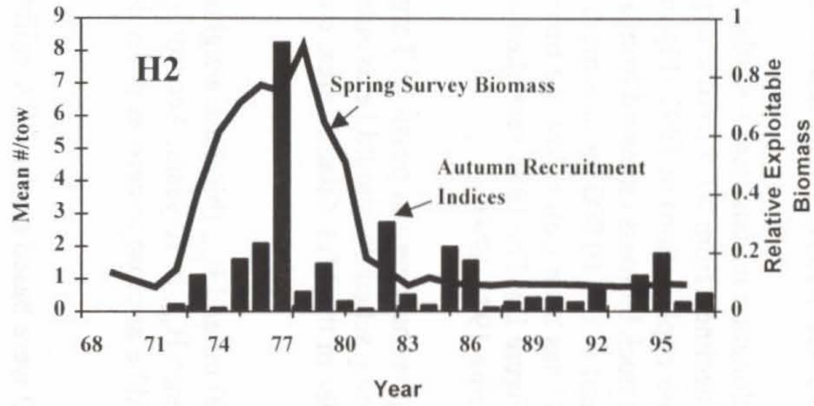
Source of Information: Report of the 27th Northeast Regional Stock Assessment Workshop (27th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 98-xx.

Black Sea Bass

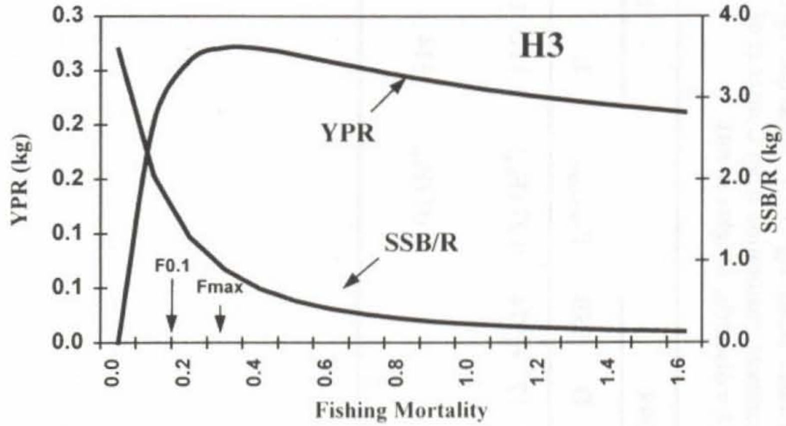
Landings and Fishing Mortality



Relative Biomass and Recruitment



Yield and Spawning Stock Biomass



I. SOUTHERN NEW ENGLAND YELLOWTAIL FLOUNDER ADVISORY REPORT

State of Stock: The stock is at low abundance and exploitation is consistent with the Amendment 7 rebuilding strategy. Fishing mortality (age 4+, unweighted) declined from >1.5 (>70% exploitation) in the early 1980s to 0.42 (31% exploitation) in 1996 and 0.07 (6% exploitation) in 1997 (Figure I1), below the target rebuilding fishing mortality rate ($F_{0.1} = 0.27$). Spawning stock biomass increased from a low of 570 mt in 1994 to 4,200 mt in 1997 (Figure I2), but is still less than half of the 10,000 mt minimum biomass threshold established under Amendment 7. Recruitment since 1987 has been well below the time series average (1973-1997), but has shown some improvement since 1993 (Figure I2). The 1996 year class is apparently the largest since 1988, but is still less than half of the average during 1973-1997.

Management Advice: Fishing mortality should be kept as near zero as possible. Targeting of the 1996 year class, which could jeopardize the Amendment 7 rebuilding schedule, should be avoided. Given the potential relationship between this stock and yellowtail flounder in the Mid-Atlantic area, catches in the latter area should be restricted.

SFA Considerations: B_{msy} was estimated to be 61,500 mt and F_{msy} (biomass weighted) to be 0.23. Current total stock biomass is below $\frac{1}{4}B_{msy}$ and is unlikely to reach B_{msy} in 10 years. According to a proposed control rule for this stock based on SFA requirements, F should be as close to zero as possible, based on the current level of stock biomass.

Forecast for 1998-2000: The forecasts for 1998-2000 were based on the VPA-calibrated 1998 stock sizes. Projections were performed for $F_{0.1} = 0.27$ (22% exploitation) and $F_{98} = 0.07$ (6% exploitation). Recruitment at age 1 in 1998-2000 was estimated from the distribution of the 1991-1996 year classes.

Forecast Table: Basis: $F_{98} = 0.07$ (*status quo* F_{97} from calibrated VPA); SSB estimated to be 4,200 mt in 1997; average 1994-1996 partial recruitment; maturation from Conser *et al.* (1991); 1997 catch weights at age; and 1994-1996 discard weights at age (L = landings, D = discards, weights in mt).

1998					1999			2000	
F	L	D	SSB	$F_{1999\text{-}2000}$	L	D	SSB	SSB	Consequences/Implications
0.07	226	17	6,574	0.27 ($F_{0.1}$)	1,112	103	7,855	7,828	SSB increases about 20% from 1998 to 2000, landings increase slowly
				0.07 (F_{98})	314	29	8,239	9,187	SSB increases about 40% from 1998 to 2000, landings increase slowly

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

Year	1990	1991	1992	1993	1994	1995	1996	1997	Max	Min	Mean[1]
Landings	8.0	3.9	1.4	0.5	0.2	0.2	0.3	0.2	17.0	0.2	4.0
Discards	9.1	2.5	1.1	<0.1	<0.1	<0.1	<0.1	<0.1	9.1	<0.1	2.6
Catch	17.1	6.4	2.5	0.5	0.2	0.2	0.3	0.2	20.8	0.2	6.7
SSB	14.2	3.9	1.6	0.8	0.6	1.4	2.9	4.2	21.9	0.6	7.5
Recruitment (age 1)	6.8	3.7	2.0	1.3	6.5	7.0	5.6	12.5	126.9	1.3	27.5
F (age 4+)	2.80	2.24	1.80	0.94	1.28	0.69	0.42	0.07	2.80	0.07	1.24
Exploitation rate	89%	84%	78%	56%	67%	46%	31%	6%	89%	6%	66%

[1]Over period 1973-1997.

Stock Identification and Distribution: Yellowtail flounder range from Labrador to Chesapeake Bay and are considered to be relatively sedentary. A unit stock of Southern New England yellowtail flounder extending between Nantucket Shoals and Long Island has been defined based on results of tagging experiments and studies of parasitic infestations. Some intermixing occurs with stocks on Georges Bank and off Cape Cod, and with yellowtail distributed further west and south into the Mid-Atlantic area.

Catches: Landings for this stock peaked in 1969 at 33,200 mt, but declined to 1,600 mt in 1976 (Figure I1). Landings increased to an average of 17,000 mt in 1983, but declined again to 900 mt in 1987. Recruitment from the large 1987 year class in 1989-1991 produced landings of 2,500 mt, 8,000 mt, and 3,900 mt in those three years, respectively. Landings declined to 1,400 mt in 1992, dropped to a record low level of 200 mt in 1994, and have remained low through 1997 (Figure I1). Discards reached their lowest level in the 1973-1997 period in 1997 and have been relatively low since 1993.

Data and Assessment: Southern New England yellowtail flounder was last assessed at SAW-24 in 1997. The current assessment is based on landings-at-age data from commercial sources and discards-at-age data. Landings during 1973-1993 were estimated from dealer records and interviews of selected vessels by port agents. Landings during 1994-1997 were prorated from dealer records and vessel logbooks. Discards during 1973-1992 were estimated from vessel interviews, sea sampling trips, and survey length compositions. Discards during 1993-1997 were estimated from discard ratios obtained from vessel logbooks and length samples from sea sampled trips.

Biological Reference Points: Biological reference points were not recalculated because no significant changes in input values occurred in 1997. $F_{0.1}$ for this stock is F = 0.27 (22% exploitation). Amendment 7 stipulates that below a spawning stock biomass of 10,000 mt, the fishing mortality target for stock rebuilding is $F_{0.1}$ (0.27). The SARC notes that the current minimum biomass threshold (10,000 mt) and overfishing definition ($F_{20\%}$ = 0.94) are inconsistent with the requirements of the SFA. It has been estimated that at an overfishing limit threshold (B_{msy}) of 61,500 mt, yield (MSY) would be 14,200 mt at F = 0.23 (F_{msy}).

Fishing Mortality: Fishing mortality on this stock was very high during 1982-1994 (in excess of 1.5), with exploitation rates ranging from 56 to 89%. Fishing mortality rates dropped to F = 0.42 (31% exploitation) in 1996 and F = 0.07 (6% exploitation) in 1997 (Figure I1).

Recruitment: The strongest year classes in the 1973-1996 series were the 1980 and 1987 cohorts at 127 million and 122 million fish, respectively, at age 1 (Figure I2). Year classes during 1990-1995 were all relatively small ranging from 1.3 million to 7.0 million fish. The 1993-1995 cohorts are currently supporting the recovery of this stock. The 1996 cohort may be the largest cohort since 1988.

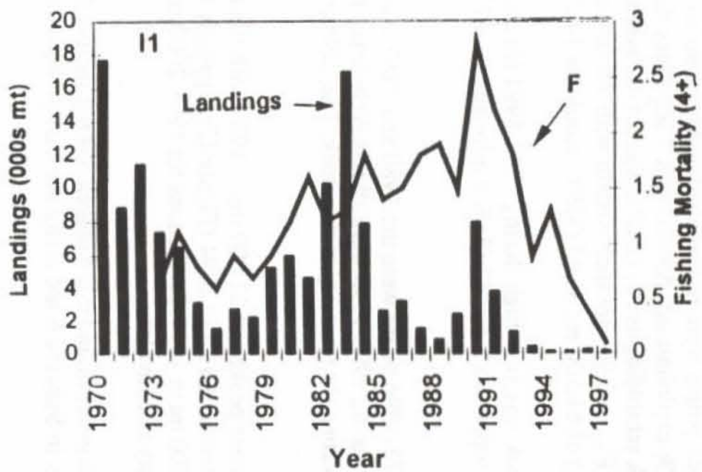
Spawning Stock Biomass: Spawning stock biomass peaked at 22,000 mt in 1989 with the recruitment of the strong 1987 year class. The spawning stock declined steadily thereafter to 566 mt in 1994 (Figure I2). Spawner biomass began to slowly recover in 1995 reaching 1,400 mt and increased further to 4,200 mt in 1997. Projections for 1998-2000 suggest that spawning stock biomass will continue to increase as long as fishing mortality remains low.

Special Comments: The Mid-Atlantic stock of yellowtail flounder in Subarea 6 is not included in the Southern New England yellowtail flounder assessment. Many of the landings in Subarea 6 are along the eastern boundary and may include portions of the Southern New England stock.

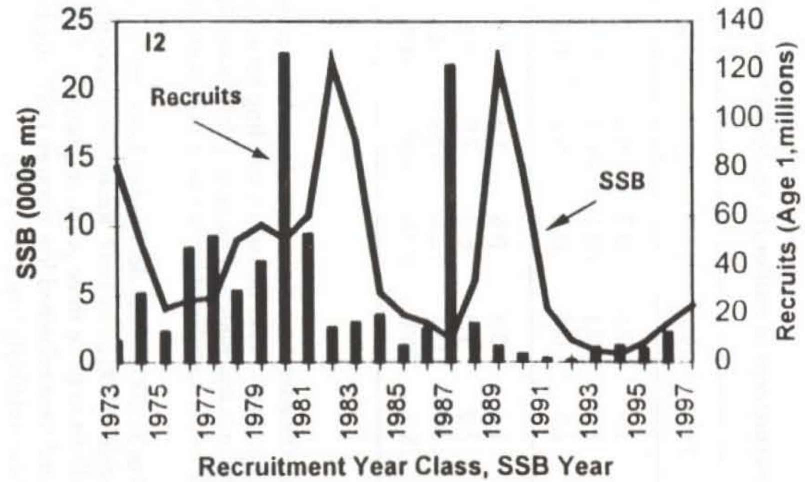
Source of Information: Report of the 27th Northeast Regional Stock Assessment Workshop (27th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 98-xx; Overholtz, W.J. and S.X. Cadrin. Assessment of the Southern New England yellowtail flounder stock for 1998, NEFSC Ref. Doc. 98-xx.

Southern New England Yellowtail

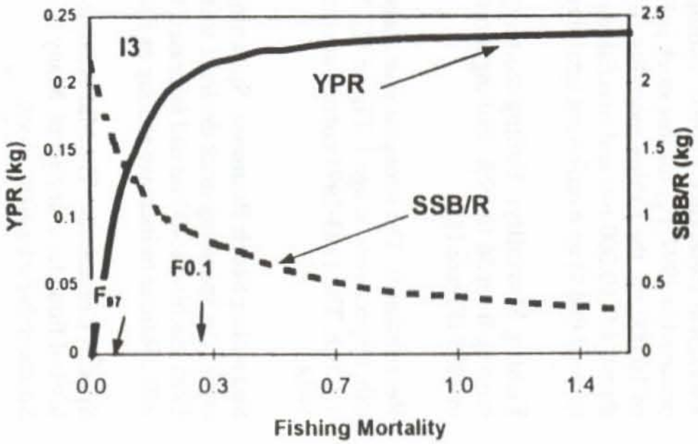
Trends in Commercial Landings and Fishing Mortality



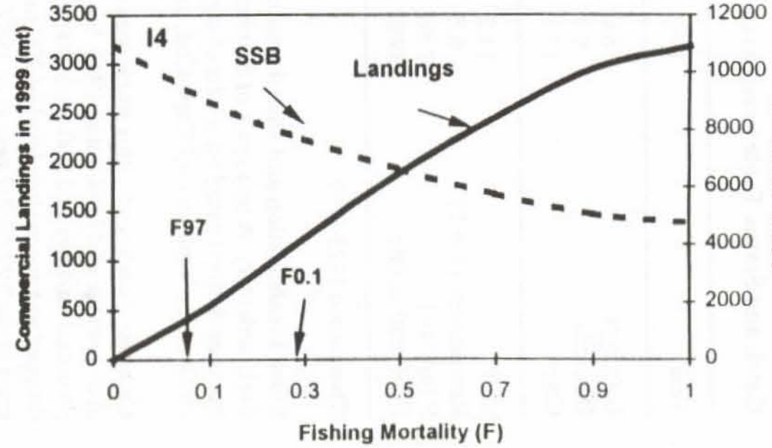
Trends In Spawning Stock Biomass And Recruitment



Yield and Spawning Stock Biomass per Recruit

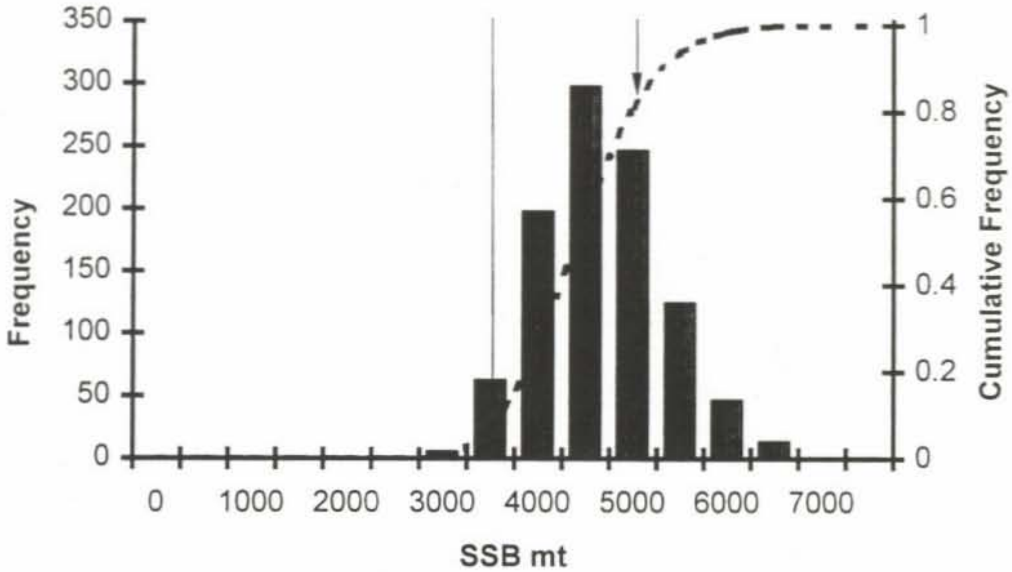


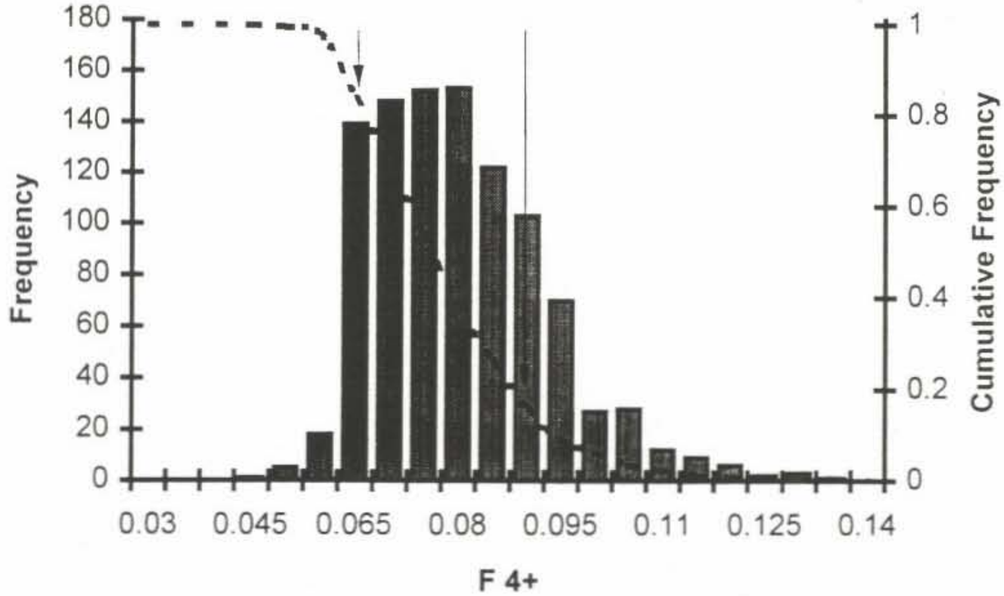
Short-Term Commercial Landings And SSB



Southern New England Yellowtail

Precision Of Estimates For SSB And F





CONCLUSIONS OF THE SAW STEERING COMMITTEE

The SAW Steering Committee met twice during the SAW-27 cycle: 1) a teleconference on May 15, 1998, and 2) a meeting on September 30, 1998. The discussion and conclusions from those meetings are summarized below.

Teleconference of May 15, 1998

The SAW Steering Committee met by teleconference on May 15, 1998. Participants were: J. Dunnigan and G. Lapointe, ASMFC; P. Howard, NEFMC; C. Moore, MAFMC; A. Rosenberg, NMFS/NER; M. Sissenwine, S. Murawski, E. Anderson (SAW Chairman), and Helen Mustafa (SAW Coordinator), NMFS/NEFSC.

The agenda items for the meeting included a recap of the joint US/Canada Transboundary Resources Assessment Committee meeting, agenda and meeting schedules for SAW-27, proposed agenda and meeting schedules for SAW-28, and SAW policy issues.

<u>TRAC Meeting</u>

The TRAC meeting held in St. Andrews, New Brunswick April 20-24, 1998 was one of the better peer-review meetings due to the participation of a number of highly respected external experts and the issues that were raised. Major complaints were that the duration of the meeting was insufficient to fully consider alternative analytical approaches suggested by the external experts, and that greater efficiency would likely be achieved by involving external experts at the working group level rather than at the peer-review level.

Discussion of issues raised at the TRAC meeting

The Transboundary Assessment Working Group meeting held in Woods Hole March 31 - April 3 prior to the TRAC meeting would have benefitted from the participation of external experts who would have had sufficient time to suggest and try alternative analytical methods. An intersessional methods meeting or workshop had been proposed at the TRAC meeting to be held either under the TRAC umbrella or, to take advantage of European experts, under the auspices of the ICES Assessment Methods Working Group. Such a meeting or workshop had been suggested for January 1999, but this would conflict with a meeting of the ICES Comprehensive Fishery Evaluation Working Group also scheduled for January 1999 in Miami. The optimal forum and time for consideration of the methods issues raised at the TRAC meeting would be resolved at a later time in consultation with relevant US, Canadian, and ICES officials.

The possibility of holding a joint US/Canada ageing workshop, proposed at the TRAC meeting, was discussed.

Another issue raised at the TRAC meeting was the apparent inefficiency created by the current practice of performing two assessments each for Georges Bank cod and haddock: a US assessment based on the entire stock and a Canadian assessment based on that portion of the entire stock located on the Canadian side of the boundary. Although this practice was based on existing management unit definitions for each country, there appeared to be some justification for performing a single assessment for each of these stocks, with allocations or shares of each resource to the two countries determined on some agreed basis. It was agreed that Drs. Sissenwine and Rosenberg would raise this issue at the next GOMAC meeting.

At Canadian RAP meetings, there is good rapport between scientists and industry created by the formal participation by industry representatives. Such involvement by the Canadian industry greatly contributes to the promotion of good communication and trust. Although the US industry is invited to SARC and working group meetings, industry representatives have not, to date, been invited to participate as formal members of the SARC. It was agreed that such participation in SARC meetings would promote better communication and understanding, but concern was expressed about giving non-scientists a role in a scientific peer-review process. The possibility of industry involvement in some capacity in future SARC meetings was discussed (see later in this report).

The issue of the consistency of overfishing definitions and appropriate biological reference points between the US and Canada was raised. Although this matter would be vetted through the SARC, it was not expected that definitions would differ. One question under this topic concerned the long time series of data for haddock, and whether or not it was more appropriate to base estimates of MSY on this time series or on a more recent, shorter data set. Since overfishing reference points were critical to the current NEFMC management measures for transboundary groundfish stocks, the Council needed to be aware of any and all discussions with Canada regarding overfishing. The issue was especially pertinent to the US regarding lawsuits and required review.

TRAC documentation

The Stock Status Reports for each of the three transboundary stocks considered at the TRAC meeting would be finalized by the Canadians. Although the SAW Advisory Report sections were also drafted at the meeting, the advice would be developed at the forthcoming SARC meeting. The TRAC Proceedings, a summary of the discussion at the meeting, would be available before the SARC meeting in June.

Stocks reviewed

The stocks reviewed at the TRAC meeting included Georges Bank cod, haddock, and yellowtail flounder. The assessments for these species incorporated the latest survey indices from both countries: the 1998 Canadian spring and 1997 NEFSC fall surveys. These stocks would also be on the agenda for the forthcoming SARC meeting for the purpose of drafting the management advice.

SAW-27

The agenda for SAW-27 was confirmed as including: Georges Bank cod, Georges Bank haddock, Georges Bank yellowtail flounder, black sea bass, scup, Gulf of Maine cod, Atlantic herring, Southern New England yellowtail flounder, and ocean quahogs. Georges Bank cod, haddock, and yellowtail flounder had already been assessed and peer reviewed in the joint US/Canada process. The Invertebrate Working Group met May 7-8 to assess ocean quahogs and would meet again May 28-29. The Northern and Southern Demersal Working Groups would meet jointly May 18-20 May to assess Gulf of Maine cod and Southern New England yellowtail flounder. The Coastal/Pelagic Working Group would meet May 18-20 to assess Atlantic herring, scup, and black sea bass. The working group reports would be mailed to SARC members two weeks before the SARC meeting. With nine stocks on the agenda, the amount of time available for each stock would be rather limited at the SARC meeting. To provide for a better meeting environment, arrangements had been made for the SARC to meet at the Quality Inn in Falmouth June 22-26. The SARC's draft reports would be ready by mid-July for use by the relevant oversight committees of both Councils. The SAW-27 Public Review Workshop sessions would be held during the August 10-11 NEFMC and August 17-20 MAFMC meetings.

SAW-28

Of the stocks previously suggested by Steering Committee members for inclusion in the SAW-28 agenda, only six were proposed: sea scallops, Georges Bank winter flounder, American plaice, Atlantic mackerel, Cape Cod yellowtail flounder, and white hake. Squid should not be on the agenda until preferably fall 1999 as research on life history parameters and growth was still in progress. Ageing of silver hake was behind schedule due to lack of personnel, and similarly there was no NEFSC staff person presently assigned to assess the species. Since ageing of witch flounder would be completed in the fall of 1998, it would be possible to assess that stock in the spring of 1999 at SAW-29. Pollock would best be addressed within the TRAC process. There was no age information for red hake, it had not been assessed since 1990 (SAW-11), and remained a low priority. Although age information existed for butterfish, there was no NEFSC staff person currently assigned the assessment responsibility.

After reconsidering current priorities, the Steering Committee agreed to the following tentative agenda for SAW-28: sea scallops, American plaice, Georges Bank winter flounder, Southern New England winter flounder, Atlantic mackerel, white hake, Cape Cod yellowtail flounder, and tilefish. Tilefish, however, was questionable pending a determination whether there were sufficient data available to provide the basis for an assessment. The final decision on tilefish would be made at the next Steering Committee meeting. In addition, tilefish could be a candidate for the MAFMC Scientific and Statistical Committee (SSC). The Southern New England winter flounder assessment would be handled by an ASMFC assessment subcommittee. With virtually all of the assessments on the tentative agenda viewed as "benchmarks," this would again be a very heavy load for the SARC.

Policy Issues

SARC status re FACA

At the last meeting, the Steering Committee had agreed that the SAW Chairman would investigate making the SARC a Council advisory committee. As such, it would function as other Council advisory committees and be subject to the same procedural requirements. The only additional requirement from current SARC procedures would be that of announcing meetings and agendas in the Federal Register. Both Councils viewed this arrangement favorably, but indicated that announcements in local newspapers would also be necessary. The cost of such announcements was not trivial, and financial support from the NEFSC would be necessary. Relative to other procedural requirements, it would not be required to tape SARC meetings. The current SAW reports would be sufficient, with the possible addition of a "public comment" section. The Steering Committee authorized the designation of the SARC as a Council advisory committee, with the details of such an arrangement to be worked out following consultation with and advice from NOAA General Council.

Industry participation in the SARC

Although it was generally agreed that industry participation in the SARC would enhance communication and understanding, it was considered important that industry not be perceived as interfering with the peer-review process and the preparation of management advice. The option of designating observers from Council and ASMFC industry advisory committees, with specific guidelines governing their role and participation, was explored and it was suggested, as a start, that advisory committee chairs attend SARC meetings and be granted formal observer status and seats at the table with the scientists. The Steering Committee would still need to decide how to pay for such industry participation. Dr. Anderson was asked to develop a specific proposal on industry participation to be implemented beginning with SAW-28.

Role of the Scientific and Statistical Committees

Discussion of the role of the Councils' Scientific and Statistical Committees (SSCs) in the SAW process continued at this meeting. Given the need to review assessments and provide management advice on three dozen or more stocks in the Northeast Region, it was concluded that it would be most efficient for the SSCs to peer review the "updated" assessments and for the SARC to handle "benchmark" assessments that would be done approximately every 3-4 years for a given stock. In this way, the SARC, in two meetings, would review approximately 10-12 benchmark assessments each year. Assessment updates for the other stocks in the interim would be reviewed by the SSCs with the participation of NEFSC scientists.

Within ASMFC, a stock assessment peer-review process had been developed and adopted, with oversight and review of this process provided by the Management and Science Committee (MSC). The possible elimination of the MSC review, with the SARC providing recommendations, was discussed. It was noted that, under the Sustainable Fisheries Act (SFA), the NEFSC Status of Stocks report would no longer be adequate as a Stock Assessment Fishery Evaluation (SAFE) report.

The same format needed to be followed every year for over 30 stocks including 1) when advice was needed by annual adjustment committees and 2) when to develop information. An annual schedule of decision points to back up Council and ASMFC FMPs was deemed useful. A detailed logical process was required specifying what would happen and when, the frequency of decision points for what processes, and to interface with what groups (e.g., the SSCs, parallel or sequential reviews). The Councils would peer review this schedule and make recommendations.

To address each species or species group, the Steering Committee would need to review the decision points and assessment years before they were locked in and look at options for groups and individuals to do assessments and to whom advice must be provided. A well-described annual cycle of who does what and when must be prepared. The fact that Plan Development Teams were constantly changing things must be considered. The goal must be a stable management system with a routine way for making adjustments. In addition, there may be situations when an annual review of a stock was needed, but not an annual adjustment. To help develop a structure regarding who does what, a day-long workshop should be held to devise a timetable and define management requirements, timing of input data, and availability of staff resources to do the work. As a first step, the two Councils must assemble timetables of their needs. Mr. Howard and Dr. Moore should cooperate in assembling such a timetable and then meet with the SAW Chairman a week before the June SARC meeting to incorporate the NEFSC input and perspective.

Status of the national pool of experts

With the expectation that people would apply, an advertisement regarding the opportunity for assessment experts could be carried in the Federal Register. Applicants would be reviewed on the basis of scientific merit, and the pay scale adjusted according to credentials. Enough money would be provided to fund up to five persons for a pilot program. Although this may be in direct competition with SSCs, some SSC members may choose to apply and participate in both activities. It is conceivable that the SARC may be able to tap into this pool in the fall of 1998. If the national pool does not solve the problem, it may be possible to develop a regional list of potential experts.

Other Business

The SAW Chairman announced that the NEFSC was preparing to put SAW information on the Internet. SAW information would be added to the NEFSC Home Page and linked with the Councils and the ASMFC.

Meeting of September 30, 1998

The SAW Steering Committee met September 30, 1998 at the Northeast Fisheries Science Center in Woods Hole, MA. Participants were: J. Dunnigan, ASMFC; P. Howard, NEFMC; C. Moore, MAFMC; P. Kurkul and H. Mears, NMFS/NER; M Sissenwine, J. Boreman, F. Serchuk, S. Murawski, R. Mayo, P. Rago, E. Anderson (SAW Chairman), and H. Mustafa (SAW Coordinator), NMFS/NEFSC.

The agenda items for the meeting included 1) highlights of SAW-27; 2) proposed agenda, terms of reference, and meeting dates for SAW-28; 3) tentative agenda for SAW-29; discussion of an issue paper on "Towards a more comprehensive stock assessment process in the Northeast Region"; and a discussion of MARFIN as other business.

Recap of SAW-27

It was agreed that SAW-27 had one of the toughest agendas of any SAW. Nine stocks had been considered: Georges Bank cod, Georges Bank haddock, Georges Bank yellowtail flounder, scup, ocean quahogs, Gulf of Maine cod, Atlantic herring, black sea bass, and Southern New England yellowtail flounder. Although the SARC developed management advice for all nine stocks, it only performed peer reviews for six stocks. Three stocks (Georges Bank cod, haddock, and yellowtail flounder) were reviewed earlier by the US/Canada Transboundary Resources Assessment Committee (TRAC). Based on the experience of so many stocks on the agenda, it was concluded that a smaller number of stocks (e.g., 5-6) should be scheduled for future SAWs.

The process of preparing the documentation had worked extremely well. The two SARC reports were completed two weeks after the meeting and available for presentation at meetings of the NEFMC Groundfish Committee on July 16 and the MAFMC Surfclam and Ocean Quahogs Committee on August 6. Errors in the draft reports would be corrected and the reports finalized as soon as possible. Public Review Workshop sessions were held in Peabody, MA August 10 for the NEFMC and in Philadelphia, PA August 17 for the MAFMC.

One problem which had arisen from the SARC advice pertained to the MSY estimate for Atlantic herring. The SARC had expressed reservations about the estimate of 317,000 mt, which had been developed by the NEFMC Overfishing Definition Review Panel, already included in the new Atlantic Herring Fishery Management Plan for developing specifications for the 1999 fishing year, and recommended by the SARC Coastal/Pelagic Working Group, and instead advised that a value of 200,000 mt would be more prudent. The inconsistency between the SARC advice and the higher MSY value being used in the FMP had been raised at the SARC meeting, but a lack of time at the SARC meeting had prevented a more thorough analysis and examination of alternative options. One month after the SARC meeting, further analyses on this question were presented to and reviewed at a joint meeting of the ASMFC Herring Technical Committee and the NEFMC Herring Plan Development Team. The joint meeting concluded that some of the analyses on which the SARC had advised an MSY of no more than 200,000 mt was unreliable, and that the original estimate of 317,000 mt was valid and should continue to be used in the FMP. Concern, however, had been expressed by Council members and others at the time of the Public Review Workshop sessions relative to the inconsistency between the SARC advice and the MSY value being used in the Herring FMP, and a reluctance to disregard SARC advice and potentially undermine the SAW process.

This dilemma was discussed extensively by the Steering Committee. Four options were suggested and considered for dealing with the issue: 1) ask the SARC to clarify its advice, 2) the Steering Committee would note its concern about the lack of time at the SARC meeting to fully examine the MSY question and would reconvene the Coastal/Pelagic Working Group to perform the necessary alternative analyses, 3) do nothing to the SARC advice, but acknowledge in the FMP and in any review of the management measures the different MSY estimates and the desirability of resolving the differences in due time, and 4) assign a term of reference for SAW-29 to reexamine the MSY issue.

In spite of this problem, it was concluded that the SAW process worked well, and that the advice was good considering the level of uncertainty. It was emphasized that NMFS would accept the use of the higher MSY estimate in the FMP, particularly in light of the current high abundance of herring. The Committee agreed on options 3) and 4).

<u>SAW-28</u>

Dr. Anderson explained that, in earlier consultations with the two Council staffs, agreement had been reached to remove sea scallops, Atlantic mackerel, and tilefish from the SAW-28 agenda. In the case of sea scallops, analysis of data from the Closed Area II experiment involving industry vessels precluded any possibility of an assessment in the fall of 1998. Atlantic mackerel would be assessed and reviewed in the spring of 1999 within the US/Canada process, and tilefish would be handled outside of the SAW process, with assessment analyses done by NEFSC staff by December 1998 and peer reviewed by the MAFMC SSC.

Stocks

American plaice
Georges Bank winter founder
Southern New England winter flounder
Cape Cod yellowtail flounder
White hake

Terms of reference

<u>American plaice</u>

a. Update the status of the Gulf of Maine - Georges Bank American plaice stock through 1997 and characterize the variability of estimates of stock size and fishing mortality.

b. On the basis of anticipated catches and abundance indicators in 1998, estimate stock size at the beginning of 1999 and provide projected estimates of catch and spawning stock biomass for 1999-2000 at various levels of F.

c. Comment on and revise, if necessary, the overfishing definition reference points for American plaice recommended by the Overfishing Definition Review Panel.

Cape Cod yellowtail flounder

a. Update the status of the Cape Cod yellowtail flounder stock through 1997 and characterize the variability of estimates of stock size and fishing mortality.

b. On the basis of anticipated catches and abundance indicators in 1998, estimate stock size at the beginning of 1999 and provide projected estimates of catch and spawning stock biomass for 1999-2000 at various levels of F.

c. Comment on and revise, if necessary, the overfishing definition reference points for Cape Cod yellowtail flounder recommended by the Overfishing Definition Review Panel.

Georges Bank winter flounder

a. Update the status of the Georges Bank winter flounder stock through 1997 and characterize the variability of estimates of stock size and fishing mortality.

b. On the basis of anticipated catches and abundance indicators in 1998, estimate stock size at the beginning of 1999 and provide projected estimates of catch and spawning stock biomass for 1999-2000 at various levels of F.

c. Comment on and revise, if necessary, the overfishing definition reference points for Georges Bank winter flounder recommended by the Overfishing Definition Review Panel.

Southern New England winter flounder

a. Update the status of the Southern New England winter flounder stock through 1997 and characterize the variability of estimates of stock size and fishing mortality.

b. On the basis of anticipated catches and abundance indicators in 1998, estimate stock size at the beginning of 1999 and provide projected estimates of catch and spawning stock biomass for 1999-2000 at various levels of F.

c. Comment on and revise, if necessary, the overfishing definition reference points for Southern New England winter flounder recommended by the Overfishing Definition Review Panel.

White hake

a. Characterize current and historic length and age composition, abundance, and catch for the Gulf of Maine - Georges Bank white hake stock as data permit.

b. Provide current information on stock structure and biological parameters based on growth and maturation rates, yield and spawning stock biomass per recruit analyses, and surplus production models.

c. If possible, provide current and historical estimates of stock size and fishing mortality and projected levels of catch and stock size for 1999-2000 at various levels of F.

d. Comment on and revise, if necessary, the overfishing definition reference points for white hake recommended by the Overfishing Definition Review Panel.

Meeting dates and places

SARC

30 November - 4 December 1998
Woods Hole, MA

Public Review Workshop

NEFMC

27-28 January 1999
Portsmouth, NH

MAFMC

2-4 February 1999
New York, NY

Discussion

It was noted that all five of the SAW-28 assessments would be "benchmarks" and would be age-based VPAs. It was also stressed by Mr. Howard that, in the future, social science information would be required along with the standard assessments.

Dr. Mark Terceiro would chair a meeting of the Southern Demersal Working Group October 13-16 to assess the two winter founder stocks and Cape Cod yellowtail flounder, and Mr. Ralph Mayo would chair a meeting of the Northern Demersal Working Group November 16-20 to assess American plaice and white hake.

The status of SARC re FACA was discussed. To date, there had been response from NOAA General Council on the advisability of placing the SARC under the auspices of the Councils. It was suggested that FACA may not apply in this case as the SARC is not an advisory body to the Councils, ASMFC, and NMFS. The Steering Committee agreed to maintain the *status quo* and not have the SARC designated as a Council advisory committee. A suggestion was made to rename the "Advisory Report" the "Stock Status" report.

It was agreed that it would be useful to have formal industry participation at SARC meetings beginning with SAW-28. Dr. Anderson was requested to develop guidelines for industry participation. An invitation should go out for industry people to participate at the next SARC meeting as observers. Although it would not be possible to do so this year, the NEFMC would be willing to cover the cost of industry participation next year. It was noted that members of industry should also be invited to participate in working group meetings since their experience and observations would likely be very useful at that level.

SAW-29

The second annual TRAC meeting would tentatively be held in Woods Hole April 19-23, 1999. The final agenda for the meeting had not be set, but it was planned to update the Georges Bank cod, haddock, and yellowtail flounder assessments, do a benchmark assessment of Atlantic mackerel, and address questions regarding stock migration and identification. The preparation of management advice for the three groundfish stocks would be handled by the NEFMC Multispecies Monitoring Committee in November 1999, whereas advice for Atlantic mackerel would be developed at the SAW-29 SARC meeting. Atlantic herring may possibly be handled by the TRAC in 2000.

The assessment methods questions raised at the April 1998 TRAC meeting would be addressed in part by the ICES Comprehensive Fishery Evaluation Working Group at its January 14-21, 1999 meeting in Miami, FL. Some NEFSC scientists would participate in this meeting as part of the normal training and professional enrichment process as well as to keep abreast of assessment state-of-the-art developments.

In addition to the regular full assessment of sea scallops, the NEFMC will require an assessment of scallop abundance in the groundfish closed areas, as well as an analysis of potential bycatch of groundfish by scallops dredges in the closed areas. The timeline for the receipt of the results from the scallop analyses would be discussed by the NEFMC Executive Committee on October 15. Data collection from the scallop closed area experiment would be concluded by about October 9. Six fishing vessels had participated in this unique experiment that was strongly encouraged by the industry. The experiment had produced an enormous amount of data from 660 dredge hauls. Unfortunately, data processing had not been thoroughly addressed prior to the start of the field work. It was anticipated that two months would be required for data analysis following the completion of data entry to computer files.

A thorough analysis of *Illex* and *Loligo* squid was critical. Industry expected these stocks to be assessed in the spring of 1999. It was cautioned that the heavy workload imposed on NEFSC staff to process and analyze the sea scallop data could have an impact on staff resources available for assessing the two squid stocks.

Mr. Dunnigan stressed the importance of re-assessing lobster as soon as possible, preferably at SAW-29. In view of the heavy NEFSC workload associated with assessing sea scallops and the two squid stocks, coupled with a heavy SAW-29 agenda, assessing and peer reviewing lobsters within the SARC was deemed impossible at this time. It was agreed that such an assessment would be handled by the ASMFC Lobster Technical Committee, with the subsequent peer review performed by an external panel of international experts similar to that convened in 1996.

The MAFMC would require assessment updates in 1999 on summer flounder, scup, and black sea bass. After some discussion, in which it was noted that the NRC review of the summer flounder assessment was not yet finished, it was agreed that such updates would be performed by NEFSC staff, with assistance from relevant state agency biologists, and peer reviewed by the Council's SSC. Ongoing differences in summer flounder ageing between NEFSC and North Carolina Division of Marine Fisheries personnel needed to be resolved.

It was agreed that the tentative SAW-29 agenda would include *Illex* and *Loligo* squid, witch flounder, sea scallops, Atlantic herring (MSY question only), and Atlantic mackerel (advice only).

The species/stocks considered at the various SAWs are listed in Table 2.

Issue Paper

Dr. Anderson reviewed the main points of the issue paper on "Towards a more comprehensive stock assessment process in the Northeast Region" (see **Appendix I**), which he had authored.

The regional SAW process had served well until requirements mandated by SFA necessitated annual assessment results and advice for all stocks under management. This change meant that the workload previously borne almost exclusively by the SARC and its working groups would have to be distributed to individual scientists, Council SSCs, and Council Monitoring Committees. There were details still remaining to be completed (e.g., schedules, staff resources) before fully implementing a program of preparing and peer reviewing annual assessments for all managed stocks. The future process needs to be flexible, open, and with sequential review to avoid management decisions being perceived as influenced by individual scientists. Those involved in peer reviews should themselves be capable of performing assessments. In the future, as now, work must be planned cooperatively by the Steering Committee, and a SAW schedule must be maintained for benchmark assessments, taking account of priority needs and available staff resources. All possible ways of completing priority work must be employed. A list of primary data sources (Federal, state) required as input to the various assessments as well as a list of people who can be assigned to do the work must be prepared as soon as possible. In addition, a timetable must be developed specifying when each assessment and the advice is needed. All planning must take account of the current shortage of qualified assessment people. In contrast to the ICES assessment working group structure for the Northeast Atlantic, where several hundred experts from 19 member countries participate in the annual assessments of about 100 stocks, only about 25 NEFSC and state scientists are available to assess about 40 stocks in the Northeast Region. Consequently, there is a need for more assessment expertise in the Region, particularly at the state level.

Mr. Howard indicated that SAFE reports were an annual requirement representing new specifications. Beginning in 1999 for the NEFMC, these would be a joint product of the Council, the Monitoring Committees, and the NEFSC. The reports would be reviewed by the SSC based on terms of reference provided by the Council, and would be a combination of the SAW and Monitoring Committee reports. The timing of assessments which must feed into the management process for the transboundary groundfish stocks need to be discussed with Canadian officials. SAFE reports for groundfish would have to be published in November of each year.

It was suggested that the fishing years for all the FMPs needed to be reviewed to ensure that they were in synchrony with annual fishing patterns, made sense relative to the annual adjustment process., and took account of optimal times for performing assessments (based on availability of input data and staff resources).

It was also proposed that, before the next Steering Committee meeting, a strawman schedule of benchmark assessments by the SARC for the entire set of stocks under management in the Region be developed for a 3-4 year cycle.

Other Business

Mr. Harry Mears (NMFS/NER) reviewed the Northeast MARFIN program for FY 1999.

MARFIN, a smaller version of the S-K program tailored to more partnership with the Fishery Management Councils and the states, is relatively new in the Northeast Region. The SAW Steering Committee was being used as a sounding board for the program which would continue for a second year in the Region. In FY 1998, the principal MARFIN focus was "socioeconomics", with a secondary emphasis on SARC research priorities. An announcement for competitive application would be submitted as soon as possible.

Options suggested for the FY 1999 MARFIN emphasis included: 1) a high quality inshore survey from Maine to North Carolina which would require Federal and state collaboration to identify and address specific needs; 2) specialized surveys for species such as bluefish and black sea bass; 3) basic biological characterization; 4) pilot studies; 5) a workshop on the notion of rotating open/closed areas for scallop management; 6) continue last year's priorities; 7) and ten quick studies (e.g., enforcement monitoring and observer validation of bycatch information).

Table 2. **SAW/SARC Assessment Reviews by Species**

YEAR	85	1986		1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1997			1998		1999	
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
Black Sea Bass	[X]				+	+			[X]		[X]		[X]							[X]					[X]		[X]			
Bluefish	[X]		[X]	[X]	[X]	[X]					[X]						[X]	[X]					[X]							
Butterfish	[X]	[X]		[X]		[X]		[X]		[X]		[X]					[X]													
Cod, Georges Bank	[X]		[X]				[X]				[X]		[X]		[X]			[X]			+			[X]			[X]			
Cod, Gulf of Maine	[X]		[X]				[X]					[X]			[X]				[X]		+			[X]			[X]			
Cusk	[X]																				+									
Flounder, Am. Plaice	[X]	[X]		[X]							[X]			[X]							+							X		
Flounder, Summer	[X]		[X]			[X]	+	+	[X]		[X]		[X]			[X]		[X]		[X]		[X]			[X]					
Flounder, Winter, Offshore	[X]		[X]																											
Flounder, Winter, Inshore	[X]		[X]		+	+	+						[X]																	
Flounder, Winter, SNE																					[X]							X		
Flounder, Winter, GOM																					[X]									
Flounder, Winter, GB	[X]		[X]										[X]															X		
Flounder, Witch	[X]	[X]																[X]			+								X	
Flounder, Yellowtail, SNE	[X]	[X]					[X]					[X]					[X]				+			[X]			[X]			
Flounder, Yellowtail, GB	[X]	[X]					[X]					[X]						[X]			+			[X]			[X]			
Flounder, Yellowtail, CC																												X		
Goosefish														[X]							+		[X]							
Haddock, Georges Bank	[X]	[X]		[X]									[X]							[X]	+			[X]			[X]			
Haddock, Gulf of Maine	[X]	[X]																			+									
Herring, Atlantic					[X]				[X]		[X]		[X]			[X]					[X]						[X]		X	
Lobster, American	[X]		[X]							[X]		[X]		[X]		[X]						[X]								
Mackerel, Atlantic	[X]	[X]		[X]		[X]		[X]		[X]		[X]								[X]									X	
Ocean Pout	[X]										[X]										+									
Ocean Quahog	[X]		[X]							[X]					[X]				[X]			+					[X]			
Pollock	[X]		[X]						[X]	[X]						[X]					+									
Red Hake	[X]	[X]									[X]										+									
Redfish	[X]	[X]													[X]						+									
River Herring/Shad	[X]					[X]																								
Salmon, Atlantic	[X]																													
Scallop, Sea	[X]	[X]				[X]			[X]	[X]	[X]	[X]	[X]	[X]						[X]			[X]						X	
Scup	[X]			[X]			[X]		[X]		[X]								[X]						[X]		[X]			
Shrimp, Northern	[X]		[X]		[X]																				[X]					
Silver Hake	[X]	[X]		[X]						[X]	[X]						[X]				+									
Skate	[X]																													
Spiny Dogfish	[X]										[X]							[X]								[X]				
Squid, Illex	[X]	[X]		[X]		[X]		[X]		[X]		[X]		[X]			[X]				[X]								X	
Squid, Loligo	[X]	[X]		[X]		[X]		[X]		[X]		[X]		[X]			[X]				[X]								X	
Striped Bass	[X]																									[X]				
Surfclam	[X]		[X]				[X]		[X]						[X]				[X]			[X]				[X]				
Tautog																				[X]										
Tilefish	[X]													[X]		[X]														
Weakfish			+																							[X]				
White Hake	[X]	[X]									[X]								[X]		+							X		
Wolffish	[X]																				+									

+ = No formal assessment review; research needs, working group or special topic report.

X - assessment suggested or [X] - assessment completed

Appendix I

TOWARDS A MORE COMPREHENSIVE STOCK ASSESSMENT PROCESS IN THE NORTHEAST REGION

by

Emory D. Anderson

INTRODUCTION

The primary objective of the fish stock assessment process is to develop scientific advice for fisheries management. This process involves several steps including data collection and collation (both fishery-dependent and fishery-independent), data analysis (i.e., assessments performed either by individual scientists or in a working group mode), assessment review by scientific peers, drafting of scientific advice based on assessment results, and ultimately the provision of the advice to relevant fisheries managers. In the Northeast Region, this takes place primarily under the auspices of the Northeast Regional Stock Assessment Workshop (SAW) process. The SAW process has evolved steadily in structure and procedure since its inauguration in 1985, with most years having two SAW cycles each generally handling 4-6 assessments (Anderson 1997). Most assessments are performed or agreed by subcommittees or working groups comprised of scientists mainly from the Northeast Fisheries Science Center (NEFSC), but also from state agencies, regional Fishery Management Council staffs, and occasionally from academic institutions, Canada's Department of Fisheries and Oceans, and other external organizations. The Stock Assessment Review Committee (SARC) peer reviews the assessments and drafts the management advice. Following the SARC meeting, the assessment results and advice are presented to the New England Fishery Management Council (NEFMC), Mid-Atlantic Fishery Management Council (MAFMC), and occasionally the Atlantic States Marine Fisheries Commission (ASMFC) at Public Review Workshop sessions.

Over the past several years, the SAW Steering Committee has engaged in discussion focussing on ways and means of improving the SAW process to enable it to better meet growing demands for increased and more timely assessment advice for management. In recent months, NEFSC staff have met both internally and with the executive directors of the NEFMC and MAFMC to discuss the annual provision of scientific advice for all stocks included in fishery management plans (FMPs) primarily in light of the requirements implied by the Sustainable Fisheries Act (SFA). Such discussions have pertained both to the annual scheduling of assessments and peer reviews on all stocks as well as the preparation and format of reports containing this information (e.g., SAW, Stock Assessment Fishery Evaluation or SAFE, NEFSC Status of Stocks).

The purpose of this paper is to summarize some of the relevant discussion and expressed views pertaining to ways to accommodate the need for annual assessment results, advice, and reports for fisheries management in the Northeast Region and provide a basis for decisions that will have to be made by the SAW Steering Committee as well as the NEFSC in the near future in order to bring about the desired modifications to the present process.

MANAGEMENT NEEDS

There are presently over 40 finfish and shellfish species-stocks included in FMPs either in place or in preparation by the NEFMC, MAFMC, or ASMFC. The fishing years for the various FMPs differ, with those of the MAFMC and ASMFC being on a calendar-year basis, while those of the NEFMC begin at different times (e.g., March 1 for sea scallops, May 1 for groundfish). Management tactics also differ among the FMPs developed by the above three management bodies, with the MAFMC and ASMFC using annual total allowable catches (TACs) as the primary regulatory tool and the NEFMC primarily employing effort controls (i.e., days-at-sea limits) coupled with target TACs.

Both Councils have indicated a desire to receive assessment results and advice (i.e., SAFE report) for every stock according to a prescribed annual time schedule in order to meet deadlines for planning, evaluation, industry advisory and public input, annual quota setting or review/modification of other regulatory measures. For the MAFMC and ASMFC, annual scientific advice is required during the period July 1 - August 1. For the NEFMC, initial assessment results and advice are required by April 1 for Atlantic herring, June 1 for sea scallops, and August 1 for groundfish and goosefish, with subsequent (about 3 months later) evaluation and updating by Monitoring Committees and incorporation with initial results into a SAFE report.

In addition to assessment results and advice, the Councils have also expressed a desire to receive an annual economic evaluation/report for each fishery to be included in the above SAFE reports.

With respect to SAFE reports in the Northeast Region, these have traditionally included the two reports emanating from each SAW cycle (i.e., *SARC Consensus Summary of Assessments* and *Advisory Report on Stock Status*), reports from Council Monitoring Committees, as well as the annual NEFSC status-of-the-stocks reports on the *Status of the Fishery Resources off the Northeastern United States*. However, the latter reports, as currently structured, do not contain explicit quantitative assessment and catch/stock forecast results, or scientific advice and, consequently, are of little use to managers except as a source of general information. Given the need for annual up-to-date assessment results and scientific advice for all stocks under management, there is an associated requirement for a more structured SAFE report specifically designed for the purpose at hand.

DATA AVAILABILITY

Data required as input to stock assessments include commercial landings and length frequencies, recreational catches/landings and length frequencies, NEFSC and state research vessel survey results, NEFSC sea sampling results (for estimating discards), and age/length keys from commercial and research survey samples.

Commercial landings for a given calendar year are generally available by March 1 of the following year for landings in principal ports monitored by NMFS and by June 1 for landings in lesser ports accounted for by annual state canvas reporting.

Recreational catch estimates and length frequencies from the NMFS Marine Recreational Fisheries Statistics Survey (MRFSS) for a given calendar year are available by about mid-April of the following year.

NEFSC research vessel survey data (standard station data, catch per tow in weight and number, length frequencies) are generally available on the computer database three months following the end of a given survey (i.e., winter survey - June 1, spring survey - August 1, autumn survey - February 1). With the eventual implementation of shipboard processing of survey data, all computer entry will be done during a survey and a complete database will be available at the end of a survey.

Data collected from the NEFSC Sea Sampling Program in a given calendar year are generally available for use by the following March 1.

NEFSC age data from commercial and research survey samples for construction of age/length keys are available no later than 9 months following their collection, but usually much sooner in the case of high priority species. Age data for stocks scheduled for a given SARC are usually available one month prior to the time of the assessment (e.g., working group meeting).

The scheduling of the assessment for a given species-stock must take account of the timing of the availability of the fishery and survey data required as input to the assessment.

ASSESSMENT AND PEER-REVIEW PROCESS

Types of Assessments

As defined in previous SAW Steering Committee discussions (Anderson 1997), annual assessments would be classified either as "benchmarks" or "updates". A "benchmark" assessment would be defined as one which had not been done for about 3-4 years, which included new multi-year input data (e.g., fishery catch at age, survey indices), and for which new or revised analytical methods would likely be used or previous assumptions and methods re-examined. An "updated" assessment would be defined as one which included only a single year of new input data and all analyses and projections would be done employing analytical methods used and accepted in the previous "benchmark" assessment for the stock in question.

Types of Peer Reviews

Two of the three types of possible peer reviews identified earlier by the Steering Committee (Anderson 1997) are 1) an integrated review and 2) a sequential review. An integrated review would be one in which the peer review would be integrated into the assessment process itself. For example, a SARC working group, with the participation of relevant external experts, would review its own assessment. A sequential review would be one similar to that currently used in the two-tiered SAW process where assessments and peer review are done in sequence by working groups and a review body (e.g., SARC). In the current process, the SARC membership does not usually include working group members, the SARC assumes "ownership" of the accepted assessments, and in addition to reviewing the scientific results also determines and drafts the management advice.

Within the Northeast Region, there are other bodies capable of and authorized to perform peer reviews of scientific analyses. ASMFC, although a partner in the SAW process, has recently implemented an internal peer-review procedure for vetting the results of assessments which, for various reasons (e.g., updates), are not handled within the SAW process. In addition, the Councils each have a Scientific and Statistical Committee (SSC) comprised of well-qualified scientists capable peer reviewing stock assessments.

PROPOSED PROCESS

Annual Schedule

Each of the 40+ species-stock under management in the Region would be assessed each year at a prescribed time. Such assessments would generally be defined as updates except when benchmarks were necessary (i.e., every 3-4 years). Given the time of year when assessment results and advice have been requested by the Councils (i.e., April 1 - August 1), it is envisaged that most assessments would be performed during the first 5-6 months of the year. Circumstances would undoubtedly dictate that some assessments would have to conducted during the latter half of the year, but these would be viewed as exceptions (e.g., some benchmarks).

Some of the benefits accruing from this type of scheduling arrangement would include the provision of assessment results for all stocks to managers at prescribed times, ensure much greater predictability in the annual workload of assessment scientists by confining all assessments to a particular time of year, and allow scientists the opportunity to conduct much-needed assessment-related research activities during the remainder of the year.

Responsibility for Assessments

Most assessments would be performed, as at present, by staff of the Population Dynamics Branch of the NEFSC Resource Evaluation and Assessment Division (READ) either individually (generally in the case of most updates) or in cooperation with relevant state agency staff in SARC working groups or in relevant ASMFC Technical Committees or their assessment subcommittees. In the case of some species-stocks largely within the domain of the ASMFC, the lead assessment responsibility would continue to remain with particular state staff.

In the case of an updated assessment, the work could be done either by an individual scientist, by several scientists working together, or by a working group or subcommittee, depending on input data (e.g., survey indices from the NEFSC and a number of states), state vs. Federal responsibility, individual preferences by scientists, and so on.

In the case of a benchmark assessment, it would be expected that the work would be done or at least agreed in a working group forum to ensure a thorough consideration and analysis of all new input data and full agreement on new or alternative analytical methods by a group of scientists each hopefully contributing special skills and experiences. For benchmark assessments, it is anticipated that external expertise would supplement the local (e.g., NEFSC, state, and Council staff) competency in the working group. In fact, based on recent experience and comment, the contributions provided by external experts are viewed as being more valuable at the working group meeting (i.e., to afford ample time and opportunity to suggest/introduce/use alternative methods and analytical approaches) than at the time of the peer review at SARC meetings where a lack of time generally precludes the consideration of alternative approaches that may be proposed by such experts.

Since there are some transboundary stocks that are shared by the US and Canada, it is expected that those will continue to be assessed jointly by US and Canadian scientists. In 1998, a new annual joint US/Canada assessment and peer-review process was implemented. Georges Bank cod, haddock, and yellowtail flounder were assessed by the Transboundary Assessment Working Group (TAWG). As with other stocks, it would be expected that benchmark assessments of these stocks would only be performed every 3-4 years, with updates being sufficient in the interim. It is anticipated that additional transboundary stocks such as Atlantic mackerel, Atlantic herring, *Illex* squid, spiny dogfish, and pollock may eventually be assessed jointly.

Responsibility for Peer Review

At present, the SARC is the prime peer-review forum for all stocks assessed by the NEFSC, although in the past year a couple of exceptions have been made in the case of bluefish and summer flounder. Assessment analyses for bluefish done under the auspices of the ASMFC Technical Committee and updated catch and stock projections for summer flounder performed by an NEFSC scientist were both peer reviewed by the MAFMC SSC. As noted above, the ASMFC also has adopted a formal peer-review process for handling stock assessments performed by its Technical Committees and not placed on SAW agendas.

Under the process proposed in which all 40+ species-stocks under management in the Northeast Region would be re-assessed every year according to an agreed time schedule, it would be impractical and unworkable to subject all of these assessments to peer review by the SARC. Instead, it is envisaged that the SARC would only peer review benchmark assessments. By maintaining the existing schedule of two SAW cycles per year and about five stocks per SAW, it would be possible for most or all of the 40+ stocks to be subjected to a benchmark assessment every 3-4 years.

For any transboundary stocks placed on the agenda in a given year for consideration by the joint US/Canada assessment and peer-review process, the peer review would be conducted by the Transboundary Resources Assessment Committee (TRAC). For the foreseeable future, it is anticipated that, at a minimum, the stocks of Georges Bank cod, haddock, and yellowtail flounder would be handled in this way.

For all of the remaining stocks not on a SAW agenda in a given year and subjected to only an updated assessment, the peer review would be delegated to a Council SSC or to the ASMFC peer-review process, with such assignments determined on the basis of which Council or the ASMFC held the FMP responsibility.

Alternatively or in addition, some updated assessments could be peer reviewed at the working group level in what would be termed an "integrated" peer review, as noted above. One of the advantages of this procedure would be to lighten the workload of Council SSCs for peer reviews. However, if peer reviews were to be integrated into the working group process for handling updated assessments (assuming that all benchmark assessments would continue to be peer reviewed by the SARC), appropriate external experts would need to be brought to the working group meeting. Previously it was noted that external experts would generally be needed only at those working group meetings handling benchmark assessments.

Responsibility for Preparing Management Advice

In the current SAW process, the SARC not only peer reviews the assessments, but also develops and drafts the management advice. The desirability of the same body of scientists being assigned the responsibility of handling both of these important tasks has been discussed, but since there are advantages and disadvantages associated with the present procedure, no clear consensus has yet emerged as to whether these two tasks should be separated and assigned to different groups of people. Further debate on this issue is necessary.

One view put forth in discussion is that, having in hand the assessment results peer reviewed either by the SARC, the Council SSCs, the TRAC, or by a working group strengthened by external experts and functioning in an integrated review mode, and with the benefit of last-minute analyses/projections based on such assessment results which they themselves have prepared, the Council Monitoring Committees may be better suited to prepare the appropriate management advice. Alternatively, the SSCs, following their review of updated assessments or the peer review by the SARC of benchmark assessments, could be assigned the responsibility to frame the management advice.

With respect to the continued role by the SARC in offering management advice, another possibility would be for the SARC to only offer general generic advice (e.g., reduce fishing mortality) and for the Monitoring Committees or SSCs frame the specific advice in support of the general advice given by the SARC.

Other scenarios for how and by whom management advice can or should be prepared need further discussion.

Status-of-Stock and SAFE Reports

As noted earlier, SAFE reports in the Northeast Region have traditionally included the two reports emanating from each SAW cycle, reports from Council Monitoring Committees, as well as the annual NEFSC status-of-the-stocks reports. It has become evident, however, that these separate reports are individually unsatisfactory as sole sources of scientific information and advice on which the Councils or ASMFC need to base and document their managerial decisions. Particularly in light of the need for annual up-to-date assessment results and scientific advice for all stocks under management, it is timely to develop and use a more structured SAFE report that is specifically designed for its intended purpose and which contains all the information deemed necessary by the respective management authorities.

It is suggested that the current format of the SAW *Advisory Report on Stock Status*, or something similar, may be appropriate for development as a singular SAFE report for each stock. The specific contents would need to be agreed as well as who would have the responsibility of providing the relevant information and of actually assembling and preparing the reports. This matter, too, requires further discussion among the SAW process partners.

Such SAFE reports, in whatever format is ultimately adopted, need to be made available in their final form for general usage in a widely accessible vehicle (e.g., NEFSC Reference Document series). Because of the different times of the year when SAFE reports for individual stocks or groups of stocks would be prepared, consideration needs to be given to consolidating all such reports from a given calendar year into a single volume for ease of reference.

The NEFSC status-of-stocks reports, published as documents entitled "*Status of the Fishery Resources off the Northeastern United States*", although they do not fulfill the needs of managers for providing information and advice useful to making regulatory decisions, serve a valuable role in providing general information of interest to a wide-ranging audience. As a result, such reports will likely continue to be produced. The preparation of such reports on an annual basis, as was the practice through 1994, would be made easier with a schedule of annual assessments for all stocks. Given the usefulness of this report to a wide audience, it will likely be made available in electronic format via the World Wide Web. In addition, since updates for individual stocks would likely be completed at different times of the year, the version available for access at any given time would carry a date to indicate when it had been prepared. As in the case of SAFE reports, all of the reports for individual species-stocks would be consolidated into a single volume for publication.

CONCLUSION

This paper has attempted to summarize and assemble many of the thoughts and suggestions made over the past several years, and particularly in recent months, relative to how the Northeast Regional SAW process needs to be modified to accommodate the expanded needs and time schedules facing the Councils and ASMFC with respect to meeting the mandates of the Sustainable Fisheries Act.

A revised process is proposed which would call for assessments, either as benchmarks or updates, for every species-stock in the Northeast Region under management to be completed according to a fixed schedule on an annual basis. Suggestions are offered relative to who would perform those assessments, and what bodies would be responsible for their peer review. The issue of whether the peer-review and advisory tasks should be handled by the same group of scientists was raised, but left open pending further discussion. Lastly, the need for a more structured SAFE report for managerial use was noted, together with the recognition that the traditional NEFSC status-of-stock reports, while not serving managers needs, nevertheless fulfill an important role in providing general information to a wide audience.

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